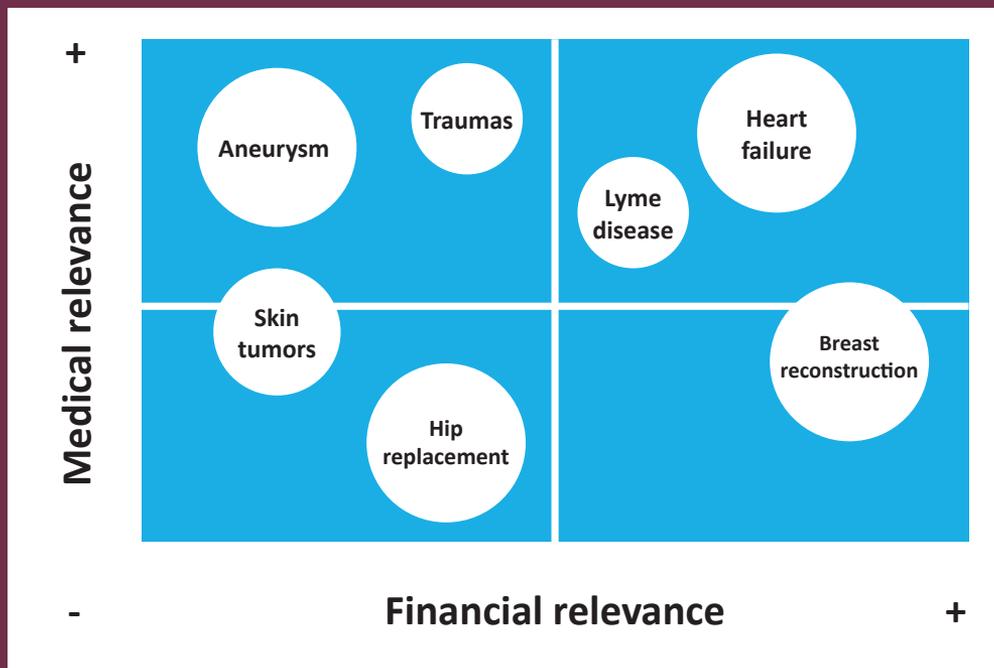
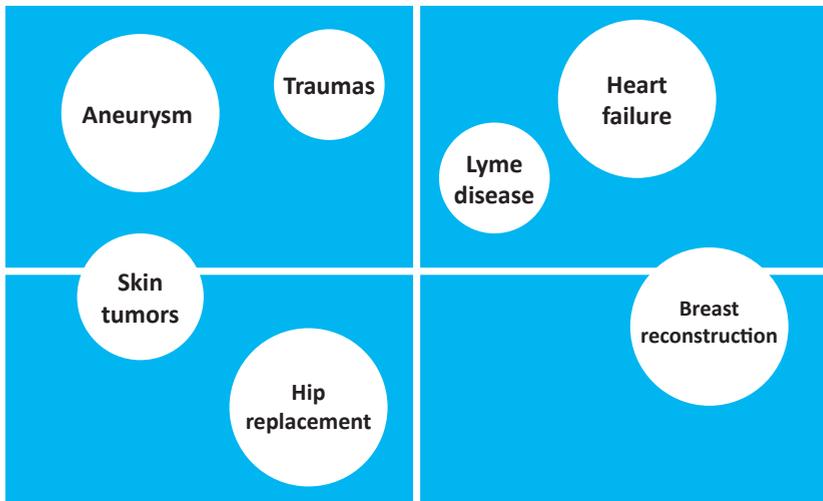


# The design and implementation of a case-mix information system in a Dutch university medical center: A design-oriented approach



Franck Asselman

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No lord, it seems the best is yet to come  
no lord, it seems the best is yet to come  
I'm screamin' it out boy, screamin' it out  
no lord, it seems the best is yet to come

**Lyrics of Novastar - The Best Is Yet To Come**

Proefschrift  
ter verkrijging van de graad van doctor  
aan de Radboud Universiteit Nijmegen  
op gezag van de rector magnificus prof. dr. J.H.J.M. van Krieken,  
volgens besluit van het college van decanen  
in het openbaar te verdedigen op woensdag 29 maart 2017  
om 14.30 uur precies

door Franck Ferdinand Asselman  
geboren op 4 juni 1968  
te Eindhoven

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## Voorwoord (Preface in Dutch)

Toen ik in 1999 bij het AMC ging werken had ik niet kunnen vermoeden dat ik ooit promotieonderzoek ging doen. Het idee is geleidelijk vanuit mijn praktijk als stafadviseur ontstaan. Vanaf 2005 werd marktwerking in de ziekenhuizen geleidelijk ingevoerd, gebaseerd op het Diagnose Behandel Code (DBC) systeem. Deze ontwikkelingen waren geheel nieuw voor de sector en we hadden geen idee wat de impact hiervan zou zijn voor het AMC. De verwachting was in ieder geval dat hierdoor de concurrentie en financiële druk zouden toenemen. Als antwoord hierop werd gestart met het project Patiëntenzorgprofielen, waarvan ik in 2006 projectleider werd. Het doel van dit project was informatie te ontwikkelen waarmee (medische) managers beter gefundeerde beslissingen zouden kunnen nemen ten aanzien van de mix van patiënten, oftewel de case-mix. Het uiteindelijke doel hiervan was (en is) om tot een optimale invulling van de verschillende kerntaken te komen, gegeven de schaarse middelen.

Het DBC systeem bood tal van mogelijkheden voor het ontwikkelen van nieuwe soorten informatie, bijvoorbeeld ten aanzien van de medische inhoud van de zorg, kenmerken van de patiënt, bedrijfsvoering en combinaties hiervan. We wisten alleen niet wat we met deze informatie konden, wilden en wat de kansen, maar ook de risico's hiervan waren. Het DBC systeem was nieuw en uniek, ervaringen in Nederland waren er niet en ervaringen met systemen in andere landen waren maar beperkt bruikbaar. Het werd wel snel duidelijk dat de impact van deze informatie op de managers groot kon zijn. Toen we de eerste case-mix informatie aan hen lieten zien, maakte dit veel los. We kregen positieve en negatieve reacties, extreem en genuanceerd. Het maakte me bewust dat het ontwerpen en implementeren van deze informatie om een zorgvuldige aanpak vroeg. Op basis hiervan heb ik in 2008 het idee opgevat om dit project ook op een wetenschappelijke wijze te benaderen en hierop te gaan promoveren.

Nu, acht jaar later, is mijn proefschrift eindelijk afgerond. Het heeft, zoals wel vaker met onderzoek, langer geduurd dan gepland. Als je onderzoek combineert met werk en gezin, delft onderzoek toch vaak het onderspit. Het is immers minder urgent en in mijn geval was er geen sprake van een harde deadline. Daarnaast heb ik er in 2012 bewust voor gekozen om mijn onderzoeksperiode te verlengen. In dat jaar werd het DBC systeem vervangen door het DOT systeem en ik wilde de effecten hiervan observeren. Er is mij geregeld tijdens deze jaren gevraagd of ik geen spijt had van het onderzoek en de vele tijd die het heeft gekost. Dat is nooit het geval geweest. Ik heb het om meerdere redenen als zeer waardevol ervaren.

Ik heb met mijn onderzoek een bijdrage willen leveren aan zowel wetenschap als praktijk. Wat betreft de wetenschap zijn we mijns inziens veel te weten gekomen over welke bijdrage een case-mix informatiesysteem (CMI) kan leveren aan universitair medische centra (UMC's) en over de factoren die het succes hiervan bevorderen of belemmeren. Het is voor het eerst dat zo'n langdurig en diepteonderzoek naar dit onderwerp is uitgevoerd in Nederland. We hebben hierdoor gedetailleerd inzicht gekregen in hoe managers in een UMC denken, werken, keuzes maken en wat zij hiervoor nodig hebben. Op basis hiervan hebben we wetenschappelijke kennis kunnen aanvullen, soms weerleggen en goede suggesties kunnen geven voor vervolgonderzoek.

In praktische zin heeft het onderzoek geleid tot een werkend informatiesysteem waar dankbaar gebruik van werd gemaakt, niet alleen door de managers, maar ook door business analisten, klinisch onderzoekers en stafadviseurs. Hoewel het moeilijk is om in maat en getal vast te stellen wat precies de effecten van dit systeem zijn, durf ik op basis van de verschillende evaluaties wel te concluderen dat het heeft bijgedragen aan betere inzichten in de case-mix, een betere dialoog over keuzes, verbeteringen van zorgprocessen en registraties, afspraken met verzekeraars en andere zorginstellingen, kostenreductie en beter onderbouwde beslissingen. De bouw van het systeem alleen al heeft professionals gestimuleerd om actief na te denken over hun case-mix en het belang ervan. Misschien is dat wel de grootste winst geweest. Het feit dat het systeem inmiddels (deels) ook door andere UMC's wordt gebruikt en dat we hiermee genomineerd waren voor de Porter Prize 2014, is voor mij het bewijs dat we hiermee iets goeds hebben ontwikkeld en qua kennis voorop liggen in Nederland en waarschijnlijk ook buitenland.

Toch hebben we niet alles bereikt wat we hoopten. We hebben tegenslagen gehad. De invoering van de marktwerking verliep nogal traag en chaotisch en de effecten van marktwerking voor de UMC's waren aanzienlijk beperkter dan gedacht. In feite bestaat er na 10 jaar nog steeds een budgetsysteem en komen de onderhandelingen met zorgverzekeraars maar moeizaam tot stand. Dit beperkte tijdens het onderzoek de noodzaak en de mogelijkheden van het systeem en hierdoor nam het draagvlak voor het project ook af. Aan de andere kant is het systeem voor doelen gebruikt die we niet voorzien hadden, zoals interne visitaties, doelmatigheidsonderzoeken en het aangaan van allianties met andere ziekenhuizen. Het hoort nu eenmaal bij onderzoek, je weet van tevoren niet wat er uit komt. Ik denk dat we per saldo veel mooie resultaten hebben bereikt waar we als AMC best trots op mogen zijn. Bovendien staan we pas aan het begin van de verkenning van wat er überhaupt mogelijk is met case-mixinformatie. Het mooiste komt waarschijnlijk nog als het zorgstelsel en DOT-systeem verder zijn uitgekristalliseerd.

Het promotieonderzoek heeft mij ook persoonlijk veel gebracht. Onderzoek vereist een aantal vaardigheden, waar ik van nature minder sterk in ben, zoals gestructureerd kunnen werken, kunnen abstraheren, afstand nemen en compact kunnen schrijven. Ik was meer iemand van de praktijk, niet de typische academicus. Ik wil niet beweren dat ik de vaardigheden nu volledig beheers, maar ben er wel in gegroeid. Ik denk dat ik mijn gebreken heb kunnen compenseren met vaardigheden als nieuwsgierigheid, analytisch vermogen, logisch verstand en vooral doorzettingsvermogen. Ook inhoudelijk heb ik heel veel kennis opgedaan. Door dit onderzoeksproject ben ik bij vele onderwerpen actief betrokken geweest, zoals portfoliostrategie, planning & control, bezuinigingsprogramma's, kwaliteitsprojecten, leiderschapsprogramma's, onderhandelingen met verzekeraars en communicatie. Hierdoor heb ik niet alleen het AMC nog beter leren kennen, maar het gaf me ook de mogelijkheid om deze onderwerpen en personen met elkaar te verbinden. Ik denk dat ik hiermee een waardevolle bijdrage heb geleverd aan het AMC, ook als stafadviseur. De keerzijde is overigens dat ik nu goed zie welke kansen er in het AMC (vooralsnog) onbenut blijven. Dit maakt me weleens onrustig en kan me in de weg staan bij mijn dagelijkse werk.

Per saldo ben ik echter zeer blij dat ik de kans heb gekregen om dit promotieonderzoek te doen en dan ook nog eens in het AMC. Wat een voorrecht! Het is in mijn ogen één van de meest waardevolle organisaties in één van de mooiste steden mooiste steden die ik ken. Ik heb me hier altijd als een vis in het water gevoeld en ben er trots op hier onderdeel van te zijn.

Er zijn vele mensen die me op directe of indirecte manier geholpen hebben, waarvan ik een aantal mensen expliciet wil bedanken. Om te beginnen met Ellen Bien en Louise Gunning. Ellen was aan het begin van het onderzoek mijn leidinggevende, Louise voorzitter van de Raad van bestuur. Zij waren direct enthousiast over mijn onderzoek en hebben mij de mogelijkheid gegeven om dit te kunnen combineren met mijn werk als stafadviseur. De kerngedachte om de patiëntengroepen centraal te stellen in de sturing en de stuurinformatie van het AMC is afkomstig van Louise. Ik vind het dan ook bijzonder leuk om te laten zien waartoe haar oorspronkelijke idee heeft geleid. Ik realiseer me dat Ellen en Louise de buitenwereld een behoorlijke inkijk hebben gegeven in de (strategische) keuken van het AMC en hun eigen rol hierin - en dat vind ik dapper. Dank jullie wel!

Dan ben ik uiteraard veel dank verschuldigd aan de top managers van het AMC, dat wil zeggen medische afdelingshoofden, divisiebestuurders, leden van Raad van Bestuur en directeuren RvB-staf. Zonder hen had dit onderzoek niet plaatsgevonden. Zij waren de primaire doelgroep van mijn onderzoek en zijn zeer bereid geweest om hieraan

mee te werken. Dit geldt zowel voor de deelname aan formele interviews, enquêtes en pilot groepen, als de informelere gesprekken. Hierdoor heb ik jarenlang intensief contact gehad met een groot aantal managers van uiteenlopende specialismen. Ik heb het altijd als een voorrecht beschouwd om met deze inspirerende mensen te mogen werken. Ik heb inzicht gekregen in de vele complexe vraagstukken en dilemma's waar zij dagelijks mee te maken hebben – mede door de toenemende markwerking, bezuinigingen en maatschappelijke druk. Ze hebben mij een kijkje gegeven in hun denk- en belevingswereld. Niet alleen door enquêtes in te vullen en concrete vragen te beantwoorden, maar ook door te filosoferen 'met de benen op tafel'. Met velen heb ik een persoonlijke band opgebouwd. In het bijzonder wil ik nog de mensen bedanken die meegelezen hebben met mijn proefschrift: Ivo van Schaik, Wytse Fokkens, Marijntje Wetzels en Paulina Snijders.

Dan zijn er de vele mensen achter de schermen die een grote directe of indirecte bijdrage hebben geleverd aan mijn onderzoek. Allereerst de mensen van de afdeling ADICT. Zij zijn de bouwers van het informatiesysteem en verdienen veel eer. De data, systemen en informatiewensen wijzigden voortdurend en dan was er ook nog vaak te weinig capaciteit. Ik realiseer me goed dat ik een lastige klant voor hen was. Ik had veel wensen en eisen, kon ongeduldig en kritisch zijn en bezorgde ze een veel werk en hoofdbrekens. Maar gelukkig hadden we veel begrip voor elkaar en zijn onze contacten altijd prettig gebleven. Ik zal de vele mails en rapporten die ik regelmatig in de avonden en weekenden van Jaro Noordegraaf ontving niet vergeten.

Ook wil ik graag mijn (oud) collega's bij Finance & Control (F & C) enorm bedanken. Ik heb ruim 10 jaar met hen gewerkt en altijd met veel plezier. We hebben intensief met elkaar gewerkt, niet alleen op de pieken, maar ook in de dalen. Inhoudelijk konden we kritisch naar elkaar zijn, maar altijd in positieve en constructieve sfeer. Zij hebben mij scherp gehouden, afgeremd waar nodig, voor nuances gezorgd en veel denkwerk verricht. En wat hebben we veel met elkaar gelachen! Ook buiten het werk en ik hoop dat we dat nog lang zullen doen. Verder wil ik Marianne Schumacher van de medische bibliotheek zeer bedanken voor haar hulp bij het zoeken naar de juiste literatuur en belangstelling door de jaren heen voor mijn onderzoek.

Ook buiten het AMC ben ik veel mensen dank verschuldigd. Ik wil mijn collega's van het UMCG bedanken voor hun bereidheid aan mijn onderzoek mee te werken. We hebben bij hen de portfoliomatrices van het AMC in het UMCG geïmplementeerd en heb ik heb een aantal (medische) managers geïnterviewd over hun ervaringen. Het UMCG heeft vruchtbaar gebruik gemaakt van onze kennis en ervaring en tegelijkertijd heeft het mij interessante inzichten gegeven in welke kennis generiek toepasbaar is of

aanpassing behoeft aan de lokale organisatie. Ik voelde me zeer welkom in het UMCG en kijk met plezier op onze samenwerking terug. Ook onze VUmc collega's hebben de portfolio matrices van het AMC geïntroduceerd en vervolgens hun kennis royaal met mij gedeeld. Ik zie het als een mooie voorbode voor wat wij in de toekomst samen kunnen bereiken.

Dan wil ik mijn bijzondere dank uitspreken naar mijn promotoren Ed Vosselman en Rob de Haan. Ik heb het hen tussentijds meerdere keren laten weten maar herhaal het nog maar eens: ik had me geen betere en fijnere promotoren kunnen wensen! Ik heb hen allebei ervaren als zeer deskundige, kritische en betrokken personen en zij hebben me uitstekend begeleid. Zij hebben allebei een behoorlijk verschillende achtergrond, maar juist daardoor heeft het proefschrift mijns inziens de juiste kwaliteit gekregen. Rob bracht voornamelijk zijn kennis en ervaring als klinisch epidemioloog en AMC-er en in en heeft dat op zeer positief-kritische wijze gedaan. We hebben nogal zitten stoeien met het feit dat dit onderzoek overwegend kwalitatief van aard is en moeilijk meetbare elementen bevat, maar ik denk dat we hier een goede modus in hebben gevonden. Ik zal de vele prettige gesprekken met hem niet vergeten. Met Ed heb ik veel kunnen sparren over het vakgebied van management accounting, met nogal eens een uitwijding naar andere onderwerpen in de wereld. We hebben heel wat keren met elkaar gegeten en geborreld en hebben elkaar ook privé aardig leren kennen. Ik heb me vaak bezwaard gevoeld voor de vele tijd en aandacht die ik van mijn promotoren vroeg en me soms verontschuldigd dat ik nu eenmaal niet de voorbeeldige academicus was. Ik troost me maar met jullie eerdere opmerking dat dit onderzoek ook voor jullie bijzonder en uitdagend was en jullie de gezamenlijke bijeenkomsten als een feestje beschouwden, ik neem het maar voor waar aan. Verder bedank ik de leden van de promotiecommissie voor hun bereidheid om mijn proefschrift te lezen en beoordelen.

En er zijn natuurlijk de mensen buiten mijn werkomgeving die belangrijk zijn geweest voor de morele steun. Hierbij staan mijn vriendin Sandra en twee dochters Ilse en Eva met stip bovenaan. Ik realiseer me heel goed dat ik de tijd die ik aan mijn onderzoek heb besteed niet aan hen heb kunnen besteden. Ik heb me daar af en toe wel schuldig over gevoeld, hoe zeer ik ook mijn best heb gedaan om er op alle belangrijke momenten voor hen te zijn. Ik ben onwijs dankbaar voor alle ruimte die ik van hen gekregen. Ik ben trots om deel te mogen uitmaken van zo'n fijn en hecht gezin. Ik hoop dat mijn onderzoek ook op enigerlei wijze een bijdrage levert aan de complexe maatschappelijke vraag hoe we ervoor zorgen dat de zorg betaalbaar en kwalitatief hoogstaand blijft, nu en in de toekomst. Het zou mooi zijn als de generatie van mijn kinderen en de generaties daarna er nog iets aan hebben. Dan zijn er mijn vele familieleden en vrienden. Zij hebben me veelvuldig de vraag gesteld wanneer het proefschrift nu eindelijk klaar was. Niet zozeer

Niet zozeer vanwege de inhoud, meer vanwege het feest - en gelijk hebben ze. We gaan er goed op feesten, dat garandeer ik jullie!

Ook ben ik Ben Vogels en Jan Willem Groot zeer dankbaar dat zij mijn paranimfen wilden zijn. Ben en ik zijn jarenlang collega's en kamergenoot geweest en daardoor heb ik het grote plezier gehad deel te mogen uitmaken van zijn denkwereld, humor en menselijkheid. Ik heb daar zowel zakelijk als privé veel aan gehad. Ben is ook al die jaren de grootste sponsor geweest van dit (onderzoeks)project, omdat het in zijn ogen bijdraagt aan onze publieke taak: zorg op de juiste plek. Ik hoop dat Ben nog veel voor het AMC kan blijven betekenen. Jan Willem en ik kennen elkaar vanaf het begin van de Economiestudie en we zijn sindsdien zeer goede vrienden gebleven. We hebben al veel met elkaar meegemaakt en stellen na 24 jaar vriendschap nog bij iedere ontmoeting vast dat we nog lang niet uitgepraat zijn.

Tot slot wil ik mijn ouders bedanken. Ik heb vroeger de nodige strijd met hen geleverd. Over school, mijn cijfers, het spijbelen en over hoe in het leven te staan. Zij maakten zich toen grote zorgen over mij en twijfelden of het wel iets met me zou worden. Hoewel dit niet leuk was om te horen, heeft dit bij mij wel gewerkt. Ik maakte namelijk, net als bij veel andere dingen, zelf wel uit of het iets met me ging worden en heb uiteindelijk toch mijn diploma's gehaald. Eerst Havo, toen Meao, Heao, Economie en nu mijn promotie. We hebben in de loop van de jaren steeds meer begrip voor elkaar gekregen. Mijn ouders hebben nog allebei de oorlog meegemaakt en echte armoede gekend. Dankzij hun verhalen realiseer me hoe blij ik mag zijn dat ik in vrede en welvaart ben opgegroeid en alle mogelijkheden heb gehad om me te ontplooien. Mijn vader hoopte zo dat hij mijn promotie nog mee kon maken. Helaas is dat niet meer gelukt. Een dag nadat mijn promotoren hadden geconcludeerd dat mijn proefschrift kon worden afgerond kreeg hij een hersenbloeding en is overleden. Ik weet zeker dat hij trots op me was. Als dank voor alles wat hij voor me heeft gedaan en wat ik van hem heb geleerd, draag ik mijn promotie aan hem op.

## List of acronyms

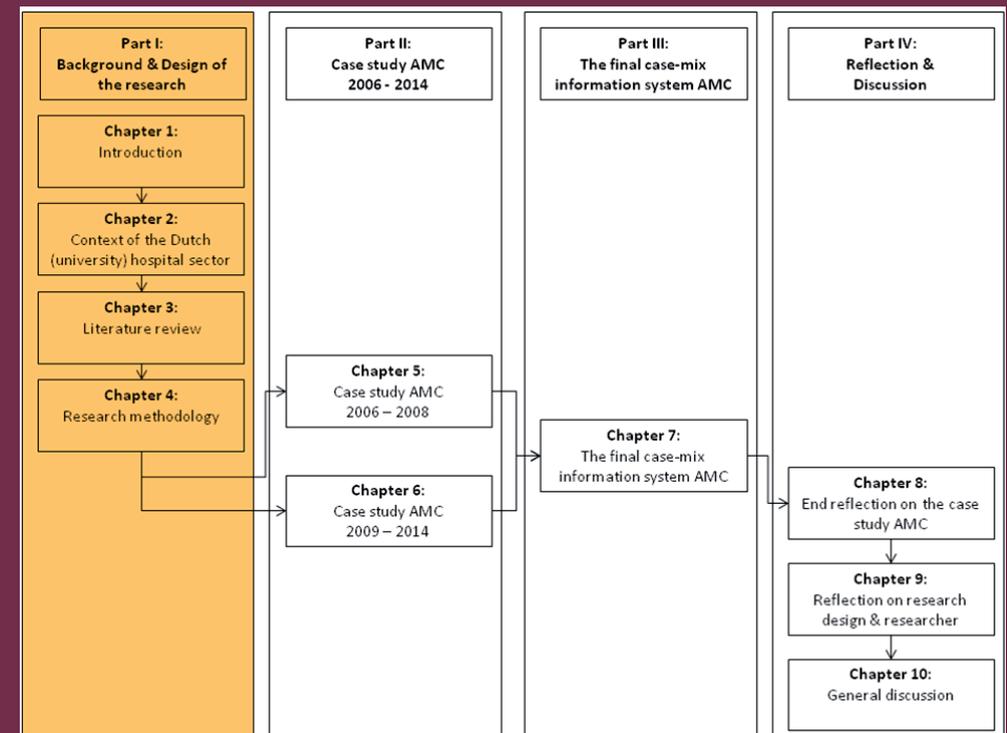
Acronym	Description
ABC	Activity Based Costing
ACM	Authority, Consumer and Market Authority
AIS	Accounting Information System
AMC	Academic Medical Center Amsterdam
CMI	Case-mix Information System
DBC	Diagnosis Treatment Combination
DOR	Design-Oriented Research
DOT	DBCs On their way to Transparency
DRG	Diagnosis Related Groups
F & C	Finance & Control department
FB	Function-based budget
GDP	Gross Domestic Product
NZa	Dutch Healthcare Authority
OECD	Organization for Economic Co-operation and Development
P & C	Planning and Control
UMC	University Medical Center
UMCG	University Medical Center Groningen
VWS	Ministry of Health, Welfare & Sport
VUmc	Free University Medical Center
WMG	Health Care Market Regulation Act
WTZi	Health Care Institutions Accreditation Act

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# PART I: BACKGROUND AND DESIGN OF THE RESEARCH



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# Chapter 1

Introduction

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### 1.1 Introduction

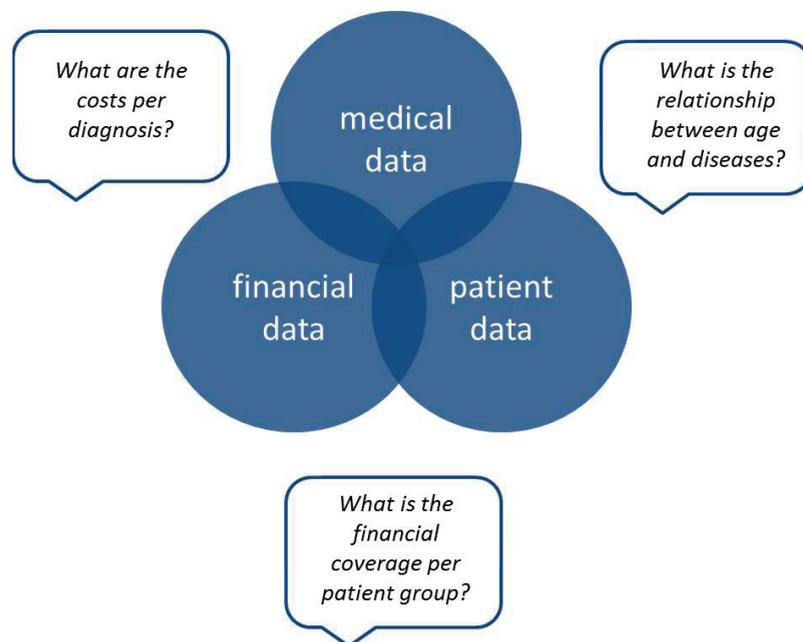
Due to the overall aging of the population, technological developments, and increasing health care demands, health care expenditures are escalating worldwide. As a result, many countries are implementing far-reaching reforms in order to make health care more effective, more efficient, and more patient friendly. One example of this is the introduction of Diagnoses Related Groups (DRG)-based prospective payment systems in countries such as the United States, Germany, and France. The introduction of DRGs for determining hospital products has been advocated as offering hospital management the means to understand and control resource usage within hospitals (Samuel et al, 2005). On the other hand, it can be stated that because of the DRGs, a functioning market in care was created through the identification of the products of engineers with the assumptions of economists. Neoliberal ideals, according to which markets mechanisms should replace planning as regulators of economic activity in the public sector, gained widespread acceptance by political decision-makers across a broad international arena from the mid-1970s onward (Kurunmäki, 1999).

In 2005, the Dutch government introduced a new reimbursement system, the Diagnosis Treatment Combinations (DBC), for the registration and reimbursement of hospital and medical specialist care (Oostenbrink & Rutten, 2006). For the first time in Dutch history, hospitals and health insurance companies had the opportunity to freely negotiate on prices for medical care. With these measures, the government aimed to control the fast-growing expenses in the health care sector in order to keep it within its budget. The Dutch health care reforms were highly economically oriented and had many consequences for hospitals. Hospitals were confronted with cuts in expenditures, an increase in competition and a reduction of income guarantees. In the process, a new role had been assigned to hospitals, that of the entrepreneur (Asselman, 2008). Hospitals were faced with new challenges, such as determining a portfolio strategy and a selling strategy. Alongside this, other topics gained relevance, such as negotiating with health insurers and dealing with liquidity risks. After the reforms, one strategy by the top management of hospitals was to delegate entrepreneurship and responsibilities for resources to the managers of the medical specialties (i.e. the chief physicians and division or cluster managers) as it recognized that the control of health costs lay in the hands of individual physicians and their managers (Doolin, 1999<sup>1</sup>). To fulfill this role, the managers needed effective management knowledge, skills, and information about their patients, which is essentially case-mix information. With regard to information, they felt the urge to have more accurate information as well as new types of information, such as cost and revenues (Cardinaels et al, 2004), patient characteristics, information on quality, and information on the hospital market.

### *Case-mix information systems*

Perhaps the most significant change in the health sector since the health care reforms concerns the introduction of case-mix information systems (CMIs), and most commonly the use of data related to Diagnosis Related Groups (DRG) (Lowe & Doolin, 1999). The term 'case-mix' simply means the mix of cases treated (Reid, 2013). Case-mix management is considered the management of clinical activity on the basis of a range of patient categories and the associated differential resource allocation (Doolin, 1999<sup>1</sup>). In literature, several examples of CMIs can be found in the United States, New Zealand, Sweden and Finland (Abernethy et al, 2007; Covaleski et al, 1993; Doolin, 1999<sup>1</sup>, 2004; Lehtonen, 2007; Lowe, 2000<sup>1</sup>, Lowe & Doolin, 1999; Reid, 2013; Scarparo, 2006; Sumner & Moreland, 1995). In a CMI, medical data, patient data, and financial data are collected at the patient level (see Figure 1.1). This data can be integrated, correlated, and aggregated at different levels, such as by individual patient, patient group, individual clinician, or medical specialty. With the use of this system, a range of questions may be answered, for example: what are the costs per diagnosis, what is the relationship between the age of the patient and the presence of different diseases, and what is the financial coverage per patient group? This information can then be used in the prioritizing, planning, controlling, and pricing of medical services. The objective is to provide information on medical activity, cost, and the returns of treating patients among clinical staff and management in hospitals, and to rationalize and codify clinical activity (Lehtonen, 2007; Doolin, 1999<sup>1</sup>; Lowe & Doolin, 1999).

**Figure 1.1: A case-mix information system**



### **1.2 Case-mix information systems: the research gap**

Several prior studies about the design and implementation of case-mix information systems in hospitals were published (Abernethy et al, 2007; Covaleski et al, 1993; Doolin, 1999<sup>1</sup>, 2004; Lehtonen, 2007; Lowe, 2000<sup>1</sup>, Lowe & Doolin, 1999; Reid, 2013; Scarparo, 2006; Sumner & Moreland, 1995). The main themes of these studies relate to the on-going transformation in the health sector, the role of accounting in this process, and the implementation of accounting information systems in organizations. Some implementations were successful and led to positive results, such as the increase of cost consciousness, the rationalization of decision-making and operating processes, and cost reduction. However, many CMI implementations failed and had negative effects, such as the increase of conflict between hospital board members and hospital managers, information overload for the users, and the fear that the quality of care may be adversely affected. It can be concluded, therefore, that CMIs affect the way hospitals operate, both in beneficial and in harmful ways. Although we find that these issues are extremely important, we are left with a partial picture and an incomplete explanation of the effects of CMIs (Lehtonen, 2007). In general, too little research has been done to study the effects of CMIs in different contexts. Many important research topics have therefore been left unexplored, conflicting results have been unresolved, and a consensus on the performance benefits has not been attained.

First, in the academic literature about CMIs, most studies are related to the effects of the implementation and the use of an already existing system, not to the whole process of design and implementation of a new system. Therefore, there is a lack of scientific design knowledge. Second, many studies about information systems relate to cost (accounting) systems; only a few studies relate to real case-mix information systems in hospitals where medical, patient and financial information is integrated. Also, in scientific literature, the CMIs are mostly described in a global fashion, but in practice they consist of several different types of information, tools, and reports, with specific attributes that promote or obstruct the success of the system. Also the relevance, applicability, and use of the information provided by the system seem to vary among organization levels and among individuals. Therefore, for a better understanding, we need to examine CMIs in a more detailed way.

Third, because these systems have only gradually been introduced since 2005, no studies have been done in Dutch (university) hospitals so far to examine the mechanisms that cause successful implementations of CMIs. Before 2005 CMIs were not available in hospitals. The knowledge and experience from other countries was of limited use to the Dutch medical community because the contexts were very different from the situation in the Netherlands, such as with regards to the organization of hospital care, the timing of the introduction of hospital reforms, the type of reimbursement, the specifics of

the product system, and the legal regulations. Besides this, most scientific theories that were applicable to the design and implementation of information innovations were too general to use for a specific situation, such as the Dutch University Medical Centers (UMCs). Specific innovations demand specific implementation strategies. In general, we know which factors can affect benefits of the innovation to organizations, but we don't know which factors prevail in which contexts (Lehtonen, 2007). At the same time, in the literature there are conflicting and unresolved research results and there is no consensus on the performance benefits. Sometimes CMI's appear to be successful but there are also many examples of failure. Since extant research shows that the results differ considerably per country and per organization, it is important to investigate which strategy works best for the design and implementation of a specific innovation (CMI) for a specific target group (top management) in a specific setting (UMC) in a specific country (the Netherlands).

Fourth, in academic literature on the use of CMI's, most studies are limited to a specific kind of behavior by the individual physician, such as the prescription of medicines or the use of a laboratory. These are decisions at a more operational level. However, it is unknown what the long-term impact of CMI's would be on more strategic and decisions on the meso level, such as the selection of patient groups. Longitudinal research is hardly been done in management accounting research and is mostly limited to time periods of four years or less. Finally, in general it can be stated that there is still a gap between the validity of the research and its practical relevance (Van Aken, 2005). According to Van Aken, this means that most academic research in organization and management is based on the approach of explanatory sciences, and does not solve the problems of the professional. The professional is mainly interested in practical answers to questions such as: how does a CMI have to be designed and how can it be implemented in a successful way? There is a need for design knowledge to be used for the successful design and implementation of a CMI.

### 1.3 CMI's in Dutch hospitals

In the Netherlands, there had been little experience with CMI's because the DBC system had been—as described previously—only recently introduced, and it takes several years to design and implement such a system and to determine its success. The DBC's provide an opportunity for the design of new kinds of information types. The DBC's are defined in a national product structure, consisting of types of diagnosis and treatments per medical specialty. As a result, since 2005 all physicians began registering diseases and activities uniformly, making their professional activities transparent and making it possible to benchmark medical activities and hospitals in a detailed way. Furthermore,

the DBC system enables an integration of medical (diagnosis and treatment) and financial (cost and tariff) data. Previously, these 'worlds' were separated from each other. By doing this, a new language was introduced that could be spoken by both medical and financial professionals. Finally, for the first time in Dutch history, the cost and revenues per patient could be calculated. Until 2005, Dutch hospitals had been funded by a global budget system within which there was no direct link with the individual patient because it consisted of a considerable number of fixed components. The DBC system increases the ability to take economic aspects into consideration when making decisions in hospitals on, for example the types of patients and/ or methods of treatment.

#### *Innovation in the Dutch hospital sector*

Since there were no ready-made CMI's available for the Dutch hospital sector, several hospitals decided to design and implement their own systems. These information systems are very innovative for the Dutch hospitals in several respects. New types of information are introduced, such as costs and revenues per patient group, types of referrers, and market shares. The information is also based on new source data; the DBC data. The strengths and weaknesses of this source are unknown. Furthermore, the CMI's are designed and implemented at a time of major change, both within the hospitals (the introduction of internal output budgeting) and externally (the liberalization of care). In fact, the impact of these systems on Dutch hospitals cannot be predicted. There is actually no design-oriented knowledge available. Within the Dutch hospitals, the UMC's have a special position because, contrary to many general hospitals, they integrate three core tasks: patient care, (bio) medical research, and medical education. Furthermore, all hospital staff members are employed with a fixed salary, which implies that they have no personal interest in the financial consequences of the case-mix. This is considered to be an important factor that may affect the design and implementation of a CMI.

#### *The Academic Medical Center*

Until 2006, as in most other hospitals, the management information in the Academic Medical Center (AMC) about patient care was mainly focused on costs and global budget parameters, which included the number of admissions, patient days, and outpatient visits. Information hardly focused on the types of care (case-mix) and their relevance for the different core tasks. Moreover, the information was only available at the level of the medical specialty or department, not at the individual patient or doctor level. Besides, there was no tool to translate (qualitative) medical policy decisions into quantitative financial or capacity planning. Finally, the information was not easily accessible. In times of austerity the internal discussions (about cost overruns) intensified and the external pressure for more accountability increased. As a response the Board of Directors decided in 2006 to design and implement a computerized case-mix information system (CMI)

that should focus on patient groups and that was capable of linking medical, patient, and financial data for case-mix management. The core idea was that the type and number of patients treated had a significant impact on how the AMC performs its core tasks and on the financial consequences. The CMI primarily had to be designed for the top medical and non-medical management, i.e. the chief physicians, division managers, and central managers (including Board of Directors), because they were considered to be the key decision makers in the AMC. Because of the lack of knowledge about case-mix information systems in Dutch university hospitals and the uncertainty about the impact on the organization, it was concluded that the processes of design, implementation, and outcome evaluation had to be conducted in a scientific way.

#### 1.4 Research objectives

Between 2006 and 2014 an in-depth longitudinal design-oriented case study was performed at the AMC. The research objectives were:

1. To design and implement a CMI for the top medical and non-medical management in the AMC
2. To gain in-depth design-oriented knowledge about a CMI

#### 1.5 Research methodology

In the study the methodology of *design-oriented research* was used. The aim of this methodology is to develop reliable and valid knowledge to be used in designing solutions to real managerial problems in the field in question (Van Aken, 2004). Knowledge is developed in cooperation with the professionals. In this way, both scientifically relevant and practically useful knowledge is developed. Design-oriented research has been applied earlier in several disciplines, including medical science, engineering and management. It is essentially a process of gaining knowledge (developing theories) on the basis of reflection on the functioning of the *regulative cycle* (Vosselman, 1996). Key elements of this cycle are problem formulation, problem diagnoses, design, implementation, and evaluation of the effects of an innovation. The iterative process continues until a satisfactory solution that works well for the specified class of problems crystallizes. Design-oriented research can be considered as an alternative to the classical empirical research where theory-driven and data-driven hypotheses are tested with the use of statistical methods and accordingly are accepted or rejected.

#### *A design-oriented case study in the AMC*

For this research a longitudinal design-oriented case study was conducted at the Academic Medical Center (AMC), which took place from 2006 until 2014. During this study, a case-mix information system (CMI) was designed and implemented in close cooperation with the top medical and non-medical managers. The regulative cycle was passed through several times. In the process it was determined what products would be (re)designed and implemented, based on the evaluations of the existing CMI and new developments, such as external developments and related developments at the level of the AMC. Eventually, several physical and non-physical case-mix information products were designed and implemented. The CMI was iteratively designed and implemented at the AMC consisting of several physical and non-physical products, like a Standard Report Patient Care, Portfolio Matrix and Data Cubes (Cognos). Some of these products were primarily designed for the top (medical) managers, whereas other products were designed for their business analysts to support their managers in the use of the CMI. During the period, there was extensive reflection on the outcomes of the CMI-project and the factors which promoted or obstructed its success. Interviews were held, questionnaires were sent to participants and various personal observations were made. In 2014, it was concluded that the CMI had been completed and the objectives of the project had been fulfilled, so the project was finished. Based on this case study, the implications of the research for the management accounting discipline, as well as for hospital managers and regulators were outlined.

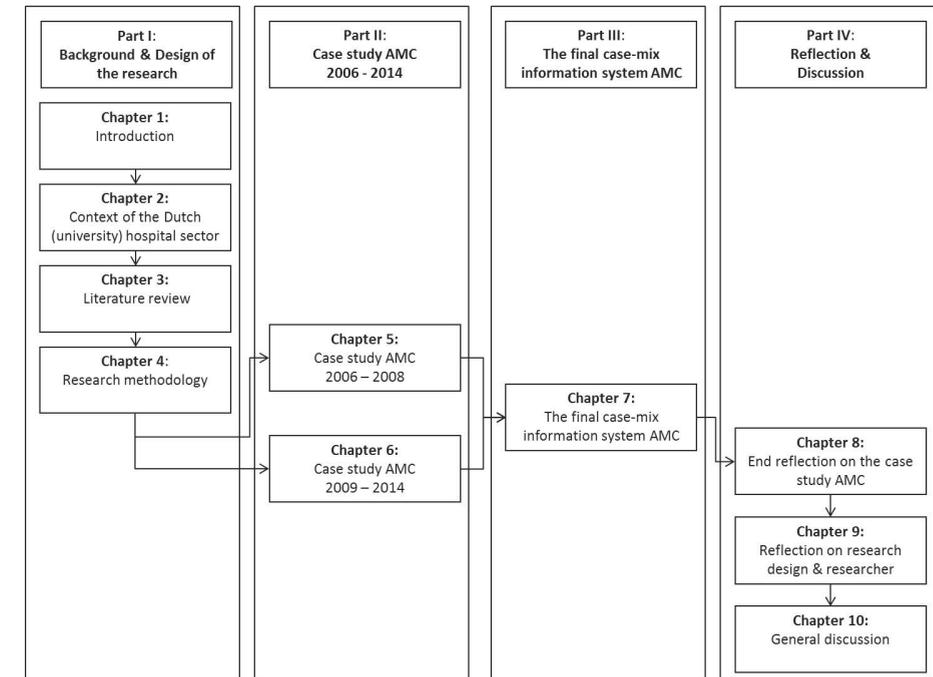
#### *The applicability of design oriented knowledge in a similar context*

To determine the applicability of the design oriented knowledge in a similar context, in 2010 - 2011 a limited secondary case study was conducted at another university medical center (UMC): *the University Medical Center Groningen (UMCG)*. During the study, one key product of the AMC's CMI, the Portfolio Matrix was redesigned and implemented hospital wide in the UMCG by passing through the regulative cycle. In 2015, a third UMC, the *Free University Medical Center (VUmc)* adopted also the AMC's Portfolio Matrix and implemented it at some specialties in its organization. Through these (limited) studies, insight was obtained about the scope of the application of the design knowledge as it was gained at the AMC.

## 1.6 Thesis structure

This thesis is structured in four parts, each consisting of one or more chapters (see Figure 1.2). *Part I* describes the background and design of the research. It contains the introduction (this **Chapter 1**); the context of the Dutch (university) hospital sector (**Chapter 2**); the literature review (**Chapter 3**); and research methodology (**Chapter 4**). *Part II* presents the iterative processing of the design and implementation of the CMI in the AMC, broken down into the periods 2006 to 2008 (**Chapter 5**) and 2009 to 2014 (**Chapter 6**). In these chapters, the regulative cycles are described. Also, the most important developments in the hospital sector and the AMC are described. In *Part III*, the end products of the final CMI of the AMC are described (**Chapter 7**). *Part IV* offers the final reflection on the outcomes of the CMI project for both users and organization and on the factors that promoted or obstructed success. The conclusions are based on the results of the qualitative and quantitative results of the interim reflections and the end reflection (**Chapter 8**). Moreover, the objectives of the research project, the research methodology, the role of the researcher and the applicability of the research findings to other hospital organizations are reflected upon (**Chapter 9**). In **Chapter 10**, the main implications of the research project with regard to the management accounting discipline are presented. To further expand the knowledge of CMIs in health care settings, also several suggestions and directions for future research are given. Finally, the gained design-oriented knowledge was translated into practical guidelines (or recommendations) for a successful implementation of a CMI in Dutch university hospitals (UMCs). The guidelines are meant for practitioners who can directly or indirectly influence the success of CMIs in UMCs, such as hospital managers (Board of Directors, division managers, chief physicians, project managers, IT managers) and regulators (Ministry of Health, Ministry of Education, and health authorities such as the NZa and ACM).

Figure 1.2: Thesis structure



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# Chapter 2

Context of the Dutch (university) hospital sector

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## Abstract

The Dutch health care sector is under great financial pressure. Since 2005, several major reforms have been introduced to liberalize the health care market as much as possible. The reforms consisted of a number of significant legislative changes and the introduction of a new reimbursement system based on the Diagnosis Treatment Combinations (DBC). This system replaced the budget system which had been in use since 1988. The DBC system was based on the registration of care episodes including all diagnostic and treatment activities for the patient. In the Netherlands, a decision was made to develop a tailored system and therefore the DBC system is unique. The DBCs were divided into three segments: regulated, free (negotiable), and fixed and were billed in this way to the insurers. The free segment was increased from 10% in 2005 to 70% in 2012. In 2012, the DBC system was replaced in 2012 by the DOT system, which was a considerably less fine-grained system. Also the university medical centers (UMCs) had to join the DBC and DOT system in a similar way to the general hospitals and were expected to compete for patient care in the hospital market. The hospital care reforms and other developments, such as increasing pressure on finance and accountability, required adjustments to the ways UMCs were generally managed in the budget era. Entrepreneurship, adjustments to the organizational structure, adjustment to the planning and control systems, and detailed and better information about patient populations became increasingly important. In 2006, the Academic Medical Center in Amsterdam (AMC) began the design of a CMI to support their top (medical) managers at different phases of the strategic management cycle, i.e. analyzing, decision making, planning, implementation, monitoring and legitimization.

## 2.1 Introduction

To better understand the context of this study, in this chapter, the Dutch hospital sector and specifically the university medical centers (UMCs) are described. First, in Section 2.2, there is a description of the general characteristics of the Dutch hospital sector. Section 2.3 focuses on healthcare spending in the Netherlands in comparison to other countries and explains why healthcare reforms were necessary. In Section 2.4, the Dutch health care reforms in 2005 and 2006 are further described and this includes new laws and the introduction of a new reimbursement system based on the Diagnosis Treatment Combinations (DBC). In Section 2.5, the DBC system is further explained and compared to the budget system used in the period from 1988 to 2005. Section 2.6 summarizes what the impact of the reforms was on Dutch hospital organizations and what adjustments to the organizations were necessary to survive in this new market environment. Section 2.7 focuses on the UMCs and describes which of their characteristics are distinct from those of general hospitals, like their responsibilities, funding, and position in a market environment that makes them a specific sector within the Dutch health care sector. In Section 2.8, the general characteristics of the AMC are described with regard to strategy, organizational structure, management, culture, finance, planning and control, and the healthcare market.

## 2.2 General characteristics of the hospital sector in the Netherlands

In the Netherlands, health care is organized according to the principle of echeloning (Boot & Knapen, 2005). It is a hierarchy of provisions based on specialization and intensity of care. There are three echelons: primary, secondary, and tertiary care. Being referred by a member of the first echelon is mandatory for access to the second and third echelons. *Primary care* is well developed in the Netherlands. It is provided by general practitioners, district nurses, physiotherapists, social workers, dentists, and pharmacists (www.oecd.org). In particular, the general practitioner plays the role of a gatekeeper to secondary care and patients are referred to specialists in only 6% of contacts. Secondary and tertiary care is mostly provided by medical specialists in hospitals. *Secondary care* is the health care services provided by medical specialists, dental specialists and other health professionals who generally do not have first contact with patients: for example, cardiologists, urologists, and oral and maxillofacial surgeons (www.wikipedia.org). In The Netherlands, patients are required to see a primary care provider for a referral before they can access secondary care. *Tertiary care* is highly specialized health care on referral from a primary or secondary health professional, usually for inpatients, in a facility that has personnel and facilities for advanced medical investigation and treatment, such as a university medical center.

In 2014, there were 131 hospital sites and 112 outpatient clinics (www.zorgatlas.nl). Medical specialists are generally self-employed and linked with hospitals through contracts. However, in the Dutch UMCs, they usually work as employees. UMCs are in charge of different tasks: patient care, education, research, and training. They are leading hospitals with advanced clinical treatments, and last-resort functions. In the Netherlands, some specialized procedures can only be carried out in medical institutions that hold a license provided by the Ministry of Health. The UMCs carry out the majority of these procedures on the basis of these licenses. The supply of hospital care is also increasingly differentiated. Hospitals often choose to concentrate on specific functions in one location. That means some hospitals get more, and enhanced features, and others fewer. At the same time, outpatient and day treatment care is increasingly provided. A growing trend is observed nowadays: the formation by medical specialists of collective medical offices (independent treatment centers), which provide routine care and light surgery. They constitute a not insignificant challenge to hospitals since their small size and their highly specialized and programmed activity, allows them to be quite competitive.

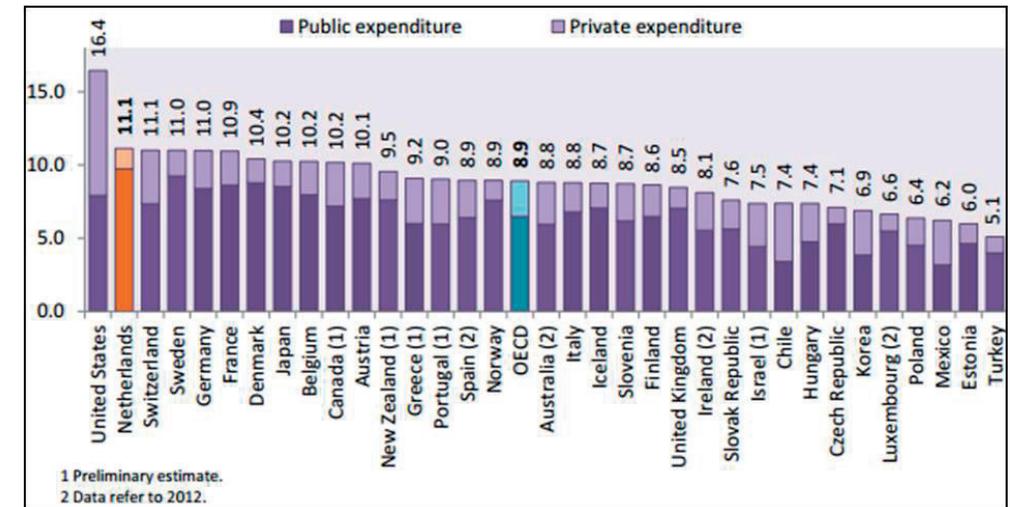
Hospitals in the Netherlands are mostly not for profit, as are health insurance companies. Most insurance packages allow patients to choose where they want to be treated. However, this changed from 2016. From then on, health insurers gain the power to determine to which medical specialist, psychologist, or other mental health practitioner the person will be referred. With the new policy, insurers may choose to pay only part of the treatment or nothing when they have no contract with the care supplier. Patients can still choose where they want to be treated, but when there is no contract between the insurer and care provider, this may cost have financial consequences. Health insurers play a central role in the Dutch health care system. The four big insurers account for about 90% of the market share (www.zorgwijzer.nl). For basic insurance, insurers face acceptance duty and are not allowed to apply premium differentiation. Health insurers can use their power of negotiation to reduce costs and increase quality.

### 2.3 Health care spending in the Netherlands

In 2013, health care spending in the Netherlands (excluding investment expenditure in the health sector) was 11.1% of the Gross Domestic Product (GDP), well above the OECD average of 8.9% (www.oecd.org). This had increased by 1.6 percentage points since 2005 and is the second highest share across Organization for Economic Co-operation and Development (OECD) countries<sup>1</sup>, See Figure 2.1.

<sup>1</sup> OECD uses its wealth of information on a broad range of topics to help governments foster prosperity and fight poverty through economic growth and financial stability (www.oecd.org).

Figure 2.1: Health care expenditure as a share of GDP, OECD countries, 2013



OECD Health Statistics, 2015

Health spending in the Netherlands continued to grow despite the economic crisis and averaged an annual real term growth rate of over 3% between 2006 and 2012. The rate of growth slowed to 1.2% in 2011 but went up again in 2012 to 3.5%. About 30% of the total cost of healthcare in the Netherlands is spent on hospital care, making it by far the most expensive within overall health care provision (Balogh & Van Veen-Dirks, 2010). The increase is partly due to the increasing costs of medical technology, pressure from society to expand the care package, unhealthy lifestyle behaviors (e.g. increasing obesity), and the effects of aging. As for the latter, it may be noted that the Netherlands is a relative young country in comparison with its European partners and the real aging has yet to begin. Another explanation is the anchoring of the right to healthcare in 2000, so that the limitation of healthcare by waiting lists is no longer possible (Inspectie der Rijksfinanciën, 2010). The Dutch health care system is therefore under great pressure and that pressure will further increase. In 2012 86% of health spending is funded by public sources, which is well above the average of 72% in OECD countries. Various measures are taken by the government and insurers to restrict supply so that increases in costs of care remain limited. This includes setting a maximum growth rate for healthcare suppliers. For example, every year parliament passes a law on the global development of health expenditures (in Dutch: Budgettair Kader Zorg). This determines which part of the Dutch economy can be used for health, without harming its other components. If this amount is exceeded, in the following year all health providers will have to reduce

their expenses. In a way, this system doesn't give individual incentives to reduce one's budget since everybody has to bear the consequences of possible budget cuts.

## 2.4 Dutch hospital care reforms

Since 2005, several major reforms in the health care system have been introduced in the Netherlands. In a context of growing health care expenditure, the government wanted to make the Dutch population feel more concerned about the costs. In addition, there were too many people on waiting lists for health care services. By introducing *regulated market mechanisms*<sup>2</sup> and demand-driven supply policies, the government tried to incite providers and insurers to provide the best services, adapted to the needs of the population (and the same by increasing some activities), against the lowest possible cost. The government also wanted to promote more transparency.

### *Liberalizing the healthcare market as much as possible*

The core of the reforms was that the responsibilities were assigned as closely as possible to the main players in healthcare: the public, the health insurers, the health care providers, and in some cases, the municipalities. The government aimed to achieve this by liberalizing the healthcare market as much as possible and by introducing 'incentives in care.' It expected that when personal responsibility and initiative by the parties in healthcare were given priority, the needs of the care recipients would be better met (VWS, 2007). By introducing incentives in care, the government aimed to motivate parties to act more efficiently and therefore achieve better quality and innovation in care. The patient had to become a critical care consumer who was encouraged to make responsible choices. Insurers had to compete with each other on price, service, and quality; and care providers should be stimulated to provide care more effectively and efficiently. The government retained an important role in ensuring quality, accessibility, and affordability of care.

The reforms of health care consisted of a number of significant legislative changes in 2005 and 2006. In 2006 the new *Health Care Insurance Act* was introduced. The main aim is to make care more efficient and affordable in the longer term. The core of this law is that there is only one insurance and the government determines what is insured and that insurers have to accept everyone regardless of age or health risks. All insured have to pay a nominal premium independent of their income, which could vary by insurer. People who have to pay too much of their income on healthcare premium, will be compensated with a statutory allowance. The purpose is to introduce managed

<sup>2</sup> Regulated market mechanisms means that although buyers and sellers have some freedom, but that freedom is circumscribed by laws and regulations to prevent unwanted effects and ensure the public objectives of quality, accessibility and affordability (Balogh & Van Veen, 2010)

competition between health insurance companies and between healthcare providers as well. Insurers can compete on the level of the nominal premium, but also on the manner of pricing, on service, quality of care, and the associated premiums. The expectation was that health insurers in their new role would put more pressure on providers to improve quality, and that efficiency in care would increase. Also in 2006, the *Health Care Market Regulation Act (WVG)* was introduced. This law regulates the development, planning and supervision of the health care markets. This law stipulates the establishment of the Dutch Healthcare Authority (NZa) as an independent administrative body that oversees the markets for care. The aim of the law is to bring about an effective and efficient health care system, to control costs in health care and to protect and promote the position of the consumer ([www.nza.nl](http://www.nza.nl)). In 2005, the *Health Care Institutions Accreditation Act (WTZi)* was introduced. The aim of this law is to lower access barriers for health providers to enter the health care market, by making the procedures simpler and shorter. On the other hand, they are obliged to be transparent about their governance and to have an orderly administration. The aim of the WTZi is to increase access for new entrants to the health care market, such as Independent Treatment Centers, as much as possible (VWS, 2004). In combination, these laws aim to motivate actors in the health care market to enhance competition; they enhance selective contracting, free access for new entrants, free consumer choice for insurers, and direct access to quality information (Krabbe, 2014). Finally, in 2005, a new funding and performance system for hospitals and medical specialists was introduced based on Diagnosis Treatment Combinations (DBC). This system is outlined in Section 2.5.

### *Other developments*

Except for the formal, legal, reforms in the hospital sector, there were other developments that had a major impact on hospitals (Asselman, 2008). First, in the course of time, the *pressure on financial resources* increased considerably in most hospitals, because costs rose faster than revenues. With regard to revenues, the government has several tools to directly or indirectly intervene in the hospitals' sources of revenue. For example, in 2012 a Gentleman's Agreement between the Ministry of Health, hospitals, and health insurers, was made. The Agreement was a controlled expenditure growth of 2.5% structurally per year in the hospital sector for the period 2012 to 2015. Apart from directly intervening in the budget, the government used indirect instruments to control costs, such as interventions in the insured package, and increasingly licensed new entrants on the hospital market such as independent treatment centers.

Second, the increasing pressure on resources had consequences for the relationship between hospitals and their funders. This in particular concerned the relationship with insurers, banks, and for UMCs, the relationship with the affiliated university, the Ministry of Education, and industry. In times of financial distress, the negotiations

between hospitals and funders became tougher. Banks established stricter demands on hospitals, for example with regard to creditworthiness. The health care reforms implied that hospitals were treated more like private companies with corresponding requirements on equity (at least 20 to 40% of total assets), administrative organization, and business management. Also, the suppliers of hospitals were expected to adjust their terms of delivery.

Third, the pressure on hospitals for external accountability concerning their policies, outputs, and costs increased considerably. This applied to both the level of detail and frequency of the accounts given. For example, under pressure from patients and health insurers hospitals were increasingly forced to report on performance indicators regarding patient safety, effectiveness, patient satisfaction, quality, and content of care (e.g. the number of cases, re-operations, complications). Although several comments might be placed on these indicators, there was and is the tendency to publish them. As a consequence various opportunities emerged to compare hospitals on the basis of benchmarking. This is evidenced by the many publications existing in this area, including the regular reports, but also in the Dutch national media (Elsevier, Algemeen Dagblad) where statements were published ranking hospitals from the “best” to the “worst” in the Netherlands. The benchmarks also created opportunities for the hospitals themselves to assess their own performance against other hospitals.

## 2.5 Funding of Dutch hospitals

In this section, the DBC system is explained and compared to the budget system used in the period from 1988 to 2005.

### Hospital funding in 1988 - 2005

Until 2005, most hospitals were funded on the basis of the model of a function-based budget (FB) that was introduced in 1988. The FB budget was determined by fixed, semi-fixed, and variable cost components (Krabbe, 2014). The fixed cost component was associated with costs related to the number of inhabitants (adherence) living in the hospital's service area; it was viewed as serving the availability function of the hospital. The semi-fixed components were associated with the hospital's capacity, such as the number of beds and the number and type of medical specialists. The semi-fixed component changed from time to time, depending on capacity decisions. The variable components of the budget depended on the activity level in hospitals. They were expressed in a number of budget parameters such as admissions, hospitalization days, day patient treatments, initial outpatient clinic visits and specific treatments in regular care, and top-level clinical treatments. Hospitals usually got additional budgets, particularly for capital expenditures, or academic budgets (for university medical

centers). The negotiated budget was constituted by agreements between insurance companies and hospitals on the forecasted development of the activities and the nature or costs of some services. The aim of the budget system was to contain the growth of health care expenditures. However, the most important drawback of the budget system was that there was little incentive to provide care innovation, to work efficiently, and to be transparent. It gave insufficient insight into the performance of individual hospitals. Hospitals were thus not sufficiently rewarded for good performance or settled on poor performance. Furthermore, there was a lack of competitive incentives for insurers (VWS, 2004).

### Hospital funding since 2005

Given the drawbacks of the budget system the government decided to create a reimbursement system related to activities, which would give incentives to hospitals to search for cost reduction and quality improvement, and consequently, created the Diagnosis Treatment Combinations or DBCs. The DBC structure was in operation between 2005 and 2011 (Krabbe, 2014). Although partly inspired by the DRG (Diagnosis Related Groups) system, the DBC system was unique, which made international comparisons difficult. The Netherlands chose to develop their own patient classification system because the system also had to be used for market regulation and output pricing. At that time, there was no DRG system that could serve these targets. The fee for medical specialists was not included in the DRG tariff and there were no DRGs for outpatient care. The objective of the DBC system was to make the patient's health issue the focal point (Hofdijk, 2011). The DBC system was a reimbursement system based on the registration of care episodes (Krabbe, 2014). It included all diagnostic and treatment activities for the patient from the first to the last hospital visit. The DBC classification system ideally should define DBCs that were homogeneous in resource consumption. DBCs were only registered by the so-called portal specialties<sup>3</sup>. The production of the supporting specialties (diagnostic and anesthesiology products) was part of the care process of the DBC.

#### *DBC product structure*

A DBC described with codes how a patient entered the hospital, with which complaint, what diagnosis, and the proposed treatment within a predefined period; a care trajectory. A care trajectory could consist of one or more sub-trajectories. This period was determined by fixed algorithms. For example, in a clinical sub-trajectory, the closing date of the DBC was the 42nd day after discharge, in a non-clinical sub-trajectory with conservative (non-surgical) treatment it was on the 90th day after the opening of the

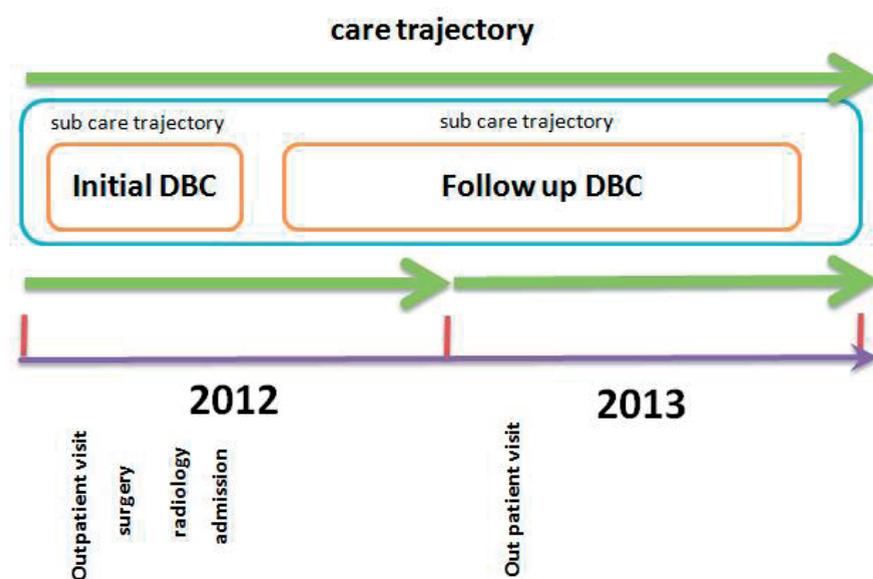
<sup>3</sup> These were specialties where the patient first came into contact after referral by the GP, such as cardiology, surgery, dermatology, gynecology, and neurology.

initial sub-trajectory. For follow-up DBCs, the closing day was on the 365th day after the opening of the sub-trajectory.<sup>4</sup> A computer program (grouper) was used to classify the sub-trajectories in DBC care products and to conform to rules adopted by the Dutch Healthcare Authority (NZa). All sub-trajectories formed a separate DBC care product and had their own start date. The start date of the DBC care product determined which health insurer was invoiced. The DBC product definition was associated with care activities (or procedures), for example diagnostic, surgery, and laboratory activities, that together made up the DBC's *resource use profile*, specifying the proportion of DBCs in which procedure was performed and the mean use of this service (Oostenbrink & Rutten, 2006).

#### Example of a DBC trajectory

In this example, a patient was admitted to the hospital in February 2012 with a broken hip. The patient underwent surgery the next day and they stayed in the clinic for one week. In February, the DBC was started and automatically closed after 42 days. In 2013, the patient returned for a follow-up consultation and a new follow up DBC was started.

Figure 2.2: Example of a DBC trajectory broken hip



<sup>4</sup> Since 2015 the closing day of follow up DBCs was reduced to the 120<sup>th</sup> day.

The example shows that the (sub) trajectories passed through calendar years. This was quite different from how medical production was recorded up to this point, which was

namely per calendar year. In addition, a DBC contained all of the direct and indirect activities and associated costs that could be attributed to the DBC, so including the medical and non-medical supporting departments.

#### Segments

The DBCs were divided into three segments: a regulated, free, and fixed segment. Health insurers negotiated with hospitals on health care production in both the A and B segments (Krabbe, 2014). The *regulated segment* (A-list DBCs) contained top clinical care, top referral care, and specific care/ materials (the so called *add-on*) like expensive drugs, intensive care, and blood products. The tariffs for the DBCs were determined by the National Health Authority (NZa) and were elaborated on the basis of cost information collected amongst hospitals. Some top referral care was not accurately described by DBCs, like complex pediatric care, which attenuated the implementation of the DBC system for UMCs. When such care was provided, a DBC was charged for basic care as delivered by the general hospitals. The *free segment* (B-list DBCs) contained the more common and standardized care for which a real market existed, like cataract or basic hip surgery. The tariffs of the DBCs of the free segment were freely negotiable with health insurers, except for the part corresponding to the specialists' wages. Health insurers might employ different DBC prices for different hospitals (Oostenbrink & Rutten, 2006). Likewise, hospitals may negotiate different prices for the same DBC with different health insurers. The *fixed segment* contained mainly acute care where costs were mainly fixed by the needed availability of infrastructure and staff. The lump sum compensation for the fixed segment was determined by the government. In 2006, the free segment DBCs represented around 10% of general hospitals' budgets<sup>5</sup>. In 2008, this was expanded up to 20%, in 2009 up to 34%, and in 2012 up to 70%. So the free segment was gradually increased to prepare hospitals for this big change by obliging them to think about their revenues in terms of DBCs, evaluate their costs for each DBC, and, eventually, compare their performances with other hospitals.

#### Similarities and differences between the DBC and DRG system

Something that the DBC and DRG systems had in common was that in both a set of 'standard products of health care' was created by a set of defined diagnoses and standard average treatment costs for those diagnoses. The patient and his or her specific diagnosis became the focus of calculation, rather than simply the intermediate products, such as

<sup>5</sup> It should be noted that these are average percentages for all hospitals in the Netherlands. However, for university medical centers, these percentages were significantly lower because they provide relatively more complex care of whose care products are in the regulated segment.

particular medical procedures or diagnostic tests. However, the DBC system differed from the DRG system in some aspects (Hasaart, 2011; Krabbe, 2014.) DBCs were coded afterwards, while DRGs were often coded at the beginning of the treatments. The coding was done by the medical specialists and not by specific employees, which implied that the specialists had to be well informed and motivated about this coding. Contrary to the DRG system, in the DBC system the physician's payment was included in the DBC tariffs, thus motivating physicians to code accurately and perhaps opportunistically. This was not the same in university medical centers where, as noticed previously, physicians are employed, as their income does not depend on the quality of their coding. And lastly, DBCs covered the total care process, including outpatient visits, clinical episodes, day care, and rehabilitation care or aftercare. DRGs only covered the clinical episode. DBCs were validated at the end of the treatment, which generated delays in hospitals reimbursements by the insurers.

#### *From DBC to DOT system*

Although the first DBC system contained 40,000 different health care products (Krabbe, 2014), the system did not lead to a meaningful grouping of health care products and it led to excessive administrative costs (NZa, 2010). For this reason, the DBC system was replaced in 2012 by the DOT system, which stands for "DBC's On their way to Transparency". The DOT system was a considerably less fine-grained system, containing around 4,400 different case-mix groups, and it used the internationally accepted ICD-10 diagnoses classification system. The DOT system led to definitions of health care products that were more similar to patient classifications in other DRG systems. This also facilitated international comparisons, coordination, and charging of patients across borders. This development showed that the Dutch DBC system and international developments in DRG systems had converged. The DOT product structure means a less administrative burden for the medical specialists, because the care products are generated automatically via a mandatory national grouper which also increases the reliability. However, a major drawback of this system change was that all parties involved had to learn the new product structure again, and completely new agreements had to be made between hospitals and health insurers. In Section 6.3.2 we will focus more comprehensively on the implementation of the DOT system.

#### *The gradual change from budget system to performance based system*

The Dutch reimbursement system for hospitals has been gradually changing from a budget system to a performance-based system. As mentioned earlier, the revenues of hospitals for patient care were determined in two ways: by the budget system (regulated segment) and the free market (free segment). Even though, the DBCs of the regulated segment had been billed to the insurers, the reimbursement of the regulated segment

was still based on negotiations about the traditional budget parameters, such as number of admissions and days of hospitalizations. Reimbursement of the regulated segment only served as a vehicle to transfer money from health insurers to hospitals and medical specialists (Oostenbrink & Rutten, 2006). If the amount of the billed DBCs of the regulated segment didn't cover the calculated budget of the hospital, insurance companies had to pay the difference, which constituted a certain guarantee for hospitals. So for the regulated segment, reimbursement and funding was not the same thing. The B-list DBCs were freely negotiable and the billed DBCs determined the real income of the hospital. The negotiations dealt with quantity, tariffs, and more recently, with quality.

In 2012 and 2013, a *transition scheme* was introduced to enable hospitals to make the final transition from the budgeting system to the new performance-based system. This transition scheme contained safety nets. On the basis of this scheme a transition amount was determined for each hospital. This amount represented the difference between the turnover from the performance-based system and what would be achieved within the budget system. Hospitals that would receive fewer turnovers from the performance-based system compared to the budget system were compensated for the deficit in 2012 to 95%, decreasing to 70% in 2013. For hospitals that would receive more turnovers in the new system, their turnovers in 2012 and 2013 were skimmed off with the same percentages mentioned. Since 2014, there was no safety net any longer and the reimbursement was fully based on the billed DBCs. Since then, reimbursement and funding have been the same. Since 2012, the tariffs of the A-list DBCs were no longer fixed but were maximized by the government. Hospitals and health insurers were able to agree on lower tariffs. In Table 2.1, the characteristics of the reimbursement and funding systems of hospitals in the course of time are summarized.

Table 2.1: Summary characteristics of the reimbursement and funding of Dutch hospitals

	Period until 2005	Period 2005 – 2011	Period 2012 –2013	Period from 2014
Reimbursement system	Budget system	Budget system for regulated segment (70%) and free market for free segment (30%)	Free market (100%), with safety net: in 2012 (de) compensations up to 95%; in 2013 up to 70%.	Free market (100%), no safety net
Revenues based on	Budget parameters (fixed, semi-fixed, variable)	Budget parameters (A list DBCs) and DBCs (B-list DBCs)	DOT products (A and B-list DBCs), add-on's  Deficit/ surplus compensations	DOT products (A and B-list DBCs), add-on's
Negotiations about	Volumes of budget parameters, local issues	Volumes of budget parameters, local issues  List B DBCs: volumes, prices and quality of DBC	Contracting sum  List A and B DBCs: volumes, prices and quality of DBC, local issues	Contracting sum  List A and B DBCs: volumes, prices and quality of DBC, local issues

## 2.6 The impact of the health care reforms on hospitals

The health care reforms increased the pressure on resources and accountability, and required adjustments in hospital budgeting (Asselman, 2008). First, the introduction of the DBCs implicated higher financial risks. On the one hand, financial flexibility increased because the hospitals had more space for negotiation, but on the other hand it decreased because funding was more closely linked to the output of the various core tasks of the hospital, so they had fewer opportunities to cross-subsidize. This made it difficult for hospitals to subsidize unprofitable services from other services. Also, hospitals were facing more liquidity risk. This was created by the system itself, because DBCs could only be billed after closing and this was often one year after the first appointment with the patient. Furthermore, there was a risk that DBCs could not be billed because of inaccurate, untimely, and incomplete records of DBCs in the hospital. By introducing the DBC system, the contractual obligation of insurers also ended. Because of this it became a possibility that insurers would not contract specific types of care anymore with the hospital.

Second, in the budget era, the planning and control activities were often reactive in nature. In the free market, hospitals should identify changes in the environment that would affect their strategies and respond to them quicker than previously. The nature of Planning and Control had focus on the future so that it could be adjusted in a timely manner. This meant that the importance of budgeting and planning increased and that hospitals should have the appropriate (information) systems, for example for the planning and monitoring of personnel, materials, and costs (e.g. cost control systems such as Activity Based Costing). From the DBCs, management gained new possibilities for care-related management and financial management. The relationship between revenues and actual costs became more explicit. It also provided more opportunities for calculating internal budgets based on the DBCs, which might be more transparent and more free of discussion than the historic budgets and would introduce incentives that promoted aspects like efficiency, quality, quantity (production increase), and innovation. In 2009, a study showed that the liberalization in health care and related DBC system had a significant influence on the internal budgeting systems of six of the eight UMCs (see Box 2.1).

### Box 2.1: The impact of DBCs on the internal budgeting systems of the UMCs

Balogh & Van Veen-Dirks (2010) investigated whether the DBC system led to adjustments to the budgeting systems of the UMCs. The study shows that in 2009 six of the eight university medical centers used DBCs in a certain way in internal budgeting. Within three UMCs, the external (market) developments had the greatest impact on the internal budgeting system and the internal organization, because they fully coupled the external and internal funding. These UMCs conducted further changes in other areas in the internal organization such as adjusting the internal transfer costing between support units and portals. UMCs that chose to limit the impact of DBCs in their internal budget, also performed in other areas with little to no change to the internal organization.

Third, the introduction of the DBCs was not only a major change in the financing of hospitals but it also went much further. Hospitals were entering the market of regulated health care in which they were meant to operate like entrepreneurs with all the attendant risks. Entrepreneurship also required new business activities such as negotiation, relationship management, marketing, and portfolio and risk management. This meant that entrepreneurial knowledge and skills needed to be available in the hospital. This required a tremendous adjustment of the existing hospital managers, and

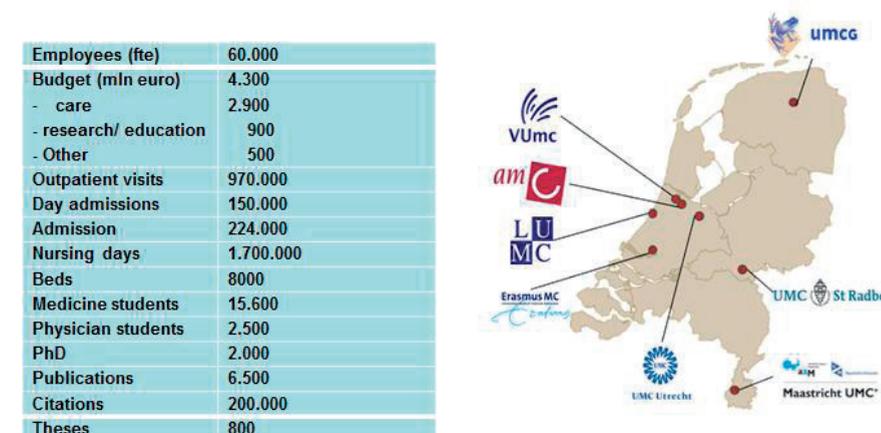
not only the Board of Directors, but throughout the organization. Fourth, the integral character of the DBC required that internal control would focus on the entire care process of the DBC rather than the individual organizational units such as divisions, clusters, and departments. It was therefore expected that more and more hospitals would adopt a decentralized organizational structure, with divisions no longer managed as cost centers but as profit centers. Finally, with the introduction of the DBCs, a detailed understanding of the care products, underlying activities, revenues, and costs became necessary. This required new management information that shows the effects of the DBCs for the hospital. This could include regular management reports regarding the timeliness of the DBC registration, validation and billing, DBC revenue per insurer, abnormalities of the DBC-resource use profiles, liquidity, work in progress, and cost. To make these new types of information available, new case-mix information systems in which various kinds of data were collected in a systematic manner would have to be implemented. From these CMI, reports could be generated.

## 2.7 University medical centers in the Netherlands

As mentioned in Section 2.2, in the Netherlands, hospital care for patients with rare and complex diseases is concentrated in eight university medical centers (UMCs), see Figure 2.3.

In a UMC, the faculty of medicine, with its responsibility for the initial training of physicians and for scientific research, is merged with the academic hospital, which has responsibility for tertiary care and clinical research and innovation (NFU, 2008; Balogh & Van Veen, 2010). All medical faculties and academic hospitals in the Netherlands are UMCs. The added value of UMCs is that they integrate the core tasks: patient care, (bio) medical research, and medical education, in close relation with, and participation in relevant networks. The interdependence of these core tasks is large and distinctive from general hospitals. In UMCs, chief physicians have general overall responsibility for all core activities. Although all UMCs provide basic hospital services, their public functions are primarily determined by the top clinical services they provide together with their last resort function for referrals from other hospitals. Such tertiary care should build on the knowledge infrastructure that the UMC provides, with clinical research, innovation, a multidisciplinary approach and a continuity of expertise, twenty-four hours a day, seven days a week, (NFU, 2008). Due to the large amount of multi-morbidity, the patients of the UMCs are mostly seen by several specialists.

Figure 2.3: University Medical Centers in size and figures 2005



NFU, 2006

### *The position of university medical centers in a market environment*

As described earlier, regulated market mechanisms were introduced in Dutch hospital care in 2005. Since then, the UMCs have operated with their activities partly on the health care market; mainly with regard to basic and elective patient care. However, the UMCs also conducted a number of public activities such as top referral care, education, scientific research, and innovation. For these activities, there was no market possible, and the quality of these activities could not be sufficiently guaranteed. It was therefore agreed between the Ministry of Health and the UMCs, how the activities of the UMC would be funded in the new system (VWS, 2007). The conclusion to these agreements was: *liberalization where possible, specific funding where necessary*. This meant that the UMCs, in a similar way to the general hospitals, had to compete in the health care market for patient care on the basis of patient opinion, and quality; and that for these patients, the UMC had to join the DBC system. Furthermore, as in the budget era, the UMCs continued to receive extra funding, in comparison with general hospitals, from the Ministry of Health (from the academic budget), the university budget (for workplace functions, and the educational function), and from other funds. The academic budget aimed to compensate the *excess costs* of academic functions as care for complicated or specific patients, and research and innovation. At a national level, the total amount of the academic budget was around € 580 million and was strictly allocated to UMCs (NFU, 2008).

## 2.8 The Academic Medical Center Amsterdam

Our empirical study was carried out in the Academic Medical Centre (AMC). In Amsterdam, there are two university medical centers (AMC and VUmc). The academic hospital and the University of Amsterdam's faculty of medicine had formed a single organization in 1994, making the AMC the first UMC in the Netherlands. The AMC is one of the largest of the eight university medical centers (UMC) in the Netherlands and has had in 2013 almost 7000 employees (AMC, Annual account 2013).

As a UMC, the AMC has three principal tasks: patient care, research, and education. Its primary task is, of course, the treatment of patients. With regard to patient care, the AMC provides three categories of patient care: basic care, tertiary care, and top referral care (AMC, Annual account 2014). Perhaps the most characteristic quality of the AMC is its diversity and social engagement. This diversity is due partly to the inherent multicultural nature of the immediate surrounding area served by the AMC, with a population that included about 120 different nationalities. Within the AMC, this richly diverse patient population is complemented by the wide variety of treatment methods, research areas, study programs and types of education. Especially to the residents in the immediate vicinity (South-East Amsterdam) the AMC offers basic care. To the residents of the province of North (-East) Holland, Flevoland, and part of the province of Utrecht, the AMC offers highly specialized clinical care. The clinical functions of the AMC included open heart surgery, IVF, kidney dialysis, and organ transplants. About 60% of the care of the AMC is top referral care. For this care, patients are referred by general practitioners and specialists from all over the Netherlands and beyond. The focal points of the AMC includes among other things: cardiovascular disease, immunology and infectious diseases, gynecological oncology, specialized care in early pregnancy, and pediatric oncology. This wide range of patients is of great importance for the quality of the education of medical students. In the course of time, patient care at the AMC has shifted more and more towards highly complex, low volume treatments. This trend was also welcomed by health insurers. This happened in order to create capacity for the tertiary care and at the same time to quickly help patients who need elective basic care. To realize this, the AMC has entered into partnerships with several hospitals and independent treatment centers (ZBCs), such as the Flevoziekenhuis and the VUmc.

### Organization

#### *Management principles*

To date, the organizational structure of the AMC is based on six principles (AMC, Structuurnota 2013) that are meant to guide the organization and control of the AMC.

First, at all levels of the organization, the management teams are led by professionals, medical specialists, scientists, and nurses (principle: 'professional in the lead'). They are expected, based on their knowledge and involvement in the primary process, to make the right decisions. Part of this principle is that the professionals who are active in management remained active in at least one and preferably more of the core tasks, which are patient care, education, or research. Second, decisions are taken at the lowest possible level in the organization, because there, close to the operation, tasks and resources can be balanced best (principle: decentralize where possible, centralize where necessary). The central level concerns strategic issues and frameworks for the division and departments, for example, in the area of financial management, human resources, and quality. Third, managers are responsible for the realization of all the goals and the use of all resources (for finance and personnel) of their unit and had the power and budgets to take full responsibility (principle: integral management). Fourth, although departments and divisions have their own interests, ultimately the importance of the AMC prevails (principle: collaboration). Cooperation and shared responsibility are ultimately more important than competition. Fifth, employees must know who is responsible, how relevant decisions are made and what considerations have played a role (principle: transparency). The sixth principle is that the allocation of tasks and resources follows the organizational structure and the associated responsibilities (principle: planning and cycle follow the organizational structure).

#### *Central management*

The top management of the AMC is formed by a Board of Directors and a supervisory board. The supervisory board has a more indirect role in checking and monitoring the processes of the overall organization. The Board of Directors consists generally of three members: the chairman<sup>6</sup>, one vice chairman, and one general member. The AMC has a divisional structure where responsibility for medical and financial policy has been delegated to division boards and medical specialties. The Board of Directors sets strategic frameworks, and then operates mostly in a facilitative role to divisions. The Board of Directors is supported by a staff department that consists of several directorates such as Finance and Control (F & C) and Patient Care (PC).

The F & C department advises the Board of Directors, divisions, and services about financial and economic topics and negotiated with ministries, the University of Amsterdam, banks, and insurance companies on the financial framework of the AMC. The director of F & C performs the role of concern controller and is responsible for giving directives on the administrative structure and management reporting for all relevant business processes within the AMC. The F & C department consists of two sub-

<sup>6</sup> The chairman is also dean for the Faculty of Medicine.

departments; Sales, and Planning and Control (P & C), and there is one Coordinator of Management Information. The Sales department defines the sales strategy and makes agreements with insurers on the production of the AMC. The P & C department is responsible for the design and implementation of the Planning and Control process of the AMC, such as drafting the AMC budget, generating periodic reports on the realization of the budget, and performing control operations for the benefit of the quarterly meetings of the divisions and services with the Board of Directors. The Coordinator of Management Information<sup>7</sup> supports these sub-departments with the appropriate information and is responsible for the coordination of the hospital-wide management information. The directorate of Patient Care facilitates professionals in order to provide good patient care in the hospital. The directorate is managed by a medical director who is engaged in various hospital-wide medical issues and advises the care suppliers in many areas.

#### *Management of divisions*

The AMC has ten divisions that are supported centrally by corporate staff and facility services. The three principal tasks come together under these divisions. Each division consists of a number of medical specialties or a support service such as laboratories. Every division is managed by a *Division Board*. The Division Board is, within the objectives set by the Board of Directors and taking into account the responsibilities of the chief physicians for the content of the core tasks, responsible for the core tasks within the division and the associated responsibilities for the management of operations. The Division Board consists of a division chairman, nursing director, and director of operations. The underlying medical specialties are semi-autonomous and self-managed entities, although this freedom is restricted by financial borders. Every division has a business administration. The *division chairman* has overall responsibility for patient care, research, and education within the division. This applies not only with respect to the chief, but also in relation to the nursing director and director of operations. The *director of nursing* is responsible for the nursing policy. Bearing in mind the principle of 'professional in the lead' and given the fact that it is expected of directors that they have an 'exemplary role' in the organization, the division chairmen and directors of nursing are active in one or more of the primary processes of the AMC. The *director of operations* is responsible for topics such as finance, HR, IT, and buildings.

#### *Management of medical specialties*

Every medical specialty is managed by a *chief physician*. The chief physician, who is usually a professor, is in charge of his/her staff group (Witman, 2008). The size of a staff group ranges from four to about thirty registered specialists. Large staff groups often

<sup>7</sup> The author of this thesis was Coordinator of Management Information between 2006 and 2012.

consist of sub-specialties including sub-chief physicians. Chief physicians have both professional and administrative roles. With regard to the professional role, the chief physicians are, taking into account the responsibilities of the Board of Directors and the division board, responsible for the patient on his/her medical field. The chief physician is also responsible for teaching and research carried out by the staff members and for the training of physician assistants. Within the clinic as a whole, and in particular in the treatment area in which the chief is a specialist, he or she has a substantial (indirect) influence on the 'house practice' in the treatment of particular groups of patients. The administrative role of the chief physician has both an operational and a strategic component. In the day-to-day operation of the clinic, the chief is frequently involved in decisions concerning the allocation of (personnel) resources. Over the longer term, the chief physician takes the lead in the preparation of the annual plan for their own specialty. The specialty can delegate some of those tasks to sub *chief physicians* and/or a teacher. The extent to which this occurred depends strongly on the sub-specialization within the field and the size of the specialty. Because of the special responsibility for all core tasks, the chief physicians has direct access to the Board of Directors at all times, provided that this is done with the knowledge of, and in consultation with, the Division Board.

#### *Management of the medical departments*

Within the division, the core tasks are performed in medical departments such as nursing departments and outpatient clinics. These departments often work for multiple medical specialties. The medical departments are managed by the so-called 'workplace management' consisting of a *chief workplace* and a *head nurse*. The workplace chief is hierarchically the manager of the head nurse. Financial and production budgets are usually set at the level of the medical departments. The head nurse is responsible for the nursing care within the department. The workplace chief and the head nurse are jointly responsible for the outcome of their unit and acted as a team.

#### **Organization culture**

In 2010, a survey was carried out to measure the personal values of employees of the AMC, the current organizational values, and the desired organizational values (AMC, Strategic Aims 2011 - 2015). The results indicated that AMC employees saw themselves as reliable people with dedication to, and responsibility for, their work; people with a happy, cheerful approach that made fundamental choices; people who explored new ideas to expand their skills and knowledge to perform well and to achieve quality; people with dedication and a passion for work. The results also showed that the AMC culture had several limiting aspects such as bureaucracy, rigid systems and processes, kingdoms, and short-term focus.

## Finance

The finances of the AMC are illustrated by reference to the income statement in 2013, see Table 2.2.

**Table 2.2: Income statement of the AMC 2013**

Operating income 2013	k€	% of total	Operating expenses 2013	k€	% of total
Turnover DBC B segment	270.219	31%	Personnel costs	495.455	59%
Turnover DBC A segment	152.113	17%	Depreciation of fixed assets	46.828	6%
Government grant workplace function	143.812	17%	Other operating expenses	280.651	33%
Government grant training fund	55.766	6%			
Government grant academic budget	103.402	12%	Financial income and expenses	18.419	2%
Other services	88.639	10%			
Availability function trauma services	7.127	1%			
Transition funding	49.802	6%			
<b>Total</b>	<b>870.880</b>	<b>100%</b>	<b>Total</b>	<b>841.353</b>	<b>100%</b>

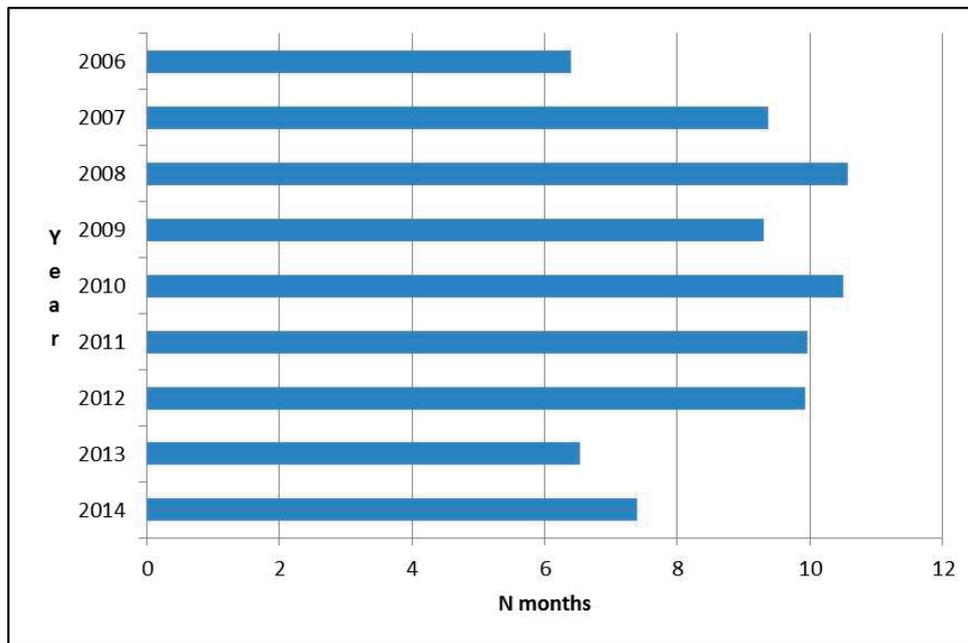
In 2013, the AMC received k€ 422.332 for the DBC production, mainly by the health care insurance companies. This income was fully related to the volumes and types of DBC produced and were thus variable. The AMC also received fixed amounts for other services consisting of k€ 7.127 for the trauma function and k€ 80.300 of the academic budget to compensate the excess costs of academic functions as care for complicated or specific patients, and research and innovation. The government's 'workplace function' grant was also a fixed amount and came from the Ministry of Education. It was meant to cover the costs related to the workplace for medical students (education) and research, like the cost of buildings and sites, medical and inventory costs, and costs associated with delays. The amounts were in fact 'historical' and didn't change much from one year to another. The training fund was a government grant that came from the Ministry of Education and was meant to cover the cost for teaching physicians and so it varied with the number of physicians in training. The other services come from the following external funds: industry, the Dutch organization for scientific research, private donations, legacies, and charity funds. The variability in the income of the AMC had increased since 2006 due to the introduction of the new reimbursement system (see Section 2.5), but slower than originally expected because of its delayed implementation.

In 2012, it was calculated that without transition funding the revenue of the AMC would decrease by € 70 million through the introduction of performance-based budgeting. To bridge this gap, the AMC used the transition period to participate nationwide in improving the DBC product structure and the internal registration. An efficiency program (SLIM) was also deployed (this will be discussed further in Section 6.3.2) with the aims of optimizing care processes and reducing cost by more effective and efficient outpatient clinics, optimization of logistic processes, and lowering purchase prices.

### *Negotiations with health insurers*

Until 2012, agreements were made with five (groups of) insurers about both the budget (in the A segment) and the DBCs in the B segment (the freely negotiable segment), see Section 2.5. The term 'freely negotiable' was slightly misleading, because in reality the possibilities for negotiation were rather limited. In fact, all insurers took past budgets as a starting point for the negotiations, regardless of the actual demand for care and number of DBCs. Since 2012, the agreements were made about the total contracted sum and about the volume and types of DBCs in the A and B segment that make up that sum. Other topics in the negotiations include the space for growth in production, (expensive) medicines, and debt servicing. There was relatively little attention to the content and quality of care. Often agreements were first made about the total contracting sum and then accordingly, agreements were made about the number and prices of the DBCs which added up to the contracting sum. As a result, the revenues of the UMCs were more or less guaranteed. In 2013, more than one third of the income of the AMC still had a predominantly lump-sum character (academic budget, government grants), although more and more agreements were made about accountability by means of performance. However, each year it turned out to be a huge effort to agree on thousands of DBCs with each health insurer about volume, prices, and quality. Because of the complexity of the DBC system, it took every year long to finalize initial agreements with insurers regarding volumes and prices per care product for the current year and this hardly improved in the course of time. It took even longer for agreements with all insurers to be finalized. Subsequently, it was labor-intensive to process the agreed prices and volumes in the computer systems. As a result, it took up six to ten months before the first care products were invoiced to the health insurers and the revenues became visible in the CMI (see Figure 2.4).

Figure 2.4: Number of months after which care products could be billed for the first time, 2006 - 2014



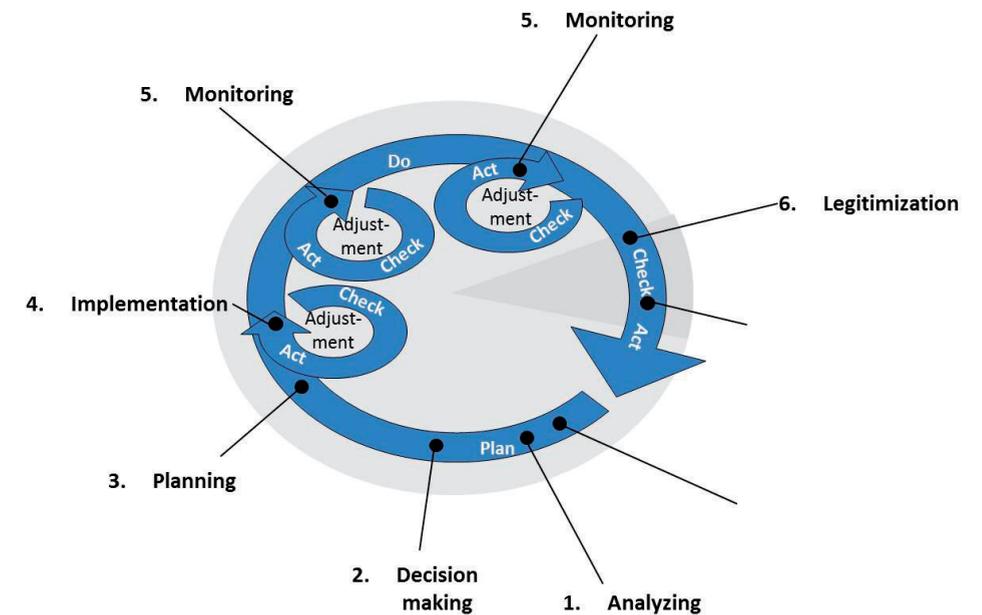
Financial Administration AMC

As a result, there were no actual DBC prices available during most of the year and users had no idea about the financial coverage of their patient groups. Because of this method and the constant changes in the product structure, the DBC prices for a care product could fluctuate enormously per year.

### Planning & Control cycle

As mentioned earlier, the Finance and Control department (F & C) is responsible for the design and implementation of the AMC's Planning and Control process. To date, the Planning and Control cycle consists of several stages, see Figure 2.5.

Figure 2.5: Planning and Control cycle of the AMC



Within the Planning and Control cycle, different parties fulfill different roles at different stages. Every five years, the AMC defines its strategic goals. The strategic objectives constitute the framework for the annual plans and budgets of the divisions and are the starting point for the Planning and Control cycle. Each year, generally between April and August, the Board of Directors drafts a so-called *budget letter*. This letter indicates what the budgets will be with regard to finance and medical production and the internal budgeting principles for the next year and is the starting point for the divisions and services to define their annual plans. The content of the budget letter is determined by the strategic aims, and external and internal developments, such as the external reimbursement and financial situation. In general, the budget letter relates to topics such as core tasks, finance, investments, human resources, and business operations, and contains instructions for the drafting of the annual plans of the divisions and services. In line with the management principle 'professional in the lead', the *chief physicians* and *division managers* are in charge of defining the annual plans.

The planning phase consists of *analyzing* (like gaining insight into current case-mix and performance), *decision making* (like desired case-mix and care processes), and translating these decisions into a (division) *planning*. It takes place between September

and November. Generally, the annual plans are first defined by the individual medical specialties and departments and accordingly integrated into a division plan. The division plans are assessed at corporate level by the Board of Directors and the F & C department and they finally fix the budgets for the divisions and services. The divisions allocate the budget within their division, the medical departments, and supporting services. Divisions have much freedom in how they allocate the budgets and therefore there are major differences between divisions, for example, regarding the level of detail of the budgets. Some medical supporting departments (such as the laboratory, operating room, and imaging) are allowed to charge the cost of their services to the clinical divisions. Over the years, the internal settlement of services has expanded in the belief that this would trigger the clinical divisions to use these services more efficiently and effectively. The division plans are implemented during the year.

*Monitoring* takes place both at divisional and corporate level. The divisions monitor the extent to which the medical policy is realized during the year, for example with regard to volumes, top referral care, waiting times, length of stay, financial coverage, and to determine where adjustments are needed. The Board of Directors and F & C department monitor the extent to which the forecasted medical production and revenues match with the agreements with the health insurers. Every year, the F & C department drafts the *reporting letter* in which is defined what and when divisions and services should report to the Board of Directors (*internal legitimization*). In general, the F & C department reports quarterly about the realization and forecast with regard to finance and production, relevant developments in core tasks, quality, and HR. For this purpose, a model set for the reports has been defined by the F & C department. In general, the managers of the divisions and services have a quarterly meeting with the Board of Directors to discuss the quarterly report. After the end of the year, the annual accounts are prepared (*external legitimization*).

#### *Strategic Planning & Control cycle*

In addition to the annual Planning & Control cycle, long term policy plans are also defined by the medical specialties, mostly for three years, some for five or seven years. These policy plans describes the priorities concerning research, patient care, and education and generally form the basis for the annual Planning & Control cycle. The way in which the long term plans are defined, differed from each other with regard to frequency, detail, and participation of staff members. Some chief physicians do this extensively and in consultation with staff members. Others define their long term policy on their own and in general terms. Generally speaking, the same steps are passed through as in the annual Planning and Control cycle, but there is more emphasis placed on some stages (like decision-making) than others (like legitimization).

#### **Internal budgeting**

Until 2012, the internal budgeting system of the AMC could be characterized as a combination of input budgeting (historic budget) and output budgeting. The income of the clinical divisions consisted both of a historic budget and of revenues based on medical production. The historic budgets were mainly calculated through the use of historical cost data, which were adjusted by inflation, in what could be understood as an incremental process. Larger investments were treated as separate cases in the budgets and decisions were taken by the investment committee. When the DBC system was introduced in 2005, the AMC started coupling the internal budget partially to the external revenues for the care products in the B segment. Divisions received 40% of the external turnover. This percentage was calculated as being the direct cost of the divisions. For the production of the A segment, the divisions received an internal rate for the regular production parameters and the WBMV operations (output). This method of internal budgeting was in place until 2011.

For 2012 and afterwards, the intention was to introduce full internal output budgeting by coupling the internal budgets to the external revenues of the DBC production in the A and B segment, but this failed (this failing will be further discussed in Section 6.3.2). The problem was that because the continuous and dramatic changes in the DBC product structures and associated selling prices in the past years, there were too little (comparable) data and too many uncertainties to implement output budgeting in a responsible way. Various alternatives for output budgeting have been examined, like the continuation of the old internal budgeting system and the option to couple the internal budget for just a small percentage of the DBC revenues, but these options were discarded. The result has been that since 2012, no output budgeting has taken place, excluding some medical production where specific recalculations were agreed with insurers (for example expensive drugs and transplants). In some cases, additional budgets were given to divisions based on growth proposals made at the beginning of the budget year. This led to the paradoxical situation that at the time when the AMC was not externally funded on the basis of DBCs (2005–2011) there was already a form of internal output budgeting, but at the moment when the AMC was finally externally funded on DBCs the internally output budgeting was abolished!

## Management information

### *Shortcomings in management information about patient care*

As described in Section 1.3, before the introduction of the health care reforms in 2006, management information on patient care at the AMC had several shortcomings. First, the information was, like in most other hospitals, mainly focused on global and finance related issues such as costs and budget parameters, like number of admissions, patient days, and outpatient visits, but hardly focused on the content and relevance of care. The information was also only available at the level of medical specialty or department, not at the individual patient or doctor level. Second, several types of information such as process, quality or financial information came from different sources and were expressed in different languages (like products, procedures, diagnoses), so it was hardly possible to link these types of information with each other. There was no tool to translate (qualitative) medical policy into quantitative financial or capacity planning. Third, the information, for example, with regard to volumes and finance, only related to the past (realization), not to the future (forecasts). There were hardly any comparisons between specialties (internal benchmarking) and other hospitals (external benchmarking). Fourth, the information was not easily accessible. Information was often spread over different systems, where users were often dependent on IT professionals. Besides, many types of information were not validated so the quality was insufficient or unknown. Finally, many users of the information did not have sufficient knowledge and experience to use the information in a responsible manner.

### *The project 'Patient Care Profiles' (2002 - 2005)*

As the pressure on capacity and finance increased, the need for more and better management information strengthened. As a response to this, the Board of Directors decided in 2002 to design a new information product called 'Patient Care Profiles.' A *Patient Care Profile* described a patient population of the AMC that was treated under the purpose of one or more of the core tasks: patient care, research, training and/or education. The product was in fact a database with definitions and quantifications of the patient groups defined by the medical specialties. The aim of the product was to provide information on what strategy should be followed, based on substantive choices regarding patients, and to serve as input for patient-oriented logistics and long term housing. To design this product, a pilot was launched in 2002 consisting of eight medical specialties. The pilot group defined a minimal dataset which described what kind of information should be collected about patient groups by the medical specialties. Based on the positive experiences of the pilot specialties, all clinical specialties of the AMC were asked to indicate which patient groups were considered relevant for their patient care, research, and education. In 2003, most clinical specialties have defined

their patient groups. This involved a total of 304 groups. The results were incorporated into a database and were made available via the intranet.

Although most specialties had participated, the usefulness of this type of information was limited. First, the patient groups were defined only in qualitative and general terms. Therefore the formulated medical policy could not be quantified. That means that it was not possible to assess whether the intended medical policy had actually been realized. Second, there was a missing link between medical and financial policy. In an ideal situation, medical policy is derived from the strategic aims of the AMC and accordingly, the financial and economic policies are derived from the medical policy of the medical specialties. With the patient resource use profiles there was only a limited relationship established between these two policies: they were independently established in a different language, and a tool for unambiguous translation was lacking. So, the consequences of the medical content policy in terms of the required capacity and money could not be quantified. To solve this problem, an appropriate and comprehensive case-mix system was needed.

In 2005, the pressure on resources further increased. For that year, a budget deficit of € 6.6 million was predicted, and for 2006 a deficit of € 12 million (AMC, Budget letter 2005) because of external budget cuts and the introduction of the DBCs. Since the Board of Directors aimed to realize a positive profit margin of 2% in 2006, a budget surplus of roughly € 20 million was required. In order to realize this, several initiatives were announced that were aimed at increasing revenues, reducing costs per patient, and the creation of an optimal patient mix. One of these initiatives was to further design and implement the instrument 'Patient Care Profiles,' see the quotation below:

We have succeeded in identifying and quantifying the 'Patient Care Profiles' for the major patient groups. A further refinement of this control mechanism will be needed to perpetuate our strategic choices, in particular for scientific research. The DBC system should make it easier to quantify patient care into diagnosis groups. The gain to be achieved is that the AMC Patient Care Profiles can be linked to capacity and cost calculations, by which negotiations with insurers will get more power. Then it will be easier to allocate the people and resources internally as agreed with the health insurers (AMC, Strategic Aims 2006 – 2010).

### *The adoption of a case-mix information system*

In 2006, the Board of Directors requested the F & C department to evaluate the instrument 'Patient Care Profiles.' Based on this evaluation, the F & C department started by drafting a project plan for the transformation of the Patient Care Profiles, into a structural case-mix information system (CMI). Because of the lack of scientific and

practical knowledge about these systems in Dutch university medical centers and the uncertainty about the effects of it on the behavior of people and the organization (see also Sections 1.2 and 1.3), it was concluded that the process of design and implementation and outcome evaluation had to be conducted on base of scientific research. The project leader wrote a research proposal and discussed this proposal with six chief physicians in the AMC, the chairman of the Board of Directors, and experts outside the AMC. The discussions confirmed that the lack of a good information system guiding rational decision management and decision control was perceived as a problem and that the development of a comprehensive CMI warranted a scientific approach.

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# Chapter 3

Literature review

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### Abstract

In 2008 and 2014 a comprehensive literature review regarding (case-mix) information systems was conducted. In this chapter, the major findings are summarized. For this review, 114 publications were retrieved consisting of empirical studies, contemplative articles, dissertations, and books. The publications focused on the outcomes of (case-mix) information systems and on the impact of factors that may determine the success or failure of these innovations in organizations. In the literature there were stories of failure and success of (case-mix) information systems. Some implementations were successful and led to positive outcomes, such as better informed choices, increasing cost consciousness, rationalizing of operating processes, better legitimization, and cost reductions. But many implementations failed and led to negative effects, such as increasing conflict between the hospital board and hospital managers, information overload for the users, and the fear that the quality of care might be adversely affected. Based on the literature review, five factors were identified that might affect the failure or success of CMIs: characteristics of the design and implementation of the CMI, the target group of (hospital) managers, the (hospital) organization, and the environment.

### 3.1 Introduction

This chapter provides an overview of the (management accounting) literature about (case-mix) information systems in (hospital) organizations. Section 3.2 describes how the literature search took place. Section 3.3 focuses on the various outcomes of (case-mix) information systems in terms of adoption, use and effects. Section 3.4 gives an overview of the main factors determining the failure or success of CMIs.

### 3.2 Literature search

#### *Literature search*

A comprehensive literature search was conducted in 2008 and in 2014 through Pub Med, Medline, Embase, EconLit, and Science Direct for articles in English and Dutch with the search terms listed in Box 3.1.

#### **Box 3.1: List of keywords**

activity based costing (ABC), (case-mix) information (system), clinical accounting, (cost) accounting system, (clinical) guidelines, constructive approach, cost-benefit analysis, cost control, decision making (process), cure, DBC system, design, design oriented research, (doctor) (physician) manager, DRG (system), economics, health care (sector), hospital (departments), hospital reimbursement, implementation, information system, internal budgeting, management control, non-profit (organizations), physician behavior, priority setting, qualitative research, rationing of care, (strategic) (tactical), unit cost calculation, (university) hospital

The literature search was done by a clinical librarian of the AMC and the researcher himself. Reference lists were checked for additional articles, with a specific focus on the top journals in management accounting (e.g., *Accounting, Organization and Society*, *Management Accounting Research*, and *Financial Accountability and Management*). Retrieved publications were screened by their title and abstract and if judged as relevant for the study the full text was evaluated in detail. Eventually, 124 publications were considered as relevant for this study consisting of 89 empirical studies, 28 twenty-eight contemplative articles, 2 dissertations and 5 books.

From the 124 publications, 10 related to research methodology, particularly to design oriented research, the constructive approach and the value of qualitative research in the management accounting discipline. The most important findings of the literature

review concerning research methodology are summarized in Chapter 4. The other 114 publications related to the design and implementation of information innovations in a broad sense. From these publications, 22 focused specifically on (Diagnosis Related Groups based) case-mix information systems (CMIs) in other countries like Sweden, New-Zealand, and the United States. There were no scientific papers found about CMIs based on the DBC product structure in the Netherlands. Two dissertations were retrieved about the impact of the Dutch DBC system on hospitals. Accordingly, 56 publications on other information systems were found, both within the hospital sector and in industry, such as (accounting) information systems, (activity based) costing systems and balanced scorecards. Although these systems were not fully comparable to CMIs, where financial and medical information are integrated, much scientific knowledge about these innovations appeared to be useful for this study. Ten publications related to the medical manager, eight related to decision making processes and the remaining 16 publications on various topics as the implementation of clinical guidelines, the DBC system and new public management.

From the 114 publications, 10 publications focused primarily on the outcomes of (case-mix) information innovations in terms of adoption, use and effects of use. The main findings of these studies are presented in Section 3.3. A total of 98 publications studied the impact of factors that may determine the success or failure of (case-mix) information innovations in organizations. The major findings of these studies are presented in Section 3.4.

### 3.3 The outcomes of (case-mix) information systems in hospitals

Lehtonen (2007) described the successful implementation of a DRG-based CMI in a university hospital in Finland. He defined a CMI successful when, from the management's point of view, the positive effects outweighed the negative effects. From the CMI, a wide range of reports could be generated. Information on outputs, resource usage, revenues, and costs could be produced at different levels of aggregation, such as by clinical specialty and patient group. It was also possible to track individual patient treatment processes on the basis of costs or services provided. The system was used for Planning and Control purposes and led to positive results like more control of the costs and more cost awareness. The clinical and financial performance was regularly monitored and discussed by the management teams. The use of a CMI encouraged the rationalization of operations and finally led to improved operating processes. The reason for this was that departments started rethinking the processes when analyzing the financial results. By benchmarking cost, cost variation declined and treatment procedures were standardized. It seemed that the quality of care was not adversely affected.

Also Lowe (2000<sup>1</sup>) provided evidence that the implementation of a DRG-based CMI (called Transition) within a large New Zealand hospital had significant constitutive effects within the organization, such as changes in patient management procedures, hospital management structures, and other decisions affecting the allocation of resources. The data came to play a significant role in decisions within the institution. Medical practice had been impacted through reductions in inpatient treatment, length of stay, and hospital operating procedures. It contributed to 'new discursive spaces for action' that meant that it provided new opportunities to various groups in the hospital to frame issues and justify or resist resourcing changes (Lowe & Doolin, 1999). It provided additional information for decision-making, which allowed other groups to issue counter arguments. Clinicians were given the opportunity to confront management with new 'facts'. However, they also manipulated the information and used the rhetoric of case-mix systems, diverting disciplinary practices to their own ends.

Furthermore, several positive outcomes from the implementation of similar information innovations in hospitals were described. Abernethy and Vagnoni (2004) examined the impact of the use of accounting information systems by physician managers in large public teaching hospitals in Italy. The results demonstrate that their use resulted in increased cost-consciousness and led to a decline of usage of intermediate services (such as laboratory tests, X-rays). Finally, Hill (2000) examined the effects of the adoption of cost information systems in 587 hospitals in the United States. He concluded that with adequately detailed cost information, hospitals could make better informed choices that increase quality of care and/or net income. Hospitals with sophisticated costing systems were also better able to use the information for 'ammunition' to obtain additional funding for their case (external legitimization).

However, there were also studies where the outcomes were in contrast with the ones mentioned above. Lowe & Doolin (1999) examined, for example, the impact of the implementation of a CMI within another New Zealand hospital. The CMI was implemented in an attempt to involve clinicians in managing resources through the imposition of clinical budgets. The intention of the CMI was to enable clinicians to enter into processes of peer review. Besides, the CMI offered opportunities for producing standard protocols for clinical practice. Examples of clinical case-mix information included measures of length of stay, same day admissions, and day surgery versus clinical surgery. Various reports and graphs were used to interest potential users in the range of information available. It could be used to produce inscriptions that would enable processes of peer pressure to operate among clinicians through the dual strategies of peer review and the development of standard protocols for clinical practice. The intention was often expressed in positive and non-threatening terms such as the

desire to empower clinicians to be part of management. Despite these good intentions, it led to many disputes. With a few exceptions, the clinicians had a poor opinion of the validity of the case-mix information and expressed little interest in using it to inform their practice. The accuracy of the system was questioned and, more fundamentally, the data that the system provided might be interpreted in different ways. Furthermore, the system provided some controlling influence but it also produced resistance. From the doctor's perspective, concern over the case-mix information arose from the uncertainty over the processing and use of the system. There was reluctance on the part of doctors to use a tool provided by management. Many doctors felt that the information would be used to justify management decisions on financial grounds while ignoring clinical issues. There was reluctance on the part of clinicians to have their practice scrutinized and their clinical freedom potentially infringed upon. Continued resistance to case-mix management (including limited uptake of clinical case-mix information) by most doctors, and reluctance by managers to challenge the long tradition of medical privilege and autonomy, meant that senior management did not enforce the use of case-mix information across the organization. Their power meant that they were able to divert the CMI towards their own ends, principally in arguing for more resources. According to Abernethy (2007), the information system can shift power from medical professions to administrators and funders. The information can potentially be used instead of an explicit contract to control physician behavior. Presenting physicians with data on their own costs, along with comparative cost, and operational information provides some incentive to modify their behavior. This may lead clinicians to see this as a subversion of their professional judgment and as an unnecessary incursion into their jurisdiction. This may lead to resistance and tensions between clinicians and technocrats and to system failure.

Finally, there were some studies which demonstrated that the implementation of (case-mix) accounting systems hardly influenced the internal processes within an organization. Jones & Dewing (1997) conducted a study in one of the largest emergency hospitals in Britain. They concluded that accounting changes associated with national health care reforms played only a modest role in helping medical staff to make sense of events. Clinicians adopted various strategies to address the tension between the logic of management and a long existing professional logic. These included distancing themselves from accounting information by claiming that their understanding of information was poor. Their resistance against this information was increased because it became symbolic of New Public Management reforms that were presented as politically inspired and that were contrary to the spirit of a health service for the entire population. The study of Jones & Dewing shows how the most significant impact has been the enabling of top management to exercise overall financial control in response to imposed changes, rather

than in supporting a robust system of decentralized responsibility and decision making.

According to Lowe (2000<sup>1</sup>), administrative and accounting system changes have failed to produce other than superficial effects on the workings of health sector institutions. Also, Covalleski et al (1993) concluded that in the US, the case-mix systems had little impact within the organization and that these systems appear to be predominantly externally oriented. These failures were explained by the *decoupling phenomenon* which means that many (case-mix) accounting systems are mainly externally directed to achieve legitimation in the institutional environment, but are not able to faithfully represent the complexities and indeterminacies of internal operating processes.

#### *Conclusion*

From the literature reviewed it can be concluded that the outcomes of (case-mix) information systems showed substantial variation, ranging from beneficial to harmful outcomes. Beneficial outcomes were: more cost awareness, the rationalization of care processes, less cost variation, a decline of usage of intermediate services, new discursive space for action, better informed choices, better legitimization of resource consumption and more funding. Harmful consequences were: power struggles, fear to lose clinical autonomy, distrust and disputes about the data and information overload. Sometimes this type of information had little impact on the organization. According to Lehtonen (2007), we are left with a partial picture and incomplete explanations of the outcomes of case-mix accounting (systems). In general, too little research has been done to study the effects of case-mix accounting (systems) in different contexts. Many important research topics have therefore been left unexplored, conflicting results have been unresolved, and a consensus on the performance benefits unattained. For a better understanding we therefore need to investigate case-mix information systems in a more detailed way.

### **3.4 Factors determining the success of (case-mix) information systems**

As mentioned earlier, there were 114 publications found on the design and implementation of (case-mix) information innovations in (hospital) organizations and the factors that may have impact on its success.

Shields & Young developed a comprehensive theoretical model about the implementation of cost management systems (Shields, 1995). This model treats the implementation of a cost management system as being an administrative innovation in an organization in which the success of the implementation depends on how well it deals with specific behavioral variables. The assumption underpinning this model is that the implementation of a cost management system is not only a technical innovation in the organization. This

distinction between administrative and technical innovations is important because the adoption decision and the success of the implementation of the former are determined more by particular behavioral and organizational variables, whereas for the latter they are determined more by economical and technical considerations.

Gordon & Miller (1976) took a contingency approach on the design of accounting information systems by taking the environment, organizational attributes, and managerial decision-making styles into account.

Grol (1997, 2001) identified six group factors that are relevant for a successful design and implementation of clinical guidelines, namely the: the characteristics of: the target group, the innovation, the social-organizational context, the economic context, the patient, and the implementation strategy. This is relevant to this study, because both clinical guidelines and CMI's are about implementing innovations for doctors (or doctor managers) with the aim of changing their behavior.

On the basis of the above mentioned studies, we identified five groups of success factors to be relevant for this study that may be aggregated in two groups of success factors: design and implementation factors and organizational and environmental factors see Table 3.1. The most relevant findings in literature are these groups of success factors and they are described per subsection.

**Table 3.1: Relevant groups of success factors for (case-mix) information systems**

Group of success factor	Factor	Relevance for this research	Sub section
Design and implementation factors	Design of the (case-mix) information system	Functions, design characteristics, design strategies	3.4.1
	Implementation of the (case-mix) information system	Types of implementation strategies	3.4.2
Organizational and environmental factors	Target group	(Medical) hospital managers	3.4.3
	(Hospital) organization	Behavioral and organizational variables, organization structure, and power relations	3.4.4
	Environment	Competition and financial pressure, Institutional pressure	3.4.5

### 3.4.1 The design of the (case-mix) information system

Accounting systems have become an instrument to serve different purposes for various stakeholders in the organization (Abernethy & Vagnoni, 2004). While (case-mix) accounting systems are generally implemented for cost containment purposes, several studies in management accounting have illustrated the non-rational nature of it as well as the multiple functions that the system might serve once implemented. In fact, they are the carriers of two different types of logic at the same time: the means-end logic, which is the basis of efficiency rhetoric, and the legitimation and cultural logic, which is the foundation of institutional aspects (Scarparo, 2006).

The following functions are further explained below: a) legitimization function, b) decision management and control function, and c) organization learning and control function.

#### a) Legitimization function

As described in the previous section, organizations can adopt (case-mix accounting) systems to conform to societal expectations. In this case it fulfills the legitimization function. These systems can provide the image of rationality that helps an organization to avoid the extremes of funding cuts, in part by providing a clear justification for expenditure (Lowe & Doolin, 1999). The extent to which these systems accordingly will be used, and will influence internal organizational practices, will depend on the power of the organizational actors' translation and use of societal expectations (Covaleski, 1993). In other words, if the system is only used for legitimization purposes towards the environment, the system has only a symbolic function. Furthermore, the system can be used as 'ammunition' to obtain additional resources not only from the hospitals budget but also to gain funds from or external constituents (Abernethy & Vagnoni, 2004).

#### b) Decision management and control function

The objectives of case-mix accounting systems can also be to provide a complete financial picture of the costs of treating individual patients and the cost of treating different patient groups to increase operational efficiency (Abernethy et al 2007; Lehtonen, 2007). This information can be used to facilitate decision-making by providing information to reduce ex ante uncertainty (decision management) and to control behavior (decision control).

With regard to the *decision management function*, case-mix accounting systems enable decision-makers to improve their actions and choices with better-informed effort. They support the formulation of strategy, assist in strategy implementation, provide information for co-ordination of organizational activities, and facilitate organizational

learning (Abernethy & Brownell, 1999). During strategy formulation, the system is used for exploring and evaluating strategic alternatives and the viability of available strategies vis-a-vis the strategic needs of the organization (Naranjo-Gil & Hartmann, 2007<sup>1</sup>). According to March (1987), the main uncertainty in decision-making is portrayed as ignorance about future consequences of possible current actions, including ignorance about the knowledge possessed by others and their probable actions, and the main rationale for information is its role in reducing that uncertainty. However, contemporary theories of decision-making are less inclined to highlight biases in estimation and inference and more inclined to focus on two additional complications in the use of information for making decisions in organizations, those of bounded rationality and conflict of interest. The fundamental idea of limited rationality is that not everything can be known, that decision-making is based on incomplete information about alternatives and their consequences. The fundamental idea of conflict of interest is that an organization is a coalition of individuals and groups pursuing different objectives. As a result, information in organizations is not innocent. Accounting and accounting standards are arenas of power politics. As a result, a good information strategy is not so much one that removes uncertainty from a pre-structured array of decision alternatives connected to a pre-determined array of preferences, as it is one that moves the whole apparatus of information, desires, and options in a productive direction, simultaneously developing ideas of what is 'productive' and instruments for achieving it.

With regard to the *decision control function*, case-mix accounting systems increase the transparency of professional knowledge, expertise, and work processes (Doolin, 1999<sup>1</sup>). Scrutinizing clinical procedures and explicitly linking patient treatment decisions to standard costs makes clinical activity visible. It stems from the assumption that individuals do not act in the organization's best interests but rather in their own (Abernethy et al, 2007). The objective of such information is to change subordinate behavior or influence the actions taken, so that organizational outcomes can be effectively achieved. The detailed information provided by the system offers management the possibility to increase control over health professionals, either directly or indirectly (Doolin, 1999<sup>1</sup>). In some literature, case-mix accounting is presented as an attempt to normalize medical practice through the increased surveillance of clinicians and clinical activity (Lowe & Doolin, 1999; Doolin, 2004). In this case, the system acts as a 'change agent' (Gordon & Miller, 1976). In the control and feedback stages, case-mix accounting systems should provide information on the drivers of success as well on the causes of failures (Naranjo-Gil & Hartmann, 2007<sup>1</sup>). Case-mix information systems can be used to legitimize and maintain systems of power as well as to redistribute power among the various organizational actors, for example, by delegating budgets through the system. The use of case-mix information systems provides a means of reinforcing the formal

delegation of authority. Accounting systems define financial responsibilities and thus can serve to reduce the role ambiguity associated with the managerial role.

### c) *Organizational learning and change function*

Thompson & Tuden (Abernethy et al, 2007) developed a useful framework where the support of a (case-mix) accounting system in the decision-making process varies with respect to two key conditions: 1) uncertainty of cause and effect relations, and (2) ambiguity of objectives, see Table 3.2.

**Table 3.2: Thompson & Tuden's decision-making framework**

	Low ambiguity of objectives	High ambiguity of objectives
Low uncertainty of cause/ effect	Decision by computations: 'Answer machine'	Decision by compromise: 'Dialogue machine'
High uncertainty of cause/ effect	Decision by judgment: 'Learning machine'	Decision by imagination: 'Idea creation machine'

Abernethy et al, 2007, p. 811

Uncertainty may occur when it is not possible to predict with certainty the outcomes that will occur as a result of actions taken. Ambiguity of objectives generally occurs when there are multiple and conflicting objectives and/ or stakeholders cannot agree on the priorities to be placed on these objectives. For example, when there is low ambiguity of objectives and low uncertainty of cause and effect, decision-making is supported by *answer machines* that provide accurate, timely, and reasonably unequivocal answers. In hospitals, this is the case for non-medical and medical-supporting departments. But when there is high ambiguity of objectives and low uncertainties of cause and effect, decisions are made by compromise and are supported by systems such as a *dialogue machine*.

In hospitals, this is the case in politicized environments where professional conflicts arise, for example, within professional groups, across professional groupings, and between administrators and medical staff. Dialogue machines need to be designed to serve as a database that can be interrogated and used to facilitate debate. When there is low ambiguity of objectives and high uncertainty of cause and effect, decisions are made *by judgment* and are supported by systems to learn more about the possible alternative means of achieving a particular outcome. The system can be used for 'what if' models and 'sensitivity analysis' and develops a better understanding of cause and effect relations. In

hospitals, this is the case in medical departments. When there is high ambiguity about objectives and high uncertainty of cause and effect, decisions are made by imagination and are supported by systems as a trigger for a *creation of ideas machine*.

In the literature, accounting systems are often conceptualized as answer machines, but managers should move away from the answer machine role and use the system to support greater interaction and dialogue to encourage learning (Abernethy et al, 2007). This is particularly true for hospital managers who face much uncertainty when making decisions.

With regard to the contents of the (case-mix) accounting system, different information dimensions can be distinguished, such as whether the information is financial/non-financial, internal/external, or historical/future-orientated (Choe, 1998). When task difficulty and variability of the user of the (case-mix) accounting system are high, broad-scope information is required continuously to help the manager understand difficult tasks more clearly. Under high task difficulty, cause and effect relationships are not well understood, and multiple foci or aggregated information may be needed. According to Chong (1996), an uncertain decision context requires information set that is much broader than the narrow financially-oriented data provided by traditional management accounting systems, because this richer set can be used in the context of learning. Chong's study showed that under a high task uncertainty situation, the extent of use of broad scope information led to effective managerial decisions and hence to improved managerial performance. On the other hand, under low task uncertainty situations, the extent of use of broad scope information led to information overload which was dysfunctional to managerial performance. Thus, the amount of information that managers use for decision-making is likely to be a function of their perceived task uncertainty. By shifting the terms of calculation and performance measurement from profession to economic, and from medical to financial, case-mix information systems are meant to provide a common language for policy makers, hospital management, and clinicians, by building up extended information transfer and discourse between health care financiers, and producers (Kurunmäki, 1999). As mentioned before, case-mix accounting systems can have multiple functions for multiple stakeholders in an organization at the same time (Abernethy & Vagnoni, 2004). For example, for managers it can serve as a dialogue machine but for a business analyst as an answer machine for controlling purposes.

#### *Design characteristics of the case-mix information system*

Contingency theory contends that a firm's strategy, organizational structure, and environment, dictate its choice of control system (Chenhall, 2003). Any associated

benefits or drawbacks are a function of the degree of alignment between the design of a firm's cost system and the specific set of circumstances the firm faces. Consistent with contingency theory, hospital cost-system design has been found to vary systematically with internal, organizational factors, and external environmental factors. When designing an information system for a specific hospital, these factors must be taken into account.

Pizzini (2006) examined the associations between cost system functionality, managers' beliefs about the relevance and usefulness of cost data, and actual financial performance, using a sample of 277 US hospitals. Consistent with contingency theory, Pizzini defined three group determinants for hospital cost-system design: strategy, structural determinants, and external environment. With regard to strategy, he concluded on the basis of the Porter framework, that hospitals pursuing a differentiation strategy are expected to focus resources on clinical care to the detriment of administrative systems, such as the cost system. Conversely, hospitals emphasizing low-cost production strategy will have more functional cost systems because managers will require more information for monitoring costs. Structural determinants include case-mix, teaching affiliation, size, and whether a hospital is a member of a multi-hospital system. University medical centers, which typically treat more severe cases, are more complex organizationally due to their research and educational responsibilities. As complexity increases, so does the need for cost information. Larger hospitals will benefit more from functional cost systems because they can spread the cost over more beds. With regard to the external environment, he concluded that hospitals with strong competition face greater external pressure to control costs and therefore require more extensive and detailed cost information.

Furthermore, Pizzini (2006) examined four critical items of cost system design in hospitals: 1) the level of detail provided: ability to supply data about objects that vary in size from patient groups to specific activities; 2) the ability to disaggregate costs according to behavior, such as fixed/variable, direct/indirect, controllable/non-controllable; 3) the frequency with which information is reported; and 4) the extent to which variances are calculated. According to his research, managers found cost data to be more useful and relevant if supplied by systems that had greater detail, could better classify costs according to behavior, and provide cost information on a more frequent basis. However, actual financial performance is significantly and positively associated only with those systems that provided greater detail. Armed with a more accurate cost of patient care, the hospital may be better able to present an informed case to the public, regulatory agents, and governments (Hill, 2000). In addition to the study of Pizzini, Lehtonen (2007) defined other design criteria such as: the CMI must combine clinical and administrative

data; classification of patients is a necessary tool to increase the financial accountability of clinicians and other decision makers, and the special characteristics of the university hospitals must be recognized in the system.

#### *Design strategies of the case-mix information system*

In the design of systems, methods can be roughly identified that 1) have a more or less linear timeline (waterfall method), 2) are relatively cyclical (prototyping), and 3) have feedback loops (Bouwman et al, 2002). In the *waterfall method*, the perspective of project management is at the forefront. Implementation and use are separated. In the *prototyping method*, the prototypes are presented to the end-users at an early stage. After testing the prototypes, they are rolled out in the organization. In the design process the end-user is more of an information source than a direct participant. There are also methods that combine the ones already mentioned. For example, in the *spiral model of Boehm*, the waterfall model and prototyping method are integrated. In this model, the project phases are embedded in an iterative process in which prototypes are evaluated by end-users in various stages of development. They can then adjust the specifications. Several iterations then deliver an ever better functioning prototype. This model involves a planning, analysis, design, and evaluation phase. These stages are very similar to the phases of the regulative cycle which is passed through at design-oriented research (see Section 1.5 and Chapter Four).

The advantage of this model is that the end-users are actively involved. Introduction of new information systems may cause problems in an organization on account of the mismatch between the functions of a system and organizational factors, tasks, and power redistribution (Choe, 1998). To reduce this mismatch, user participation is a key element of system design. User participation helps users to accept change. Eldenburg et al (2010) examined the response to implementation of an activity-based costing system developed and designed with physician input. They analyzed changes in resource utilization for treatment of cataract patients and found changes in practice patterns where physicians redeployed resources towards more severely ill patients and decreased average length of stay. They also found evidence for improvement in financial performance. They concluded that including professionals in system development may lead to changes in behavior and improve their decisions about resource allocation.

The above-mentioned design models presuppose a (rather) stable setting. Unfortunately, this is generally not the case in the context of the hospital sector where there may be continuously (unpredictable) changes in the environment, user requirements and technology, even after the completion of the final product. This certainly applied to the very dynamic context of the Dutch hospital care, because of the health care reforms

(see Section 2.4). In that case it has to be ascertained to what level of volatility it makes sense to continue the chosen design model and going past a point of volatility to choose another method or to better give it up: the means will be used in vain. To decide what design strategy should be used, the *Cynefin framework* (Snowden & Boone, 2007) could be useful, which allows leaders, for example hospital managers or CMI project leaders, to see things from new viewpoints, assimilate complex concepts, and address real-world problems and opportunities. This enhances communication and helps leaders rapidly understand the context in which they are operating.

The framework sorts the issues facing leaders into four contexts defined by the nature of the relationship between cause and effect: simple, complicated, complex, and chaotic. *Simple contexts* are characterized by stability and clear cause-and-effect relationships that are easily discernible by everyone. Often, the right answer is self-evident and undisputed. Simple contexts, properly assessed, require straightforward management and monitoring. Here, leaders sense, categorize, and respond. *Complicated contexts*, unlike simple ones, may contain multiple right answers, and though there is a clear relationship between cause and effect, not everyone can see it. Leaders in a complicated context must sense, analyze, and respond. In a *complex context*, at least one right answer exists; however, right answers can't be ferreted out. In this domain, we can understand why things happen only in retrospect. Leaders need to probe first, then sense, and then respond. In a chaotic context, searching for right answers would be pointless: The relationships between cause and effect are impossible to determine because they shift constantly and no manageable patterns exist—only turbulence. In the *chaotic domain*, a leader's immediate job is not to discover patterns but to stanch the bleeding. A leader must first act to establish order, then sense where stability is present and from where it is absent, and then respond by working to transform the situation from chaos to complexity, where the identification of emerging patterns can both help prevent future crises and discern new opportunities. Truly adept leaders will know not only how to identify the context they're working in at any given time but also how to change their behavior and their decisions to match that context. They also prepare their organization to understand the different contexts and the conditions for transition between them. A deep understanding of context, the ability to embrace complexity and paradox, and a willingness to flexibly change leadership style will be required for leaders who want to make things happen in a time of increasing uncertainty.

### 3.4.2 The implementation of the (case-mix) information system

Implementation can be seen as a step between the design phase and the stage where there is (routine) use or rejection of the new technology. It therefore covers a wide range of activities that determine whether the technology is implemented in such a way that users can handle it. The phases of changes in organizations have been described by numerous authors. Broadly speaking, it comes down to a three-way split (Bouwman et al, 2002): unfreeze (to create the basis for the willingness of the change), move (the actual change) and freeze (consolidation). Different people will experience the changes differently and different moments during the implementation process will demand different implementation strategies. Regarding the strategies, often two dimensions are distinguished: top-down versus bottom-up and directive versus participative, see Table 3.3.

**Table 3.3: Implementation strategies**

	<b>Directive</b>	<b>Participative</b>
<b>Top-down</b>	Dictation: penalties, power tools, authority	Organize: Training, opinion leaders, influence attitudes
<b>Bottom-up</b>	Directing: informing, project teams, monitoring	Encouraging: user groups, dialogue, pilot projects

Bouwman et al, 2002, p. 135

When dictating, there is a directive decision by which decision and implementation is imposed on the organization. If the directive decision is implemented bottom-up, then we speak of a process of directing, in which the management has to direct the bottom-up process in such a way that the centrally defined objectives are achieved. Encouraging is a strategy in which employees are maximally involved in the implementation process and the role of management is mainly in encouraging the participation and the implementation process. In practice, certainly, hybrid strategies will occur. The choice of a specific implementation strategy depends on different factors, such as the characteristics of the organization (organization structure, culture, available capacity) and the urgency of the innovation. Implementation is closely related to change management.

In the management accounting discipline, various studies have been published on management accounting change, for example, regarding the implementation of case-mix information systems and activity-based costing systems. For example, Lehtonen (2007) described which characteristics of their strategy to implement a CMI were successful. The implementation was enhanced by the integrated clinical and financial accountability to the profit center manager. Due to their dual responsibilities, it was

in their interest to consider both clinical and financial issues and they were willing to change. Consequently, the clinicians had a significant role during the implementation process. They also actively participated in the development and negotiation of detailed pricing rules. Moreover, the freedom of choice and flexibility of adoption seem to have alleviated conflicts and settled disputes and thereby enhanced the flexibility in adoption. Furthermore, the gradual implementation of the reforms, and intensifying institutional pressures, had fostered the adoption and implementation of the CMI.

### 3.4.3 Target group: The (hospital) managers

#### *Involvement of physicians in management*

Physicians are key stakeholders in hospitals and their involvement in resource management is seen to be critical to hospital survival (Abernethy & Stoelwinder, 1995). Physician resource management behavior is likely to be directly related to their power and influence within hospitals. The power of physicians stems from their ability to control revenue generation and also because of their claims to specialized knowledge and skills that are critical to the functioning of the hospital. Because of the increasing financial pressure and competition, there was an increasing necessity for physicians to control costs. One way to realize this was to involve them in management. Through the allocation of responsibility for budget preparation, medical professionals were to be tied into networks of calculation (Kurunmäki, 2004). By this the ‘doctor-managers’ adopt a dualistic approach to their role in which they consciously combine professional and clinical judgments with financial and organizational ones (Coombs; 1987).

The process through which doctors become ‘doctor-managers’ is called hybridization. Hybrid professionals are intended to play a boundary role between their professional colleagues at the one hand and management at the other hand, combining clinical credibility with management expertise (Doolin, 2001). But hybridization is not a matter of turning doctors into accountants (Kurunmäki, 2004), nor is it a matter of medical professionals acquiring a new body of abstract knowledge. The traditional skills of the clinician were *complemented* by a new set of techniques that enabled them to prepare budgets, calculate costs, and set prices. A new assemblage was formed among medical professionals, medical expertise, and a set of calculative practices. As decision-making by physicians relates to about 70% of hospital resources, this hybridization has been seen as critical to hospital effectiveness (Kurunmäki, 2004).

The hybridization strategy can be interpreted as an attempt to influence clinical behavior through cultural change within the medical profession by diluting or undermining professional values and norms with managerial ones (Doolin, 2001). Llewellyn (2001)

uses the metaphor of a 'two-way window,' when medical and managerial knowledge is integrated. Clinical directors can incorporate managerial tasks in their work but non-medical managers are unable to carry out clinical issues. This situation greatly increases the power base of the medical managers. From this position, medical managers became the new clinical bosses and downgraded the position of non-medical managers to operational managers. Only a lack of financial management expertise rendered their new organizational positioning vulnerable.

Although medical managers have accepted sets of ideas from management they still portray their management tasks as significant yet supplementary. They still exhibit a general lack of respect for managers' skills and education and, in particular, they question the relevance of managers training to health care (Llewellyn, 2001). Further, taking up a management position as a clinician carries a risk of loss of respect and clinical visibility within the medical establishment. Clinicians fear the loss of their clinical skills if they become embroiled in time-consuming management agendas. Some clinicians would think that becoming a manager is a betrayal of their profession (Doolin, 2001). Therefore the professional logic is hard to combine with logic of management, particularly within one person. The medical manager 'balances between two worlds', which also creates dilemmas. Sometimes the medical manager has to choose between the various, at times conflicting, values of the two worlds. The medical manager must be able to understand the logic of management to form a bridge between two worlds and also to be a two-way window. The interests of his or her medical staff may conflict with those of the organization. In general, professionals do not accept the basic premise on which bureaucratic organizations are founded and seek to develop autonomy and control in the performance of their activities (Abernethy & Stoelwinder, 1991). Physicians have not been trained or socialized to accept organizational goals and obligations. However, research by Abernethy and Stoelwinder (1991) indicates that physicians become more 'bureaucratized' once they are incorporated into the management structure (see also Section 3.4.3). This is mainly true for medical managers who self-select for managerial roles and are prepared to accommodate the demands of the organization.

Finally, Succi & Alexander (1999) argued that the extent to which physician involvement in management and governance improves efficiency may vary as a function of medical staff structure and composition. Specifically, physician executives/board members may have greater success achieving widespread behavioral change among physicians in medical staff that are small, less diverse, and composed of more salaried physicians. The characteristics that reduce the positive effects should be minimized, for example, hospitals with a highly diverse medical staff should work to foster greater communication and cooperation among physicians when adopting hospital-physician integration strategies.

#### *The background of medical and non-medical managers and their use of CMIs*

According to Grol & Wensing (2001), several characteristics of the target group play a role that can promote or obstruct the implementation of an innovation, such as skills, tasks perception, existing routines, and personality characteristics. Each target or setting is to some extent unique. Effective implementation cannot do without proper analysis of the setting and the target group. A diagnostic analysis can relate to: the implementation of the backgrounds (who wants what changes for whatever reasons), segments within the target group, and obstructing and promoting factors. It is important to have an overview, a sort of social card, and they have to have people who have an interest in the implementation. Within the target groups, subgroups of change can be distinguished that are different in nature and should therefore be approached differently. The most famous structure is that of: innovators, early adopters, early majority, late majority, and laggards (Grol & Wensing, 2001). The availability of real innovators and change agents is important for effective implementation within the group. In addition, within the target group of this study, subgroups of backgrounds of the managers can be distinguished.

As described in Section 1.4, the target group of the case-mix information system of this research exists in the top managers of the university medical centers, which mean chief physicians of clinical departments, division managers, and central managers (including the Board of Directors). In the case study of the AMC, about 90% of these managers had a clinical or nursing background, and 10% had a (financial) administrative background (see Table 8.1). There have been several studies published about the use of (case-mix) accounting information by hospital managers. Several studies show that the background of the user has an impact not only on managerial behavior and strategic choices, but also on the use of information systems. Naranjo-Gil & Hartmann (2007<sup>1</sup>) analyzed the use of management information systems (MIS) by 218 CEOs of public hospitals in Spain. Managers with a predominant clinical background appeared to focus more on non-financial (or clinical) information for decision-making and preferred an interactive style when using a CMI, which together supported flexible strategies. On the other hand, managers with a predominantly administrative background seem more effective in establishing cost-reduction strategies through their larger inclination to emphasize financial information in combination with a diagnostic use of the CMI. The explanation for this is that decisions by managers are determined and biased by patterns of knowledge formed by previous experience and training. Clinical training and practice over many years has imbued a deep-seated ethos based on patient care, and almost regardless of cost (Jones & Dewing, 1997).

In general, it can be stated that medical managers give higher priority to the interest of the patients and the non-medical managers stress the needs of the organization rather

than the individual. Also, medical managers use the CMI more as a trigger for dialogue, whereas, on the contrary, non-medical managers use it as the conclusion of a dialogue! An interactive style seems, like the diagnostic style, beneficial to the implementation of strategies focused on cost and beneficial to strategies on quality and flexibility. A diagnostic style is related to the implementation of strategy focused on cost. The use of financial information has a positive effect on strategy focused on cost but not on quality and flexibility. In Table 3.4, the differences between administrators and clinicians are shown.

**Table 3.4: Differences between managers with an administrative and clinical background**

Features Management Information Systems	Administrators	Clinicians
Supervision	Close-control to evaluate performance	Self-control, discretion and work autonomy
Governance	No debate or discussions	Focused on negotiation, discuss and share decisions with other members of the organization
Management emphasis	General activities. Efficient and effectiveness of the organization	Core activities. Effective distribution of the task and means according to the workload and processing time
Skills	Focused on organization performance and how to improve the financial position of the firm	Focus on the patient care and how to improve the health of patients
View of information system	As a tool that provides diagnoses and information about critical performance indicators of the organization (answering machine)	As a tool that stimulates continuous challenge and debate concerning data, assumptions and action plans (learning machine)

Naranjo-Gil & Hartmann, 2007<sup>1</sup>, p. 31

Managers with a balanced background may be most effective in strategic focus on cost reduction and quality enhancement. The fact that clinical managers use the accounting information more as a trigger for dialogue, than a conclusion for the dialogue, was confirmed by a study by Pettersen and Solstad (2014) among clinical managers in hospitals in Norway. Their study showed that for clinical managers, accounting information acted as ex post reporting on economic consequences but did not guide clinical action. Accounting information was to a large extent used as a basis for explaining budgetary deviations and also as a basis for discussions in the department. Furthermore,

the information was to some extent used to explain activity deviations as a background for arguments in negotiations to obtain a more realistic budget. Accounting information was used for ex post accounts on activity, but not as input for future decisions. They found signs of decoupling between plans and actions as budgets were not generally input when planning medical activity. Despite the existence of DRG information in the patient administrative systems, this information was not used in the internal control process in the clinical departments. In practice, they felt a much stronger loyalty to professional medical morals and norms and values than towards budgetary responsibilities.

They found two explanations for this decoupling. First, clinical managers face at least three different kinds of accountability: professional logic, instrumental/enterprise logic, and communicative/ political logic. In the hospital clinics, these types of logic exist side by side as the middle managers play the role of 'two-way windows' (Llewellyn, 2001). Different managers might have a different understanding of their accountability, and the managers' social and organizational context in clinical departments. They concluded that there is a triangle of these logics guiding clinical managers and that they may change and form different patterns to different contexts and differences in the professional background of the clinical managers. Clinical activity is based on professional guidelines, which are developed through discussions and experience in clinics. The clinical discourse is decoupled from the economic and administrative parts. Second, the clinical managers felt little obligation to the budget, because the budgets were interpreted as being without reality and managers had little control of the activity level. The principle of responsibility relies on the manager's control over costs, revenues, and activities. When this control does not exist, managers cannot be held responsible for department or directorate performance. Accounting information was not considered important in decision-making at the operational level. It was only considered as supplementary information. So, it can be concluded that clinical responsibility was managed by medical logic rather than the logic of management. This matched with the research by Witman (2008) who concluded that, based on the medical habitus, a physician does everything in his power to help his patient as possible. Time, cost, and effort are minor.

#### *Allocation of decision rights and use of (case-mix) accounting systems*

Several studies showed that the formal allocation of decision rights to physicians resulted in a significantly greater use of case-mix accounting information in the management of clinical activities. Abernethy and Vagnoni (2004) examined the impact of authority structures on the use of Accounting Information Systems (AISs) for decision control and decision management in large public hospitals in Italy. They made a distinction between formal and informal authority structures. Formal authority results from a deliberate choice by top management to delegate particular decisions to lower levels.

Informal authority was defined as the ability of an individual or group to influence organization decisions and activities in ways that are not sanctioned by the formal authority system. For example, the power of clinicians stems from their ability to control revenue generation and also because their claim to have specialized knowledge and skills, which are critical to the functioning of the hospital. There appeared to be a significant relationship between formal authority and the use of the AIS for decision management and control. The formal allocation of decision rights to physicians results in a significantly greater use of AISs by physicians in the management of clinical activities and has a positive effect on cost-consciousness but this operates via the AIS. However, the power of dominant physicians in hospitals has been argued to seriously limit attempts by hospitals to implement strategies directed towards improved resource management. The higher the level of power of physicians, the less they are likely to be committed to using resources efficiently.

According to the research by Naranjo-Gil & Hartmann (2007<sup>1</sup>), the participation of physicians in management appeared beneficial in controlling costs, maintaining quality, and bringing about organizational change. The implication was that training in the administrative side of management might pay off as it allowed CEOs to use typical management information in broader ways than just determined by their education. They concluded that being confronted with the administrative side of management earlier in their career would make clinical managers more effective in building and using the management repertoire. Another finding was that (case-mix) accounting systems would become particularly useful to physicians when they could demonstrate the connection between achieving management goals of efficiency and the effective performance of the hospital's output goals. Furthermore, they found it necessary that clinical managers are empowered and trained to improve the quality, relevance, and understanding of data. The management of the conflict between professional commitment and organizational responsibilities by physician managers will not be easy. This can be promoted through management development programs which not only include training in control techniques and processes but also in conflict resolution and conflict management (Abernethy & Stoelwinder, 1991; Succi & Alexander, 1999). Such training would provide these leaders with the skills needed to integrate diverse viewpoints and promote a common vision among all physicians on the medical staff.

#### 3.4.4 The (hospital) organization

Within the hospital organization behavioral and organizational variables, organization structure, and power relations prove to be important.

#### *Behavioral and organizational variables*

Shields (1995) developed a comprehensive theoretical model that could be useful for our research about case-mix information systems. He examined, from 143 firms in the United States, the degree of success of ABC (Activity Based Costing). He identified seven behavioral and organizational variables as being important to the implementation of cost management systems: Top management support (1) is crucial because they can focus resources, goals, and strategies on initiatives they deem worthwhile and provide the political help needed to motivate or push aside individuals and coalitions who resist the innovation. Linkage to competitive strategy (2), performance evaluation, and compensation (3) are important to motivate and reward employees to their firm's competitive position and profits. Sufficient internal resources (4) have to be provided to allow employees the opportunity to learn about ABC and to experiment with alternative designs and design methods. Training in designing, implementing and using ABC (5) is an important way to interrelate ABC among strategy, performance evaluation, compensation, and ABC objectives. It also provides a mechanism for employees to understand and accept ABC as well as to feel comfortable with it. Since ABC information is intended to be used by a variety of employees for analysis and action, such training also is a good method for creating non-accounting ownership (6). Non-accounting ownership (that is ownership of people that are not accountants) also is the result of top management support for ABC and the linkage of ABC to competitive strategy, performance evaluation, and compensation. Finally, consensus on clarity of the objectives of the system among designers and users (7) are necessary to ensure that ABC systems and information are produced efficiently and are effectively used.

In addition Abernethy et al (2010) demonstrated that also leadership characteristics of top management and the operating context of a firm influence the design and use of management control systems (MCSs). Their findings underlined the importance of leadership style in explaining control system choices. Leadership style is a significant predictor of both the use of the Planning and Control system and the use of performance measures for compensation and promotion. In particular, they found that top management with a consideration leadership style would use the Planning and Control system as an interactive communication device to informally reveal their preferences to subordinates and to obtain input from subordinates. Consideration is the degree to which a leader involves others in decision-making, considers the opinions of subordinates, and shows concern for their wellbeing. This supports the management literature that demonstrates the importance of strong interpersonal leadership traits as a means of sharing and communicating top management's vision and to inspire subordinates with the confidence to meet their expectations. They also found that initiating structure influenced the interactive communication use of MCSs but the use is less intensive

than it is for those with a consideration leadership. Initiating structure is the degree to which top management structures the work environment by implementing uniform procedures and by defining roles and responsibilities. Managers that are strong on this leadership dimension will express themselves in their use of formal systems with specific targets and then take actions based on results.

However, it has to be noted that the variables found in the industry might not be fully applicable to the hospital sector. Cardinaels et al (2004), for example, did research among 120 hospitals to find out which factors determined the stage of a cost system development. The results indicated that general drivers of activity-based costing (ABC) adoption from other industries (such as cost variables, quality link, etcetera) were less crucial for promoting cost system change in hospitals. Apparently, typical features of the health care sector such as the support of medical parties and the type of contracts with the physicians' should be considered if hospitals refine their cost system. Also the significance of interest of physicians in the process of redesigning cost systems should not be underestimated.

#### *Organizational structure of hospitals*

In many respects, much work in hospitals is work in project teams, performing joint tasks in patient treatments. Collaboration between team members in patient situations may not follow the lines of administrative accountability. The fragmentation of hospitals into hierarchies, sub-specialties, and functions makes knowledge-sharing difficult. One main problem in hospital settings when creating accounting entities is the hierarchical and functional organization of the institution which in turn is based on an organization of departments (Nyland & Pettersen, 2004). By making new accounting entities, hierarchical lines of responsibility may deviate from the functional lines of responsibility that follow clinical decisions on the treatment of patients. Patients are administered within a hospital according to clinical decisions and as they travel through the hospital they may cross numerous administrative boundaries. Thus, accountability in areas where ambiguous boundaries are found will make it difficult to operate an accounting system set up to control and measure the results of the entities' activities.

Kastberg & Siverbo (2013) make a distinction between horizontally and vertically oriented systems. Vertically oriented systems are designed for line organization to allocate responsibilities among managers at different levels. Although mostly these systems are used in practice, these systems can create boundaries, make cooperation harder, produce dysfunctional incentives, do not stimulate change orientation and flexibility, and lead to focus on the short term instead of continuous improvements. Horizontal-oriented systems are designed to support the horizontal dimension, that is, to support decisions and control behavior in process. In literature on process orientation, design and use

have generally been given a secondary role. Implementation of DRG-based information is then problematic, because this is not process information but vertical information.

#### *Power relations in hospitals*

According to the literature, there is a greater potential for conflict, resistance, and system failure if the introduction of accounting systems shifts power relations within the organization (Markus & Pfeffer, 1983). This can be explained by the so-called power theory (Abernethy & Vagnoni, 2004). This theory describes what happens to actors when power is acted upon them. According to this theory, there is a general tendency among those subject to power and controlling resources to resist by means of circumventing or diverting to their own ends. That means that there is a greater potential for conflict, resistance, and system failure, if the change in the organization shifts power relations within organizations. This can be demonstrated with regard to case-mix information systems: actors (for example, administrators) can use the institutional pressure to introduce such a system in the hospital and use it for surveillance practices in which individuals, departments, or services are categorized by objective calculations. By doing this, power is redistributed from physician to administrator with a technical solution. Physicians can, in their turn, resist by discussing the system or diverting it to its own hands, like claiming more budget.

Hospitals display the characteristics that enable power to become the dominant logic or behavior: they have conflicting goals, information for decision-making is ambiguous, and the cause and effect relationship between actions and outcomes is uncertain and unknown. The power of physicians within hospitals exacerbates goal conflict and is potentially problematic for implementing effective management control systems. Conflict arises when physicians pursue goals that increase their status as a professional but which are not congruent with achieving organizational goals that are critical to maintaining the resource base of the hospital (Abernethy & Stoelwinder, 1991). When physicians become powerful and are able to pursue their own goals rather than those of the organization, there is evidence that this will lead to a strong resistance to AIS implemented by top management to control or curtail their behavior (Abernethy & Vagnoni, 2004).

Robbins (2007) examined the implementation of new public management (NPM) ideas in an Irish hospital, such as the attempts to engage clinicians in management, and increased emphasis on management accounting information. He describes many obstacles. One explanation was the lack of trust between management and clinicians. There was a struggle to determine who had control over the resources. Hospital management believes that it is doctors who control activity and therefore the consumption

of resources. Yet doctors believe that management is attempting to increasingly control their work. A further obstacle to successful implementation of NPM reform in the hospital was found in the lingering bureaucratic practices. The organization was still caught in the constraints of tradition, such as a very restricted view of budgeting. There was a failure to link resources consumed with the services delivered. Hospital and health board management seek greater control and accountability through engagement of 'new managers' without supplying them with the tools to do their job.

### 3.4.5 The environment

Several studies demonstrate that environmental factors such as institutional pressure (from regulators and insurance companies), financial constraints, increased competition and environmental uncertainties, affect the adoption, design and success of (case-mix) accounting systems in organizations (Doolin, 2001; Hill, 2000; Kurunmäki, 2004; Lehtonen, 2007; Lapsley & Wright, 2004; Pettersen & Solstad, 2014; Robbins, 2007; Samuel et al, 2005). These studies particularly provide insights as to why some organizations adopt certain systems and why others do not. Important pressures for adoption come from the discourse of New Public Management and, more in general, from isomorphistic pressures. Institutional theory provides a base for researching these multiple institutional pressures.

#### *Competition and financial pressure*

Escalating health care expenditures have brought on the need for restructuring health care delivery. Since the 80s, new approaches to public sector management were introduced in the sector, characterized among other things, by quasi-market forms, increased delegation of resource decisions, more explicit and measurable standards of performance and weakening trust in professionals while strengthening the hand of managers (Dunlavy and Hood, 1994; Russell and Sherer, 1994 and Hood, 1995). The conceptualization of New Public Management was based on the language of managerial and economic rhetoric from the private sector (Robbins, 2007). The conceptualization is motivated by the desire to make the sector more 'business like'; it implies a perspective on performance measurement that is broader than the financial spending indicators (Jansen, 2008). In the hospital sector, these changes implied revised organizational goals and devolved financial accountability to physicians. They threatened deep-seated cultures, and challenged the power between clinicians and administrators (Jones & Dewing, 1997).

A common response to the escalating health care expenditures problem has been to seek market-based solutions (Lehtonen, 2007). Market-based assumptions assume that care is a commodity (Samuel et al, 2005). In several countries, product lines for

hospitals were devised, such as the diagnosis-related groups (DRGs) and diagnosis treatment combinations (DBC) in the Netherlands, with the intention of reducing medical costs (see Section 2.5). The DRGs and DBCs are calculative technologies that enable managerial control of medical activities from a distance. Moreover, these calculative technologies enable the design of markets. Such design involves both the design methodologies of engineers (standardization of activities, designation of care products) and the assumptions of economists on the functioning of markets. In the course of time, the medical domain has been overshadowed by economic considerations and vocabulary: the word 'patient' has been replaced by 'care product' and new words have been introduced like 'feeders and bleeders,' 'portfolio,' and 'market share.' The trade in care implies a merger of the physical and the fiscal and puts a 'price on life' (Samuel et al, 2005). The practice of medicine is organized as an industrial activity and decisively colored by the methods of management. Calculative expertise became part of the repertoire of practices that doctors could deploy. Thus, medicine was 'hybridized' (Kurunmäki, 2004).

The new ideology brought the hospitals within a commercial ethos and had many organizational implications, such as the involvement of physicians in management (see Section 3.4.3) and the adoption and design of accounting information systems in the context of the control of professional behavior. Accounting information is central to the assumption of economic rationality contained in the NPM-ideology as addressed in much of the health reform literature (Jacobs et al, 2004, Coombs, 1987; Lapsley, 2001; Pettersen & Solstad, 2014). Performance information is needed to set targets in management contracts, to focus on efficiency, to compare the targets and actual performance, and to emphasize outputs. However, that does not automatically mean that these systems are embraced or even accepted by the clinicians. Attempts to interest clinicians in the managerial discourses and practices encounter the generally negative opinions about managers and management held by clinicians. Clinicians' perceptions of management are frequently colored by the view that managers are poorly qualified and that management is just common sense or easily learned (Doolin, 2001). When physicians draw on a powerful professional logic are able to pursue their professional goals rather than those of the organization, there is evidence that this leads to a strong resistance to accounting information systems implemented by top management to control or curtail their behavior (Abernethy & Stoelwinder, 1995).

#### *Institutional pressure to adopt (case-mix) accounting systems*

Insights from institutional theory have been prominent in theorizing the role of accounting systems in public sector organizations. According to institutional theory, organizations have to achieve legitimation in the institutional environment in order to

survive, by becoming isomorphic with, which is to conform to, a set of institutional beliefs. There are three forms of isomorphic change (Järvinen, 2006): coercive isomorphism is the response to the pressures that are exerted on organizations by organizations upon which they are independent (like the state) and by cultural expectations. Mimetic isomorphism occurs when organizations face uncertainty and model themselves on other organizations, which means copying other organizations perceived to be more successful. Normative isomorphism arises when professionals operating in organizations are subject to pressures by occupational/ professional groups. Institutional theory-based research provides significant insights into the reasons why organizations adopt case-mix accounting systems: is it to improve efficiency (economic fitness), legitimation (social fitness) or both?

Case-mix accounting systems in health care are said to have been adopted largely because they affirm conformance to supposedly orderly, objective, and rational organization processes. They are a response to the 'rationalization of modern societies' (Abernethy et al, 2007). Hospitals may deliberately choose particular courses of action in order to confer legitimation, thus getting access to additional resources. However, actors do not merely conform to environmental and governmental pressure but might choose to resist, subvert, and even extend existing templates. According to Lehtonen (2007), one explanation for the high failure-rate of case-mix systems is that relatively symbolic displays do not represent the complexities and indeterminacies of internal operating processes. In such cases, organizations tend to avoid dysfunction by *decoupling* these symbolic management systems from the internal operating processes (decoupling phenomena). An example of decoupling in a hospital is that the hospital uses advanced information systems mainly to impress external stakeholders, such as insurers and government departments, but within the organization these systems are hardly used. Some external pressure is necessary, although not sufficient, impetus to change (Covaleski et al, 1993).

Several institutional theory based public-sector studies were conducted about the adoption of (case-mix) accounting systems. Kantola and Järvinen (2012) examined the institutional logics in the Finnish health care sector and investigated why some hospitals implemented and adopted DRG-based accounting systems almost twenty years after the first adaptors. One explanation for the delay was that hospitals have decided to either adopt such accounting systems or not according to whether they consider the organization as an independent actor (*independence logic*) or as part of the public sector (*public sector logic*). The decision of the organization to ignore institutional logic can be one important strategy to cope with outside pressure and has the potential to explain the timing of management accounting change. A legislative change and a financial reform in which responsibility shifted from the state to the municipality had a major impact

on changing the balance between the competing reasons and led to a faster spreading (diffusion) of the new accounting systems.

Hill (2000) investigated the adoption of hospital costing systems in the US over the period 1980 - 1990. He concluded that in addition to the increased environmental uncertainty (financial and competitive pressure), the organizational variables which included ownership, size, and whether the hospital was part of a multi-hospital system or not were significant in impacting on the costing system adoption. The increasing magnitude of health care costs necessitates that hospitals adopt costing systems to provide better data and greater insights for cost control and cost management. The ability to monitor costs in detail, rather than merely aggregating costs, is critical because it allows hospitals to track the costs by patient. For example, as competition intensifies, decision-makers consider external, non-financial and ex ante information to be increasingly important. Hill's research demonstrates that competition alone is not a critical variable in costing system adoption. Revenue constraint plays the dominant role in influencing hospitals' behavior. However, the combination of revenue constraint and competition does appear to drive hospitals in more competitive environments to adopt costing systems earlier. The research also showed that as the percentage of total reimbursement based on the federal rate (PPS) increases, the probability of a hospital adopting a sophisticated costing system also increases.

Finally, Lapsley & Wright (2004) examined the adoption of accounting innovations in public sector organizations in Scotland. The results of their survey indicated that adoption of accounting innovations by public sector organizations was largely affected by government influence. For the healthcare sector, the introduction of new accounting techniques was to a substantial extent due to government instigation. The internal market was a major catalyst in accounting innovation for the National Health Service (NHS), with a larger responsibility upon the accountants to accurately cost services. The high reported use of resource management had arisen as a result of this development.

#### *Conclusion*

Based on the literature review, five factors were identified that might affect the failure or success of CMIs: characteristics of the design and implementation of the CMI, the target group of (hospital) managers, the (hospital) organization, and the environment. These factors were incorporated in our design-oriented research as described in the next chapters.

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# Chapter 4

Research methodology

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## Abstract

In the field of management accounting and control, research on (case-mix) accounting systems is mainly based on contingency research with a strong emphasis on statistical techniques. However, this type of research has disadvantages, such as that in reality there is often multi-causality involved, results are not easily transferable to other contexts, and it often ignores power struggles as well as rationalities other than technical ones, which are likely to greatly influence the diffusion of new practices. Consequently there is a utilization problem because in the end, the scientific knowledge has to be applied by professionals who solve real-world problems. Design-oriented research can be considered as supplementary to the traditional empirical research. It is essentially a process of gaining knowledge on the basis of reflection on the functioning of the regulative cycle in a class of cases. It is case study research, done in order to understand a complex system in practice. The regulative cycle involves a structured organizational problem-solving process. Key elements are problem formulation, problem diagnoses, design, implementation, and evaluation of the effects of an innovation. The iterative process continues until a satisfactory solution crystallizes that works well for the specified class of problems. In the -case study of the AMC, the regulative cycle used was to some extent adjusted. It consisted of process design, object design, implementation, and evaluation. The regulative cycle was passed through several times from 2006 until 2014. During the study, the questions of how successful the CMI project had been so far and which factors facilitated or obstructed its success, were examined. In addition to the regular evaluations, two extensive reflections took place. Data were collected from multiple sources, such as questionnaires, unstructured and semi-structured interviews, documents and by 'being around'.

## 4.1 Introduction

This chapter provides a description of the methodology of design oriented research. In Section 4.2 we advocate a development towards the production of design knowledge in management accounting. Section 4.3 further explains what design-oriented research is and how scientific theories and practical design knowledge can be gained on the basis of reflection on the functioning of the regulative cycle. In Section 4.4 the methodology of our design-oriented research is presented.

## 4.2 Towards design oriented knowledge in the field of management accounting

The ultimate objective of design oriented research is to develop and to use reliable and valid knowledge in the design of solutions to problems in the field. On the one hand, the design knowledge must be founded scientifically and on the other hand it must be applicable by practitioners such as managers, controllers, and (chief) physicians. According to Van Aken (2004), the problem with much research in management is that it is description-driven and based on explanatory sciences and as such on the notion that the mission of all science is to understand, i.e. to describe, explain, and possibly to predict. He calls this *mode 1 knowledge production*, predominantly driven by academic concerns. However, this knowledge does not solve the practical problems of the practitioner and does not meet the criteria of managerial relevance. In the field of management accounting a substantial body of research has resulted in such mode 1 knowledge. Mainstream research on accounting or control systems is based on contingency research where the accumulation of knowledge is gained through an empirical cycle with a strong focus on statistical methods (Vosselman, 1996; Ahrens & Chapman, 2006). However, this type of research has disadvantages. First, in reality there is often multi-causality involved: a combination of explanatory factors that are difficult to isolate. Second, relationships are found in certain contexts (time, organization) and are not easily transferable to other contexts. Third, positivist research in management (accounting) often ignores power struggles as well as rationalities other than technical ones, which are likely to greatly influence the diffusion of new practices.

Van Aken (2004) advocates a research paradigm that is not oriented towards the production of positive knowledge, but towards the production of design knowledge. He is strongly in favor of a development from description-driven towards prescription-driven research. Van Aken calls prescription-driven research *mode 2 knowledge production*: a transdisciplinary form of research with intensive interaction between knowledge production and knowledge dissemination and application. Prescription-driven research, also called design-oriented research, may be both quantitative and qualitative. It typically

applies a case-method approach. The researcher adopts the role of a ‘change agent’ as a person who supports the participants of the organization in their learning processes (Kasanen et al, 1993). In Table 4.1 the main differences between description-driven and prescription-driven research are summarized

**Table 4.1: Main differences between description-driven and prescription-driven research**

Characteristic	Description-driven research	Prescription-driven research
Dominant paradigm	Explanatory science	Design science
Focus	Problem focused	Solution focused
Perspective	Observer	Player
Logic	Hindsight	Intervention outcome
Typical research question	Explanation	Solutions for a class of problems
Typical research product	Causal mode, quantitative outcome	Tested and grounded technological rules
Nature of research product	Algorithm	Heuristic
Justification	Proof	Saturated evidence
Type of resulting theory	Organization theory	Management theory

Van Aken, 2004, p. 236

Design-oriented research has been scarce in the field of management accounting so far. One explanation for this may be that much of the research is based on the social sciences that are strongly aimed at explaining reality. Another reason may be that the design of useful managerial constructions takes place in external consulting (ICT) firms where designers have limited access to the world of management and it inherently limits the possibility of publishing the results because of commercial reasons.

### 4.3 Design-oriented research in management accounting research

The mission of design-oriented research is to develop reliable and valid knowledge to be used in designing solutions to real-world management problems in the field in question (Van Aken, 2004). It deals – as noticed previously - with the practical application of scientific results whereby the knowledge is developed in cooperation with the professionals. Examples of solutions are the design of plans, models, a new language (such as Morse, Braille or computer language), managerial constructions (like a new budgeting system, the Return On-Investment measure in profit center accounting), or –

in the context of this thesis – a CMI. This type of research is also called the constructive approach: managerial problem solving by designing constructions (Kasanen et al, 1993).

Design-oriented research is essentially a process of gaining knowledge on the basis of reflection on the functioning of the *regulative cycle*. The regulative cycle involves a structured organizational problem-solving process. Key elements of this process are problem diagnoses, problem selection, design, implementation, and evaluation of the effects of an innovation (see Figure 4.1). The iterative process continues until a satisfactory solution crystallizes that works well for the specified class of problems.

Within design knowledge, *prescriptions* or technological rules are an important category. Many prescriptions in design science are of a heuristic nature such as: “If you tend to achieve Y in situation Z, then something like action X will help” (Van Aken, 2004). Something like action X means that the prescription is to be used as a design exemplar. A design exemplar is a general prescription which has to be translated to the specific problem at hand. Heuristics are based on a reflection on the operation of instruments in similar cases. Through testing the prescriptions by following a reflective cycle, one can gain insight into indications and contra-indications for successful applications. A person who engages in the reflective activity ‘learns as much from his failures as from his successes.’

#### *Field tested and scientifically tested*

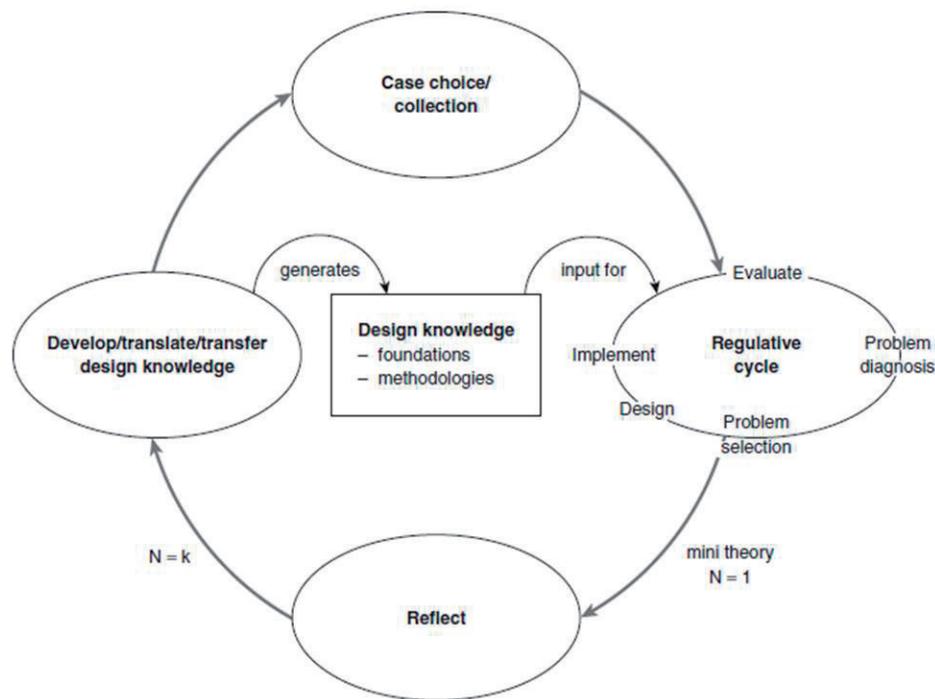
The output of the regulative cycle entails a theory of practice or ‘mini theory’ (Heusinkveld & Reijers, 2009) that is applicable to only the individual case. In the scientific process of reflecting, this mini theory may be generalized to multiple cases. The reflection process particularly concentrates on analyzing the effectiveness of the design. In order to show that the method of construction is scientific, it is not enough to show that a certain managerial construction works in its proper context. One also has to show that the construction is grounded on scientific knowledge, i.e. that it is part of a theoretical framework and that the construction in question would also work in other instances than its original field.

#### *Legitimation in design knowledge*

When design knowledge is both field tested and scientifically tested, this knowledge is not necessarily recognized, accepted, and widely drawn upon in other organizational praxis. The implementation processes in other organizations will be enhanced when adequate institutional entrepreneurship is included in the reflection process. Therefore, linking the steps in the reflective process to the presence of committed actors and suitable persuasive activities encourages the process of developing design knowledge.

Second, the process will be enhanced when the reflection concentrates on how the contents of the knowledge may fit the institutional context in which the development activities are located. In other words: the success of design knowledge relates not only to its technical performance but also to its social and institutional acceptance. In Figure 4.1 the process of gaining design knowledge on the basis of reflection on the regulative cycle is visualized.

Figure 4.1: Knowledge development in organizational design

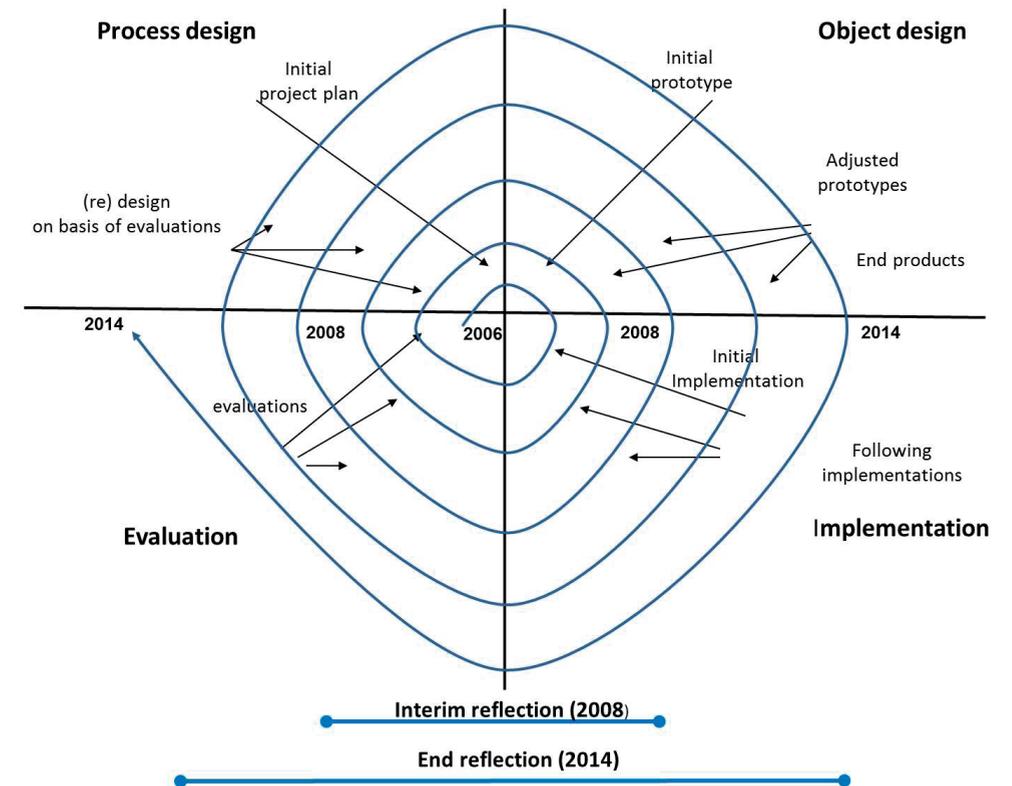


Heusinkveld & Reijers, 2009, p. 868

#### 4.4 Design-oriented methodology of this research project

In our case study in the AMC, we aimed to solve a specific problem (lack of information) of hospital practitioners by constructing a solution (CMI) in a Dutch university medical center (field of question). Figure 4.2 depicts the applied design-oriented methodology of our research project.

Figure 4.2 Design-oriented methodology of the research project



#### Phases in the regulative cycle

During the longitudinal case study, a case-mix information system (CMI) was designed and implemented at the AMC. During the research period, which took place from 2006 until 2014, the regulative cycle was passed through several times, following the *spiral model of Boehm* (see also Section 3.4.1). Although the boundaries between the different phases are permeable, the following iterative phases in the regulative cycle were distinguished: process design, object design, implementation and evaluation.

In the *process design phase*, there was determination of what CMI products would be (re) designed and implemented in the coming period and by whom, based on the evaluations of the existing CMI and new developments, such as external developments and related developments at the level of the AMC. The external developments particularly concerned the development of the DBC product structure and changing demands from insurers and the Ministry of Health. Internal developments included financial pressure, changes in the internal budgeting, available ICT capacity, and prioritization by the Board of Directors. In the *object design phase*, the products of the CMI were technically designed in several pilot groups (in 2006, 2007, 2010 and 2012), consisting of members of the CMI project management and the (potential) end users: chief physicians of clinical departments, division (or cluster) managers, central managers and business analysts. Each pilot focused on a specific topic and the composition of groups differed per pilot. During this period, several physical and non-physical case-mix information products were designed. In line with Boehm's spiral model, the object design phase was an iterative process in which prototypes in different phases of development were judged by the end users. In each phase the pilot group could adjust or refine the specifications of the CMI.

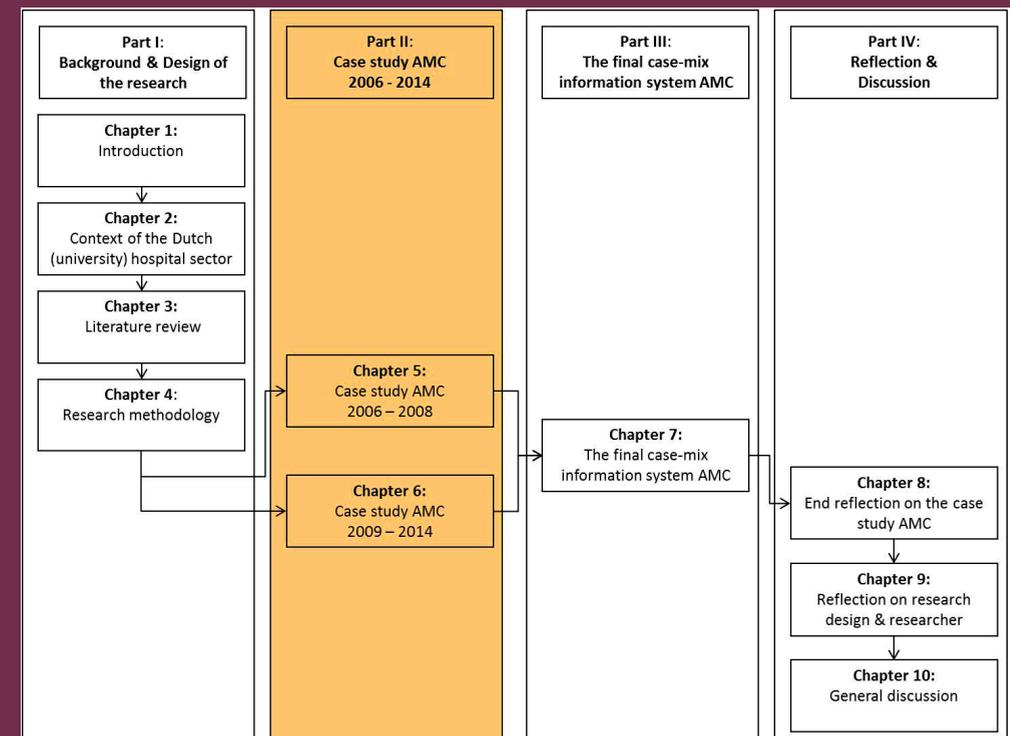
The *implementation phase* related both to technical issues (making the CMI available to the users) and organizational issues (communication, training, etc.). In this phase, the CMI was actually adopted and used and the effects of use occurred. In the *evaluation phase*, the interim success of the CMI project was assessed on the basis of informal and formal evaluations and the factors that had promoted or obstructed its success. In addition to the regular evaluation phases, two *extensive reflections* were conducted (in 2008/ 2009 and 2014) with the aim to gain contemplative knowledge about several topics over a longer time period. The opinions of the project were requested from all the people in the target group and not from only the people from the pilot groups, thus creating a more representative picture. The results were used to assess whether the project as a whole was on the right track and to identify what measures were necessary to increase the acceptance and use of the CMI. In February 2014, it was concluded that the CMI had been completed and the objectives of the project had been fulfilled, so the project was finished. In Chapter 7, the end products of the CMI are described in detail.

#### *Data collection*

Both qualitative and quantitative research methods were used. Triangulation was sought by collecting data from multiple sources, such as interviews, questionnaires, documents, and by 'being around'. In the regular phases of process design, object design, implementation and evaluation phase data were collected by several unstructured interviews with pilot group members, (medical) managers, business analyst, the ICT department and F & C department. During these phases data external and internal

documents were used to describe relevant developments, such as policy letters from the Ministry of Health and the Dutch Health Care Authority (NZa) and a range of internal documentation, such as annual reports, budgeting letters, internal memos and presentations. Sometimes limited questionnaires were used, for example to evaluate the user training sessions. Furthermore, the researcher (FA) worked at the AMC and was thus in constant contact with his research environment. From the beginning of the project, he was project leader and involved in the design and implementation of the CMI and attended numerous meetings with managers. By 'being around' he saw and heard all kind of things that might be relevant for these phases. With regard to the formal extensive reflections solely questionnaires and semi-structured interviews were used. Finally, the conclusions of this research were presented to several experts of the AMC to test the reliability, completeness, and relevance.

# PART II: CASE STUDY AMC 2006 - 2014



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# Chapter 5

Case study AMC 2006 – 2008

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## Abstract

In 2006, the Ministry of Health announced that from 2008, 70% of hospital care would be freely negotiable. Given the fact that the AMC already had a budget deficit and that it was predicted that this would increase because of the new reimbursement, the Board of Directors decided to design a case-mix information system (CMI) for their top medical and non-medical managers, in order to increase insight about patients, decision support, planning, monitoring, legitimization, and process optimization. In the design of the CMI, the patient groups of the AMC were put centrally because. It was assumed that the patient groups had a large impact on the performance in all core tasks and funding and therefore had to be put centrally in management and associated (management) information. The CMI was iteratively designed and gradually implemented in the AMC organization. In 2006, a pilot group defined what types of information were minimally required to define medical policy. These data were collected and presented to the pilot specialties by a Standard Report Patient Care and Portfolio Matrix. After the pilot, these products were rolled out to all medical specialties to support them when defining their plans for the following year. In 2008 26 medical specialties participated in the CMI project. At the end of 2008, an interim reflection on the project took place by means of a survey followed by semi-structured interviews. Chief physicians, division managers and central managers, were asked to participate in the interim reflection (N = 35). The respondents agreed with the statement that the CMI had added value to the AMC and themselves. Because of the increasing competition and financial pressures, they expressed the need to make case-mix decisions in a more rational and explicit way and expected that the CMI would support this. The majority of the managers had used the information regularly. The CMI was most used for getting more insight, decision support and, although to a lesser extent legitimization. However, doubts about the quality of the data, particularly the DBC and cost data, appeared to be a major obstacle to the acceptance and use of the information. Also several medical managers indicated that they had insufficient knowledge and skills on how the CMI could be used for decision making. Moreover, they found it difficult to really implement choices into practice. On balance, the positive effects of the instrument outweighed the negative effects. About two thirds of the respondents had perceived the CMI project as (very) successful for themselves, but it was also concluded that several necessary measures for improvement had to be taken to further increase the success of the CMI.

## 5.1 Introduction

In this chapter, the first phase of the case study in the AMC over the period 2006 to 2008 is described. In this phase, the project 'Patient Care Profiles' started on behalf of the Board of Directors (see Section 2.8). The initial information products based on DBC data were designed and implemented in cooperation with the top medical and non-medical managers. In Table 5.1, an overview is presented of the most important research-related developments between 2006 and 2008.

**Table 5.1: Overview of the most relevant developments for this research, 2006 - 2008**

Dutch hospital sector	Year	AMC			
		General event	Evaluation of the CMI	Design of the CMI	Implementation of the CMI
Introduction of the DBC system	2005	Predicted budget deficit in 2006 of 12 M euro			
10% B segment (free negotiable care)		Decision of Board of Directors to design the case-mix information system (CMI)			
Introduction of the new Health Care Insurance Act, Health Care Market Regulation Act and Health Care Institutions (Accreditation) Act	2006	Definition 'Strategic goals 2006 - 2010'	Evaluation pilot 'Patient Care Profiles' 2002 - 2005, Evaluation pilot I	Questionnaire, minimal data-set, Standard Report Patient Care, Portfolio Matrix	Roll out Standard Report Patient Care, Portfolio Matrix
	2007		Evaluation pilot II		
20% B segment (free negotiable care)	2008		Interim reflection	Standard Report Patient Care and Portfolio Matrix in Cognos <sup>8</sup>	Roll out CMI in Cognos

<sup>8</sup> The AMC uses Cognos as a management information system. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management. The software is designed to enable business users without technical knowledge to extract corporate data, analyse it, and assemble reports.

To better understand the context of the case study, in Section 5.2, the most relevant research-related developments in the Dutch hospital sector and AMC over the period 2006 to 2008, are described. In Section 5.3, there is a demonstration of how the yearly regulative cycle of problem solving (see Chapter Four) was passed through. In addition, an *interim reflection* on the project took place at the end of 2008 to reflect extensively over a longer period of time and gain contemplative knowledge about several topics. The results of the interim reflection are presented in Section 5.4. In Section 5.5, the interim conclusions are summarized.

## 5.2 Developments in the Dutch hospital sector and the AMC

### The Dutch hospital sector

In 2004, the Ministry of Health presented its plans for the liberalization of care for the next few years (VWS, 2004). One of the plans was that, starting from 2008, health care providers would be able to negotiate on the prices of the products for over 70% of hospital care with the aim of giving insurers and health care providers more opportunity for initiative and responsibility, in a way consistent with the philosophy of health insurance (see also Section 2.4). In 2007, the final plans regarding the funding and reimbursement of hospitals were presented for 2008 to 2011 and it was determined that in 2008 the free negotiable segment (B-list DBCs) would be expanded from 10% to 20% rather than 70% (VWS, 2007). Other plans included the replacement of the budget system by a DBC-based reimbursement system in 2009, and the development of the DOT system, which is a simplification of the DBC system (see Section 2.5). For the UMCs, it was determined that their funding had to match the DBC system as much as possible, but the additional costs associated with the top referral and innovation function would still be funded by the academic budget.

In 2008, the Ministry of Health evaluated the previous years' changes. According to them, the introduction of the B-segment had led to a better access to care, a decrease in waiting times, and more attention to quality, innovation, and creativity in the sector (VWS, 2008<sup>1</sup>). Despite these positive developments quality needed to have a more important role in the negotiation with, and contracting of, providers. Based on these evaluations, VWS announced the introduction of the new DBC product structure DOT in 2010 and the extension of the B segment in 2009 up to 34%. It was also determined that the introduction of a full DBC-based reimbursement system would be postponed because there were too many risks. This meant that in 2009 most of the care (A-list DBCs) was still reimbursed through the budget system, but funding was based on the DBCs. In addition to this, the Ministry of Health announced budget cuts for

the hospital sector increasing from €160 million in 2008 to €400 million from 2011, structurally. In December 2008, VWS announced that the introduction of the DBC reimbursement system would take place in 2011 (VWS, 2008<sup>2</sup>). Altogether it can be concluded that the liberalization of care had taken place in a much slower pace and more limited way than planned.

### The AMC

The introduction of the liberalization of care and the increasing pressure on financial resources had impact on the strategy of the AMC as defined in the strategic goals of 2006 to 2010 and the annual budget letters.

#### *Strategic goals 2006 - 2010*

In 2006, the AMC defined their strategic goals for the next four years. In this document, it was stated that the external developments and financial pressure made it necessary to select the right patients because they determined how the AMC performed on the core tasks of patient care, research, and training:

More than ever in the existence of the AMC, the patient is placed centrally in our strategy. We will have to ensure that the patient finds our expertise and attention to the level which they are entitled. At the same time, the shortage of medical care compels us to use the available capacity as efficiently as possible. (...). Patient Care Profiles determine the care that we have to offer. Choices with regard to type of patients are inspired by the way we fulfill our three core tasks. The AMC has shown in recent years that the introduction of the 'Patient Care Profiles' increased our ability to manage the influx of patients better (AMC, Strategic Goals 2006 - 2011).

#### *Budget letter*

In the budget letter AMC 2006, a budget deficit of €6.6 million was expected for 2005 and €12 million for 2006. Based on the deficits and the ambition to achieve a net result of 2% for innovation, cost savings of 20 million euro were required. The AMC wanted to realize this through a combination of measures, such as the freeze on hiring temporary medical specialists and nursing staff, by analyzing the budget deficits, and by making new savings plans. When the financial policy and budgets for 2008 were presented, it was announced that, despite the fact that the annual accounts of 2007 had shown a positive result, the budgets for 2008 were more sobering. At the central level, 10 million euro had to be invested in new activities and growth in core areas. For patient care, production growth was capped at 1%. To support the right choices in patient care, the Board of Directors decided that the instrument 'Patient Care Profiles' had to be updated and developed further for new purposes, including the integration of patient profiles in the 2008 budget. This meant that all clinical departments were asked

to indicate the desired volumes per patient group. In assessing the plans of the divisions, the Board adopted the principle that priority be given to five areas<sup>9</sup> and the plans would be evaluated on impact with regard to finance and capacity. In 2008, internal budgeting was still based on the budget parameters and not on the DBCs, because it was not possible to make a good split between the A- and B-list DBCs. Finally, it was announced that in 2009 the internal budgeting would become more DBC-based.

### 5.3 The regulative cycle of the AMC

The case-mix information system (CMI) was iteratively designed and implemented at the AMC and gradually spread across the organization. Between 2006 and 2008 the regulative cycle was passed through annually. The cycle consists of the phases of evaluation, process design, object design, and implementation of the CMI (see Section 4.4).

#### 5.3.1 2006

##### 1. Evaluation of the instrument ‘Patient Care Profiles’

In 2006, the Finance & Control department (F & C) evaluated the strengths and weaknesses of the instrument ‘Patient Care Profiles,’ which was developed between 2002 and 2005 (see Section 2.8). The evaluation took place with four people who had previously been involved in the project. The interviewees were positive about the further development of the instrument, because they recognized the need to better understand the consequences of medical practice and that specific choices in the portfolio had to be made due to market forces and pressure on resources. In Table 5.2, the perceived strengths and weaknesses of the instrument ‘Patient Care Profiles’ are summarized.

##### 2. Process design

Based on this evaluation, the F & C department concluded that in order to solve the problems with the ‘Patient Care Profiles’ and given the expected increase of competition and financial pressure, this ad hoc instrument had to be transformed into a real information system with regard to patients: a case-mix information system (CMI). As in 2006 there were no ready-made CMIs available for the Dutch hospital sector, the F & C department decided to design its own system. The system was designed primarily for the top medical and non-medical management, i.e. both within the divisions

<sup>9</sup> Cardiovascular diseases, gastrointestinal oncology, infection and immunity diseases, and the Cardiovascular diseases, gastrointestinal oncology, infection and immunity diseases, and the children’s hospital.

**Table 5.2: Strengths and weaknesses of the ‘Patient Care Profiles’**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• It supported a way of defining medical policy and priorities;</li> <li>• The patient groups were consistent with the experience and language of the department;</li> <li>• The patient group was an appropriate level of aggregation of care and suitable for different purposes.</li> </ul>	<ul style="list-style-type: none"> <li>• The patient groups were only described in qualitative terms and not based on data. Therefore it was not possible to quantify the patient groups, for example, in terms of volume, capacity, and money. As a result it was not possible to monitor if the medical policy was realized and there was no insight in the consequences of medical policy;</li> <li>• In the Minimal Dataset, several relevant data for making case-mix decisions were missing, for example financial data and (care) market data;</li> <li>• The definition and quantification of patient groups were limited to the areas of focus, not for all activities;</li> <li>• The definition and quantification of patient groups was optional for the medical departments and had no part in the annual cycle of planning &amp; control;</li> <li>• The process of data collection took place irregularly, was labor intensive and error sensitive;</li> <li>• The data of the patient groups was recorded in tables, and was not useful as management information for the internal dialogue about budgets and cost.</li> </ul>

(chief physicians, division management) and central management (Board of Directors, Corporate Controller, and Director of Patient Care), because they were considered to be the key decision-makers.

The CMI had to serve different functions. For management within the divisions the CMI should mainly serve the decision facilitating function (see Section 3.4.1), which meant that it would give insight (into the case-mix and underlying care processes and these insights would support management in taking (policy) decisions with regard to the case-mix and process optimization. This matched with the AMC management principle of the ‘professional in the lead’ at making decisions in the primary process (see Section 2.8). For central management, the CMI should mainly serve the decision control function, which meant that it could be used for planning (capacity, money) and monitoring of the policy plans, and for external legitimation purposes (negotiating with the insurance companies). For the design of the CMI several principles were defined, such as: the system should match with the processes and language of the medical departments, the workload should be limited, it should not lead to new registrations, and the design process should be transparent, repeatable, and documented.

To start with, two information products had to be designed: a Standard Report Patient Care and a Portfolio Matrix. The *Standard Report Patient Care* had to present the most relevant data with regard to the patient groups and had to replace the current data tables of the project 'Patient Care Profiles'. A *Portfolio Matrix* is a technique for classifying current or new businesses or products into categories on the basis of their rankings in two or more dimensions of performance (Walker & Rosco, 1988). The idea of the Portfolio Matrix originated from the Boston Consultancy Group and was primarily developed for the commercial industry. The F & C department presumed this to be a powerful tool for medical managers to assess their mix of patient groups in a systematic way. The design of the Standard Report and Portfolio Matrix would be done by *Pilot group I*<sup>10</sup>. The deadline for the pilot was June 2006 because, if the system was successfully completed, it could be used hospital-wide for the definition of annual plans by medical department, the budget, and production agreements with insurers in 2007.

### 3. Object design

#### *Design of information products*

In this phase the Standard Report Patient Care and Portfolio Matrix were designed. The Standard Report contained quantitative and qualitative data per patient group and per medical specialty. The data were classified by topic: patient characteristics, relevance, capacity, health care market, and finance. These subjects were considered as relevant by the pilot group for the preparation of the annual plans. The patient groups were presented side by side to allow comparison with each other and to evaluate strategic alternatives. In Table 5.3, an example of the Standard Report of the Plastic Surgery department is presented with regard to the subject characteristics of the patients and finance.

The financial data consisted of costs and revenues per patient group. Since the real costs were not registered in the ledger per patient but by cost center, these costs were estimated by multiplying the volumes of the underlying care activities of the DBC trajectories by the unit costs. The unit costs of care activities were calculated annually by the F & C department and included all direct and indirect costs with regard to patient care. The AMC had designed and implemented their own unit cost model since 2002 (Asselman & Snijders, 2005; Asselman, 2007). The costs for research, training and

<sup>10</sup> Pilot group I consisted of chief physicians of Cardiology, Ophthalmology, Neurology, Gastrointestinal and Liver diseases, Paediatric oncology, Plastic surgery, and Radiology. It was a combination of portal and supporting specialties, representative for the AMC. Other participants were a nursing director, two employees of the F & C department, one employee of Directorate Patient Care and a business office employee. In total, 12 people participated in this first pilot group.

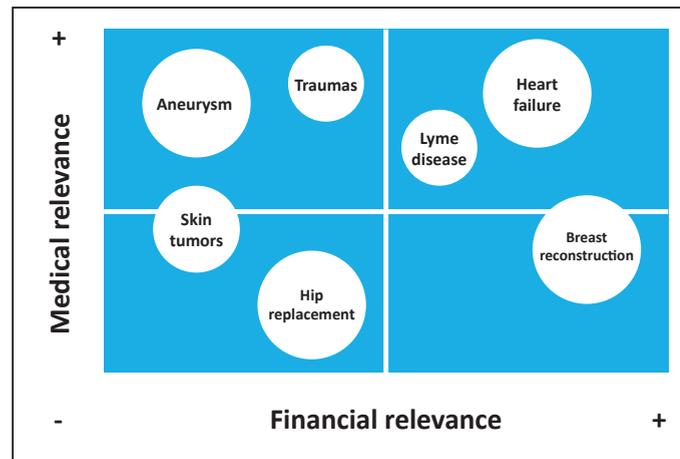
**Table 5.3: Example of Standard Report of the medical specialty Plastic Surgery (\*)**

		Consult, conservative treatment	Hand/wrist	Tumors	Breast reconstruction
<b>Characteristics of patients</b>	<b>Source</b>				
# DBC trajectories	DBC system	180	565	280	250
% top referral care	Chief physician	75%	60%	25%	25%
% of patients within Amsterdam	Patient system	50%	40%	50%	40%
% patient s <= 18 years old	Patient system	7%	7%	90%	10%
Referred by general practitioner	Chief physician	sometimes	sometimes	seldom	sometimes
Referred by other specialties AMC	Chief physician	sometimes	often	often	sometimes
Referred by other hospitals within Amsterdam	Chief physician	sometimes	often	often	sometimes
Referred by other hospitals outside Amsterdam	Chief physician	sometimes	often	often	sometimes
<b>Finance</b>					
Costs per DBC	F & C	615	684	1.080	1.787
Returns per DBC	F & C	508	985	1.811	1.419
Financial coverage per DBC	F & C	-107	301	731	-368
Financial coverage per DBC (%)	F & C	83%	144%	168%	79%
Total costs DBCs	F & C	107.019	386.416	244.097	418.191
Total returns DBC	F & C	88.392	556.525	409.286	332.022
Total financial coverage DBCs	F & C	-18.627	170.109	165.189	-86.169

(\*) Table contains fictitious data

education were excluded by using several assumptions. The revenues were determined by the tariffs (A-list DBC) or selling prices (B-list DBCs) of the DBC trajectories. Since the calculated costs included also the costs for top referral care, these costs were about 25% higher than the revenues of the DBC trajectories. These additional costs had to be covered by the academic budget (see Section 2.7). The Portfolio Matrix was designed by adjusting the measures on the X and Y-axis of the original matrix of Boston Consultancy Group to the setting of the AMC. In Figure 5.1, an example is displayed of the Portfolio Matrix of the AMC.

Figure 5.1: Example of the Portfolio Matrix of the AMC (\*)



(\*) Figure contains fictitious data

In this Matrix, the medical relevance (Y-axis) was determined per patient group by the chief physicians. They were asked to specify in terms of percentages how much of the patients' treatments per year were relevant for the clinic, research, training, and education (see Table 5.4). For example, of the patient group 'Tumors,' there was an indication that 70% had been enrolled in scientific research. The overall relevance score was calculated by averaging the unweighted percentages of the individual scores.

**Table 5.4: Calculation of the relevance scores by patient group of the medical specialty Plastic Surgery (\*)**

Patient group	It is relevant for the clinic	It is relevant for research	It is relevant for training	It is relevant for education	relevance score (un-weighted)
Consult, conservative treatment	100%	100%	100%	100%	100%
Hand/ wrist	40%	100%	100%	75%	79%
Tumors	50%	70%	100%	75%	74%
Breast reconstruction	10%	75%	10%	75%	43%

(\*) Table contains fictitious data

The financial relevance (X-axis) was determined by comparing the average cost and tariffs (A-list DBC) or selling prices (B-list DBCs) of the underlying care products. If the financial relevance was above 100%, the patient groups were profitable; below 100% the patient groups were unprofitable. Each bulb in Figure 5.1 represents a patient group, wherein the size of the bulb was determined by the number of patients per year.

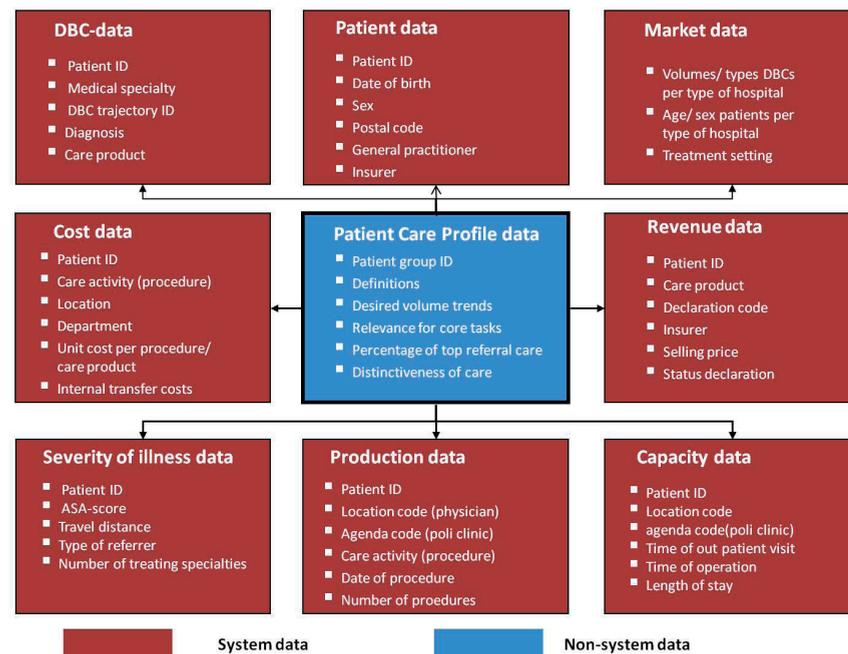
As a result, the degree of medical relevance was plotted against the degree of financial relevance per patient group. For each quadrant of the Portfolio Matrix, actions could be defined so as to optimize the portfolio. For example, if a patient group such as 'Hand/wrist' was very relevant for the different core tasks, but was unprofitable at that moment (upper left quadrant), one could decide to stabilize the volumes but focus on process optimizing and investigate if there were opportunities to increase the selling prices. On the other hand, if a patient group such as 'Breast reconstruction' was not very relevant for the core tasks but profitable (bottom right quadrant), one could decide to increase the volume and use the profit to subsidize patients from the upper left quadrant. The Standard Report and the Portfolio Matrix were generated for all medical specialties of the pilot group.

#### Design process

The design of the Standard Report and Portfolio Matrix was done by a pilot group (pilot group I)<sup>11</sup>. The pilot served as a test laboratory. During the pilot, both plenary sessions as well as one-on-one interviews were organized. The design process of the Standard Report and Portfolio Matrix consisted of several steps. In step 1, the existing *Minimal Data Set* (i.e. what data is minimally required per patient group) as used for the original 'Patient Care Profiles', was revised to match the CMI to the needs of management. The Minimal Data Set was revised on the basis of criteria such as relevance, usability, workload, and validity. On this basis, a new Minimal Data Set was defined, see Figure 5.2.

<sup>11</sup> Pilot group I consisted of chief physicians of Cardiology, Ophthalmology, Neurology, Gastrointestinal and Liver diseases, Paediatric oncology, Plastic surgery, and Radiology. It was a combination of portal and supporting specialties, representative for the AMC. Other participants were a nursing director, two employees of the F & C department, one employee of Directorate Patient Care and a business office employee. In total, 12 people participated in this first pilot group.

Figure 5.2: Minimal Data Set 2006



The main changes were related to the fact that new types of data were incorporated, such as financial data, and health care market data (such as the size and number of competitors). Moreover, the integration with other medical specialties was made visible. Besides this, chief physicians were asked to indicate how these patients could be traced in terms of DBC. Because of this it became possible to quantify the patient groups. In step 2, it was described how the data could be collected. A distinction was made between system and non-system data.

*System data* are quantitative data that are registered in digital hospital systems. For the collection of system data queries were defined. *Non-system data* are data that are not registered in systems, such as opinions about patient groups, and can only be obtained by asking the medical departments. For the collection of these data, a questionnaire was designed. The list contained mostly fill-in options so the completion time was limited to five to ten minutes per patient group.

In step 3, the chief physicians were asked to categorize their patients into clinical subgroups and accordingly to complete a questionnaire per patient group. The questions related to the type and relevance of care, current and desired volumes, use of diagnostics and surgery, and distinctiveness on the health care market. Because of manageability, the number of patient groups was limited to a maximum of fifteen groups per department

of average size. They had to classify at least 80% of their patients. The patient groups had to be traceable in the existing registrations and chief physicians were strongly advised to make use of DBC data such as DBC diagnosis, procedure, age of the patient or a combination of these data. In step 4, the system and non-system data were collected and aggregated in a data warehouse. In step 5, the Standard Report and Portfolio Matrix per medical specialty were generated in Excel.

#### 4. Implementation of the CMI

In the summer of 2006, the Board of Directors decided to roll out the Standard Report Patient Care and Portfolio Matrix to all medical specialties of the AMC to support them when defining their plans for the following year. In this way, the information products were incorporated in the Planning & Control (P&C) cycle. In this context, all specialties were asked first to define their patient groups and complete the questionnaires. Accordingly, they had to indicate the desired volumes per patient group in order to remain within the financial budget in terms of growth, stabilization, or decline. They also had to define the areas of focus in patient care, in research, and education. Eventually, 26 medical specialties participated and a total of 350 patient groups were defined. Each medical specialty received a Standard Report, Portfolio Matrix, and explanation of the report and figures. The roll out of the Standard Report and Portfolio Matrix in 2006 took place earlier than planned, because the financial deficit of the AMC had worsened. In the period from September to November the Standard Report and Portfolio Matrix were generated for all medical specialties. Unfortunately, many deliveries were later than planned so several meetings had to be postponed. The reasons for the delays were that medical specialties were too busy, there was a lack of priority, and there was a lack of willingness. The annual plans of the medical departments were discussed in group meetings that were attended by the chief physician, division chairman, corporate controller, and director of patient care. After these meetings, the annual plans were finalized and established by the Board of Directors. Based on these plans, the Board of Directors determined the priorities for negotiations with the insurers.

### 5.3.2 2007

#### 1. Evaluation of the CMI

##### *Evaluation of the information products*

In February 2007, pilot group I evaluated the completion of the pilot and the roll out of the Standard Report and Portfolio Matrix with the Board of Directors. On balance, the first experiences that were positive. The pilot group was convinced of the value of this information and saw it as necessary for the future. In general, the Standard Reports and Portfolio Matrices were appreciated by medical managers because they led to major new insights into the composition of current patient groups, the interrelation between departments, the working capacity, and the required collaboration with referring physicians and other hospitals. They, therefore, definitely contributed to the substantive discussions on choices in patient care. It also turned out that the Portfolio Matrix had a good filter function in finding patient groups where specific analyses were needed. The discussions between the division chairman and the chief physicians were experienced as constructive and satisfactory and the pilot group was convinced of the importance of these discussions. In many cases, the medical specialties got more enthusiastic in the course of time, especially after they had seen the results of the analysis. Based on this conclusion, the Board of Directors decided to continue the project but also concluded that multiple improvements were needed to increase the acceptance and use of the information.

With regard to both the Standard Reports and Portfolio Matrices there were serious doubts about the quality of the data used. First, the non-system data (such as relevance scores, type of referrer, distinctiveness) were called subjective. Second, the quality of several types of system data, particularly of cost data and DBC data were considered poor. This was not surprising, because it was the first time that chief physicians were confronted with this, and certainly with the method of presentation. Explanations for the poor quality of cost data were that many chief physicians were not personally involved in the cost calculation and did not know whether they could trust them or not. The process of cost calculation consisted of a large number of steps and assumptions and therefore the costs were easily experienced as subjective and unreliable. Explanations for the poor quality DBC data were that chief physicians had hardly been involved in the registration so far (DBC data were automatically derived by algorithms as much as possible), that they had little financial relevance in a proper registration and that DBCs were perceived as part of an artificial language that did not reflect the physicians' experience. The poor quality was also due to errors in the computer systems, such as failing algorithms, incorrect linkages between care activities and DBCs and the leakage

of data. The result was that they did not recognize the reported numbers of DBCs in the Standard Report. However, it should be noted that perceptions about the quality of the data could differ from the actual quality in terms of timeliness, completeness, and reliability. Through analyses in some departments, the actual quality of the DBC data turned out to be not as bad as the (medical) managers thought. However, the fact remained that the doubts about the quality were still a major obstacle to the acceptance and use of the information and that actions on this should therefore be undertaken. Finally, there was a general need to make the collected data AMC-wide accessible so that others, such as staff advisors, could use it.

##### *Evaluation of the design and implementation strategy*

With regard to the design and implementation strategy, it was concluded that the choice by the F & C department to have the project managed corporate-wide had both advantages and disadvantages. An important advantage was the direct contact between chief physicians through which the risk of bias was reduced and the knowledge and experience in one specialty was used in other specialties. The main criticism of the project was that the business offices of the divisions were hardly involved in the project. Their involvement, however, might have been important for the coordination of their activities (e.g. preparing the annual plan) and for creating support within the organization. The F & C department made a plea for the business offices to be given a more substantial role in the next stage of the project.

The process of generating the Standard Reports and Portfolio Matrices was fairly labor-intensive. This was partly the consequence of the size of the project: it involved all clinical departments of the AMC and much data had to be collected, checked, and aggregated. This was the result of the fact that many departments (because of their knowledge and experience) were consciously given freedom in the composition of the patient groups, but as a consequence the process was not easy to standardize. Furthermore, the distribution of reports led to many additional questions and further analysis. In the process only a few employees of the F & C department and the ICT department were involved, which made the process vulnerable.

#### 2. Process design

Based on the evaluations the CMI project management planned a number of actions for the further design and implementation of the CMI. First, the quality of the information products had to be increased; second, in order to increase the accessibility of the data, a Data Cube had to be designed in Cognos by the ICT Department, containing the system and non-system data as reported in the Standard Report and Portfolio Matrix. This would mean that the data could be retrieved by anyone who had access to Cognos.

These actions had to take place with the help of a new pilot group. The pilot had to be finished by May 2007 so that the information products could be used again for the support of the medical managers in the preparation of the annual plans and the information could be integrated in the regular Planning & Control cycle by monitoring developments in the quarterly management reports. Finally, the F & C department would investigate for what other purposes the information products could be used.

### 3. Object design

#### *Design of the information products*

The Standard Report Patient Care was improved in several ways. The report was extended with several types of system data. The volumes of DBC trajectories of the previous years were added to make volume trends visible. Further, several data with regard to (scarce) capacity were added, such as the number of outpatient visits, nursing days, surgery hours, and MRIs, because these were considered as relevant when making and defining the annual plans. Also, the quality of the cost and DBC data was improved in several medical departments. Furthermore, a Data Cube in Cognos was designed by the ICT department. The Data Cube contained the same information as the Standard Report that was generated in Excel.

#### *Design process*

As in 2006, the further design of the Standard Report took place through a pilot group (pilot group II)<sup>12</sup>. The pilot group revised the minimal dataset again and examined if the non-system data could be replaced by system data to make the data quantitative and more objective. This was mainly possible for the capacity data. Further, the quality of cost data and DBC data was reviewed. This led to several findings such as that for many essential procedures no costs were calculated, many procedures were not linked to a DBC, and wrong diagnoses were registered. As a result, several assumptions in the cost calculation process were adjusted and general improvements were made including better technical links between the cost and DBC. Furthermore, several causes were identified for the poor registrations, such as the lack of central guidelines, a lack of discipline at medical specialties, a lack of proper systems and time, and the absence of urgency. The problems with the quality were so huge and urgent that they were arrested AMC-wide. The F & C department gave several suggestions to the Board of Directors for how to tackle this, for example by increasing the link between DBC registrations and internal budgets, the definition of a policy with regard to the registration of DBC data,

<sup>12</sup> Pilot group II consisted of chief physicians of Gastroenterology and Hepatology, Throat-, Nose- and Ear disorders, Orthopedics, Ophthalmology, Nuclear medicine and Gynecology. They were selected on basis of estimated willingness, scope and nature of the department. In addition, director operations, a nursing director and member of the directorate Patient Care board were invited. In total, 14 people participated in the second pilot group.

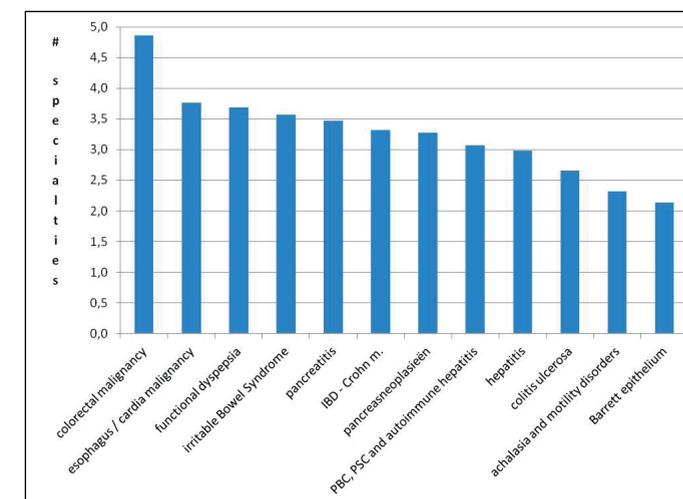
involvement of the chief physicians in the process of cost calculations, and to further analyze the DBC data in cooperation with business offices of the divisions.

#### *Exploration of new applications of the information products*

The F & C department explored new applications of the Standard Report and Portfolio Matrix in cooperation with head nurses and the chief physician of the medical specialty Gastroenterology. The *head nurses* examined which data could be used to determine the short and long-term volume of nursing staff. As a result, it was decided to add data to the minimal dataset which might be predictive of needed nursing care and to make it useful for planning, such as data with respect to the age and health condition of the (surgical) patient.

With the help of the chief physician of the medical specialty *Gastroenterology*, it was investigated how the multidisciplinary of patient groups could be determined. This specialty needed this insight because the more medical specialties and specialists were involved in a short time, the more risk of miscommunication there was. On the basis of the DBC data, it turned out to be possible to determine the number of different treating medical specialists per patient group (see Figure 5.3) and to determine where actions were needed to reduce the risk of miscommunication. As a result of this exploration, it was decided to appoint a case manager and a nurse practitioner for the high risk patient groups and to organize multidisciplinary meetings for them. On the basis of this pilot it was also decided to add the number of treating specialists per patient group to the Minimal Dataset.

**Figure 5.3: Number of medical specialties involved per patient group, medical specialty Gastroenterology**



#### 4. Implementation

In 2007, the case-mix information was used in several ways by means of the Standard Report Patient Care, the Portfolio Matrix, or directly from the data warehouse.

##### *Annual plans*

In August 2007, the improved Standard Reports and Portfolio Matrices were updated by the F & C department and sent to all medical specialties, business executives, and the Board of Directors to support them in the preparation of the annual plans for 2008. An explanation of the data was added. As in 2006, the medical specialties were asked to define the desired volumes per patient group. Now, they also had to motivate them and to explain how these volumes could be realized. Also, criteria for making case-mix decisions were specified by the Board of Directors, such as ensuring the continuity of the core tasks and connecting choices to the expertise of personnel and the demand for care. By improving and updating the cost data, the financial results for several patient groups were very different from the results in the previous year. For example, the overall negative financial results for the surgery department increased substantially because the rate of kidney transplants was reduced and the cost of the blood products were now included in the DBC. The F & C department tried to explain the differences where possible, but in many cases the differences were due to differences in the DBC product structure or calculation model. Because of this, several of the medical managers became more suspicious about the data in spite of the efforts to improve its quality.

##### *Monitoring expected versus desired volumes*

During 2007, all medical specialties were asked to explain the relevant deviations between the expected and desired volumes. They received a table with the number of DBC trajectories per patient group for the years 2006 and 2007, see Table 5.5:

**Table 5.5: Example of monitoring volumes of the Otolaryngology department (\*)**

Patient group	# DBCs 2006	# Expected DBCs 2007	Mutation in 2007 relative to 2006	Desired volume	Explanation of the deviation
Children's otolaryngology	1.231	1.013	-18%	Stable	
Otology, audiology	2.310	2.413	4%	Increase	
Mucosal path. v. nose and sinuses	1.134	1.069	-6%	Increase	
Nose Surgery	436	458	5%	Stable	
Maxillofacial surgery exc. nose Surgery	472	447	-5%	Increase	
Acute ENT	504	439	-13%	Decrease	

(\*) Table contains fictitious data

This was the first time that medical specialties had to report on the *volume of patients*, rather than on budget parameters. The medical specialties reacted that the numbers were not recognized, and in general were too low. Further investigation revealed that the data regarding a large number of DBCs were not yet complete and therefore were not included in the information products.

##### *Alliances with other healthcare providers*

Several medical specialties had used the information to discuss possible cooperation with other care providers, for example, to transfer basic care to general hospitals. For these discussions, data about volume, capacity, the healthcare market, and finance were useful.

##### *Process optimization*

The information was used for process optimization in several ways. The head nurses used the information to measure the intensity of care per nursing department and determine trends in the demand for care. The department of Quality Process and Innovation used the data to analyze the pathway for a specific patient group of the gynecology department and defined standard clinical pathways.

##### *Negotiations with health insurers*

In the context of the negotiations on price, volume, and quality of the B-list DBCs, and using data from the data warehouse different analyses were made by the F & C department, for example the cost/selling prices ratio by DBC, determining market shares and top referral care.

##### *Internal Review Committee*

The Standard Report Patient Care was also used by the Internal Review Committee to discuss with medical specialties about their policy with regard to patient care and to gain insight into the actual waiting times compared to the standards, to define what actions were needed, and how these would be monitored.

##### *External legitimization*

The data from the data warehouse were used in various ways for external legitimization purposes, for example to define the percentage of top referral care in the annual account and to influence the rate of the A-list DBCs.

### 5.3.3 2008

#### 1. Evaluation of the CMI

##### *Evaluation of the information products*

In 2008, the CMI was again evaluated by the F & C department (AMC, 2008). It was concluded that the quality of the data and the classification of patient groups had improved and that the use of the information had increased. The greatest value of the instrument still lays in the fact that the language of patient groups appeared to be useful for management, the relevance of the financial and non-financial information for decision-making, and the presentation of the information in just a few pages and figures. However, in discussions between F & C and medical specialists there were still a large number of users who doubted the quality of the data. An additional problem was that the financial data could vary dramatically per year, for example by changes in the DBC-registration, cost calculations, and DBC rates. The fluctuations were not understood by the chief physicians. Also, the estimated costs included the costs for top referral care and were about 25% higher than the revenues of the DBC trajectories, because the DBC tariff did not cover these additional costs (see Section 2.7). This was discouraging for the medical specialties, because they had the perception that they generated financial loss for the AMC whereas they worked hard. Furthermore, many medical managers still had little knowledge about the DBC structure and therefore did not recognize the data. Finally, several chief physicians indicated that they had insufficient knowledge and skills on how they should deal with priority issues and how the Standard Report and Portfolio Matrix could be used for decision making. Moreover, they found it difficult to really implement choices into practice.

##### *Evaluation of the design and implementation strategy*

The process of generating the Standard Reports Patient Care and Portfolio Matrices was still fairly labor-intensive and error sensitive. It still took a lot of effort to generate the Standard Reports and Portfolio Matrices for all medical specialties and accordingly to check and send them. The result was that the medical specialties did not receive the information until August and for several departments this came too late, because they had already started drawing up their annual plans in the summer.

#### 2. Process design

Given the fact that in the AMC one was generally convinced of the usefulness and necessity of the CMI and the fact that the information was already used for many different purposes, it was decided to continue 'full swing' with the CMI project. First, several actions were defined to further improve the quality of the data. An external audit

would be carried on the process of calculating unit costs and the unit cost themselves would be validated. Furthermore, the key assumptions in the calculation of unit costs would be checked with the medical specialties and the additional costs for top referral care would be excluded in future calculations. Also, several projects were started AMC-wide to improve the DBC registration. Second, it was decided to carry over the entire process of generating the case-mix information from the F & C department to the IT department.

In this context, the F & C department instructed the IT department to design the following information products in Cognos: the Standard Reports, drill-through reports, Portfolio Matrices, and the 'Intranet Page Management Information Patient Care'. The aims of this were to increase the accessibility of the information for users including underlying details, to accelerate and standardize the process of generating the information products, to make the quality of the process more secure, and to update the information more frequently so developments in the patient groups could be better monitored. An external auditor and an employee of the Internal Auditing Department became involved to ensure that the design process would comply with external audit requirements related to transparency, accountability, and documentation. Third, the case-mix information would be further embedded in the regular Planning & Control cycle by using it for the assessment of the annual plans by the F & C department. Fourth, training would be organized by chief physicians to increase the knowledge and skills in using the case-mix information. Finally, other measures that were desirable or necessary to increase the acceptance and use of the CMI would be identified at specialty level. In this context, it was decided that in addition to the regular evaluations, an extensive *interim reflection* among chief physicians, division managers, and central managers had take place to reflect extensively over a longer time period and gain contemplative knowledge about several topics. Hereby all people in the target group were requested to give their opinion on the project instead of just the people from the pilots, creating a more representative picture. The interim reflection took place after the drawing up of the annual plans, see Section 5.4.

#### 3. Object design

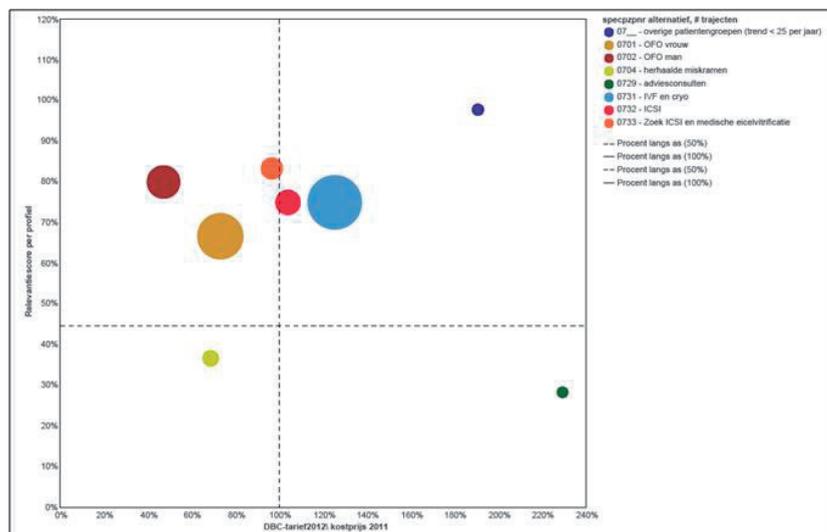
##### *Design of information products in Cognos*

In 2008, the Standard Report Patient Care and the Portfolio Matrix were designed in Cognos. The Standard Report became available in Cognos and was a digital version of the report which had been earlier generated in Excel. The main advantages for users were that they could retrieve their Standard Report at any time (and also that of other medical specialties), that the quantitative data were updated weekly, and that it

became possible to drill-down to the underlying data with ‘drill-through reports’<sup>13</sup> to get a deeper understanding about the sources of the information used in the analysis. Two types of ‘drill-through reports’ had been designed consisting of (a) *core data per DBC trajectory* and (b) *care activities per DBC*. The drill-through report ‘Core data per DBC’ contained the most relevant data for the selected DBCs such as: DBC ID, patient number, diagnosis, and use of capacity, costs, and returns (see also Section 7.4). This report could be exported to Excel and further analyzed. The drill-through report ‘Care activities per DBC trajectory’ could be retrieved by clicking on a specific DBC ID in the drill-through report core data per DBC and contained data about the executed care activities such as: type of care activity, volumes, producing department and related costs. This report gave detailed insight on the composition of the total costs.

The Portfolio Matrix became available in Cognos and was a digital version of the Portfolio Matrix which had been previously distributed on paper (see Section 5.3.1, Figure 5.1). In Figure 5.4, an example of a digital Portfolio Matrix of the medical specialty Reproductive Health is shown. The advantages of this digital version were that these analyses were generated automatically, the financial data were updated weekly and users were able to drill down to the underlying data when clicking on the bulb of a specific patient group.

Figure 5.4: Digital Portfolio Matrix in Cognos, medical specialty Reproductive Health (\*)



(\*) Figure contains fictitious data

<sup>13</sup> A drill-through report is a report with detailed data that can be retrieved by clicking on a specific patient group.

#### Design of an Intranet Page Management Information Patient Care

An Intranet Page called ‘Management Information Patient Care’ was designed. This Intranet Page contained a selection menu by which the Standard Report Patient Care could be downloaded by selecting a specific medical specialty. The Intranet Page also contained background information about the project regarding ten frequently asked questions that included: what are the aims of the case-mix information, what data sources are used, and how are the costs and returns of patient care determined? The aim was to share basic knowledge from the F & C department about several topics (such as finance, negotiations with health insurers, and the health care market) in an efficient way, and to be transparent.

#### Improvement of the quality of the data

Several adjustments were made with regard to the cost calculations, both in the process of cost calculations, and the refinement of assumptions at several medical departments. As planned, the costs for top referral care were excluded. In this context, agreements were made with the Dutch Health Care Authority (NZA) and other university medical centers (UMCs) on the way of doing this. In summary, it was assumed that the cost for top referral care was equal to the academic budget and these costs had to be excluded from the costs of a limited set of care activities, such as outpatient visits and nursing days.

#### 4. Implementation of the CMI

##### Implementation of the information products

Those who previously received the Standard Report and Portfolio Matrices on paper were automatically authorized for Cognos. Authorization was given to: the Board of Directors, division managers, chief physicians, business managers, employees of business offices and F & C department. If other employees wanted access to Cognos, written permission from the director of operations was needed.

##### Use of the information products

In July 2008, the Standard Reports and Portfolio Matrices were sent to the medical specialties in order to support them again in defining their annual plans for 2009. As in 2006 and 2007, the medical specialties were asked to define in their annual plan the desired volumes per patient group and how they thought to realize this. The Board of Directors defined on what criteria the proposals would be evaluated, such as: whether it belonged to the areas of focus, the relationship between costs and revenues, demand for capacity, and regional cooperation. The divisions’ annual plans were assessed by the F & C department. They concluded that almost all divisions had defined their policy more explicitly than in previous years. Possible explanations for this were that the Board

of Directors had appointed priority areas already in advance, which gave direction to the prioritization of the divisions and the awareness of divisions to make critical choices due to increasing market pressure and capacity constraints. There were no defined priorities that seriously conflicted with the AMC objectives and there were no major inconsistencies between divisions. Because the divisions had defined the desired volumes for each patient group, an estimate of the impact of choices could be made based on the available underlying data, for example, with regard to required capacity and money. Based on this analysis, it was concluded that no capacity problems would arise if these plans were realized.

#### User trainings

The F & C department held two training sessions for medical managers, focusing on making policy decisions on the basis of case-mix information. In total, about 30 managers participated. During this training, the types of available case-mix information and how this could be used for their practice was demonstrated.

#### Dutch press

In 2008, in Dutch national newspapers several articles were published about the CMI project at the AMC, see the headlines below. This demonstrates that at that time the AMC was a forerunner with respect to making explicit case-mix decisions by means of this information and the identification of the cost of care at detailed level.

'AMC starts to select patients' (Volkskrant, 2008)



'What does an appendectomy cost?' (Trouw, 2008)



## 5.4 Interim reflection on the CMI project

At the end of 2008 an interim reflection on the project took place to reflect extensively over a longer period of time and gain contemplative knowledge about several topics.

#### Selecting participants

To obtain the maximum number of respondents and a good representation of the different medical specialties and divisions of the AMC, all chief physicians, division managers and central managers, were asked to participate in the interim reflection; 36 managers in total. Eventually, 35 managers participated in the study, consisting of 22 chief physicians, 7 division managers and 6 central managers<sup>14</sup>, see Table 5.7.

#### Survey and interviews

The reflection took place by means of a survey using an extensive questionnaire, followed by semi-structured interviews. The participants completed the *questionnaire* consisting of a mix of open and closed questions. Depending on the content of the closed questions, participants were asked to fill in their answers using multiple choice categories, seven or ten point Likert scales, or rank answer categories on their relevance. The questionnaire was sent electronically to the (medical) managers. Separately, two appendices were sent to them: a current Standard Report Patient Care for the specific entity of the respondent (AMC, division or medical specialty) and a Portfolio Matrix. The questionnaires for chief physicians and division managers were the same; there were only some textual differences: in the questionnaire for the chief physicians there was reference to their departments; in the questionnaire for the division managers there was reference to their divisions. These questionnaires consisted of 126 items. For the questionnaire for the central managers, some questions were omitted, for example with regard to the affinity with management and detailed questions about the information products. This questionnaire consisted of 88 items. Participants had three weeks to respond. During and after that period, several emails were sent to the people to remind them about the deadline.

The *semi-structured interviews* were conducted by the researcher (FA) and took place through one-on-one meetings with managers and lasted about one hour. During the interviews, the following key topics were discussed in-depth: the background of the manager, experience of institutional pressure, the influence of actors on the case-mix, the case-mix decision-making process, the CMI, and conditions to make the CMI successful. These topics were selected, because according to the literature research and on

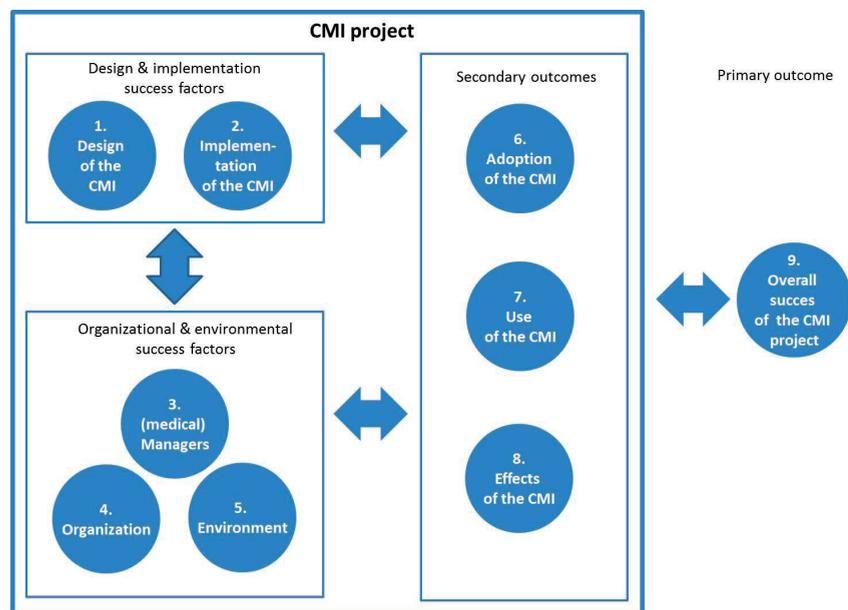
<sup>14</sup> The central managers consisted of three members of the Board of Directors, one director Staff Office of the Board of Directors, one director Patient care, and one Managing Director in charge of corporate-wide projects.

the success of the CMI. We extensively discussed the case-mix decision-making process, because we considered this as the most relevant, but also the most complex phase of the strategic management cycle to be supported by the CMI. The interviews also focused on specific pronounced results of the survey. At the beginning of the interviews, the confidentiality of the results was explicitly discussed and the managers were assured that the results would be anonymized. All the interviews were tape recorded.

*Research variables*

In the questionnaires, a distinction was made between the potential success factors and outcomes (Figure 5.5). The *success factors* consisted of design and implementation variables, organizational and environmental variables (managers, organization, and environment). All variables were selected on the basis of the literature search (Chapter 3) and on gained practical knowledge during the regulative cycle. The *outcome variables* focused on the adoption, use and effects of the CMI, as well as the respondents' perceived overall success of the CMI project. The 'overall success of the CMI project' was selected as the primary outcome measure, because 'success' was considered a general reflection of the various (interacting) success factors and outcome measures (in terms of use, and effects of use, of the CMI).

**Figure 5.5: Success factors and outcome measures examined in the interim reflection**



*Data analysis*

Survey data were analyzed using simple descriptive statistics. In view of the explorative nature of this interim reflection, the important focus on the qualitative data collected during the interviews, and the relatively small sample size, we did not perform formal statistical testing on score differences. Neither did we pay statistical attention to the impact of the success factors on their outcomes as we felt that at that moment in time the information products were too premature and that the period of use was too short to draw firm conclusions about possible associations.

**5.4.1 Results: verification of the assumptions made in the design of the CMI**

A number of assumptions were made in the design phase of the CMI. These assumptions were based on the literature (Chapter 3), the experiences from earlier pilot studies, and interviews with several managers. In Table 5.6, there is a summary of which assumptions were verified and what the findings were.

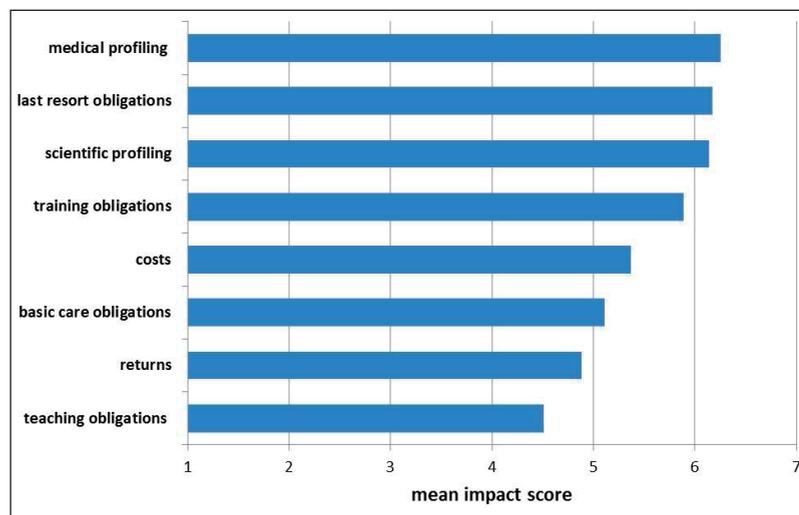
**Table 5.6: Overview of the assumptions in the design process**

N.	Research variable	Assumption	Summary of findings
1	Design of the CMI	The case-mix has a large impact on the performance in core tasks and funding.	The assumption was largely shared by the respondents; only the impact of the case-mix for the core task education and returns was rated relatively low.
2	(medical) Manager	The target groups are the key decision-makers with regard to the case-mix	The assumption was largely shared by the respondents. In addition, chief physicians and staff members could be considered as key decision-makers and there were several actors who influenced the case-mix in a more indirect way, like referrers, and insurers.
3	(medical) Manager	The target groups are able to manage their case-mix.	The assumption was partly shared by the respondents. Some managers experienced severe hurdles to manage their case-mix, because of their type of patients and the imposed budgets.
4	(medical) Manager	The target groups have much decision power within the organization.	The assumption was partly shared by the respondents. Several chief physicians indicated that their power was relatively limited, because they had no direct influence on the budgets and on specific costs, like staff and investments.
5	(medical) Manager	The chief physicians are primarily responsible for the medical and financial policy.	The assumption was largely shared with regard to the medical policy, but to a lesser extent with regard to the financial policy.
6	(medical) Manager	The target groups feel the need to change the way of making case-mix decisions.	This assumption was partly shared by the respondents. Several respondents indicated that because of increasing competition and financial pressures, they were willing to make decisions in a more rational and explicit way. Other respondents were satisfied with their way of decision-making and felt no urge to change this.

**Assumption 1: The case-mix has a large impact on the performance in core tasks and funding**

The principle of ‘putting the patient at the center’ of the decision-making processes of managers and supporting information system had already been applied in the pilot ‘Patient Care Profiles 2002 - 2005’ and had also been a key element in the design of the CMI since 2006. This principle was also used in the strategic aims for 2006 to 2011 (see Section 5.2) and was based on the assumption that the case-mix had a large impact on the performance of core tasks (patient care, research, education, and training) and money (costs and returns). The respondents largely shared this assumption (see Figure 5.6, survey results).

**Figure 5.6: Impact of patient groups on core tasks and finance AMC total (N = 35\*)**



(\*) Participants were asked to indicate the extent to which the case-mix of their department or division has an impact on the performance on the core tasks (patient care, research, training, education) and money (costs, returns). Level of impact was scored on a 7-point scale, varying from 1 (no impact) to 7 (much impact). More detailed analysis of the data is available on request.

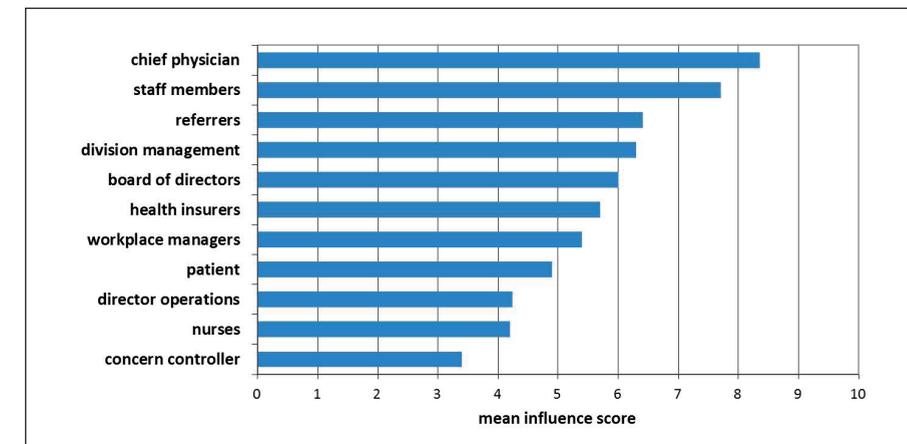
The survey results (Figure 5.6) showed that the case-mix had a profound impact on both the performance in core tasks and finance (median of the average impact scores = 5.6). The case-mix tended to have somewhat more impact on their costs (mean = 5.4, SD = 1.6, median = 6.0) than on their returns (mean = 4.9, SD = 1.7, median = 6.0). This is probably explained by the fact that the budgets of the medical specialties were not based on the invoiced DBCs, but still on the historic budgets that were determined by the F & C department. Furthermore, the impact of patient groups on teaching (mean =

4.5, SD = 1.5, median = 5.0) was perceived as lower compared to the other core tasks.

**Assumption 2: The target groups are key decision-makers with regard to the case-mix**

This assumption was based on the pilot in 2006 and interviews with several managers and matched with the management principle of ‘professional in the lead’ (see Section 2.8) where the medical professionals were expected to make the appropriate decisions, based on their knowledge and involvement in the primary process. The assumption was largely shared by the respondents with regard to the chief physicians and staff members (Figure 5.7, survey results).

**Figure 5.7: Influence of actors on the case-mix in the AMC (N = 34\*)**



(\*) N = 1 missing. Participants were asked to indicate the extent to which a number of predefined actors have influence on the case-mix of their medical department/ division. Level of influence was scored on an 11-point scale, varying from 0 (no influence) to 10 (much influence). More detailed analysis of the data is available on request.

During the interviews there was discussion on how the different actors could have an influence on the mix of patient groups. *Chief physicians* and *staff members* were clearly considered as key decision-makers. Chief physicians had the most influence on case-mix decisions because of their hierarchical position and expertise. Also staff members had a lot of influence on the case-mix because part of their patient population was related to their specific field of clinical expertise. *Division managers* had a key position between the medical departments and the Board of Directors. The division management got the budget and therefore had the means to allocate it. They also assessed the annual plans of the medical departments. In general, the division management was not directly involved in case-mix decisions, only when the budgets were exceeded.

The opinions of the respondents about the influence of the *Board of Directors* on the mix of patients varied. Some argued that they had little influence because they didn't select and treat the patients. Others argued they had much formal power because they had to provide the facilities, agreed with infrastructure investments and staff expansion, defined the core areas, and appointed loyal division managers and financial managers. Some had the feeling that much was decided for the medical specialty by the Board of Directors. *Referrers* could influence the case-mix, for example by referring patients because of specific expertise or reputation. *Health insurers* had several instruments to influence the case-mix of the AMC. They could, for example, determine the maximum growth rate, define minimum levels for a specific patient group, and decide whether to contract patient groups or not. Furthermore, they had their own policy / key areas where they wanted to profile themselves. The influence of *nurses*, the *director of operations* and the *concern controller* on the case-mix was considered as relatively limited.

**Assumption 3: The target groups are able to manage their case-mix**

The selection of chief physicians, division managers, and central managers as the primary target groups of the case-mix information system was also based on the assumption that they were able to actually manage the case-mix. The validity of this assumption was discussed during the interviews. This assumption was partly shared. Several managers indicated that the space for case-mix decisions was limited due to several reasons. First, many choices had already been made in the past and had attracted staff with specific knowledge and skills for that reason. One could not easily decide to start something completely different. See, for example, the quotation below:

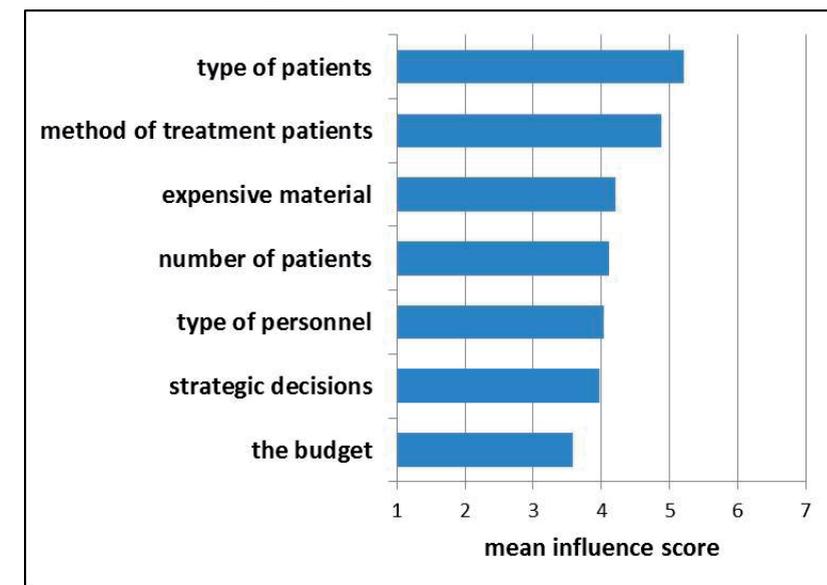
In your questionnaires there are some assumptions which do not reflect reality: (1) that medical specialties are like sailing boats that can react quickly on developments and (2) that policy can be changed by making this information available. On the contrary: developments are not so spectacular and space for choices is limited. At least 80% of what one is doing is determined and is 'business as usual'. Our department is more like a tanker. (Chief physician)

Second, the volumes of patients were strongly determined by the available (historical) budgets and capacity, which were very constant and did not enable significant changes in the case-mix. Third, it appeared that the characteristics of medical specialties had impact on the use of the case-mix information. For example: medical specialties with a high percentage of emergency patients or chronic patients indicated that their possibility of managing their case-mix was limited and therefore their need for case-mix information was also limited. Fourth, some specialties, such as Plastic Surgery and Radiology, were (mainly) supporting portal specialties and had no, or little, influence on the case-mix.

**Assumption 4: The target groups have much decision-making power within the organization**

Another assumption was that the defined target groups were not only the key decision-makers because of their function, but that they actually had much decision-making power within the organization. The assumption was partly shared by the respondents (Figure 5.8, survey results).

Figure 5.8: Extent of influence per topic (N= 34\*)



(\* N = 1 missing. Participants were asked to indicate the extent to which they have influence on a number of predefined topics on a 7-point scale, varying from 1 (no influence) to 7 (much influence). More detailed analysis of the data is available on request.

This figure indicates that the managers had most influence on type of patients (mean = 5.2, SD = 1.4, median = 5.5) and methods of treatment of patients (mean = 4.9, SD = 1.5, median = 5.0). The managers seemed to have relatively less influence on the budget (mean = 3.6, SD = 1.9, median = 3.0), probably because the budget was still determined by historically defined budgets, and not on the DBC revenues. During the interviews, it turned out that the managers also had limited influence on the cost, see the quotation below. Concerning costs and returns, the target groups lacked some decision-making power, for example with regard to the appointment of staff (at the nursing department or outpatient clinic), expensive materials, and making investments.

They also had no direct influence on the budget, since the budget was still determined by historically defined budgets, but not on the DBC revenues.

We have no influence on the budget because we don't negotiate with the insurers. Also we have no influence on new machines, like a laser. You have to write a business plan, but we are no business plan writers, we are medical specialists. We have little influence on outpatient clinic staff, nurses, administrative staff, desk staff, et cetera. It is a big frustration for us because patients are not kindly assisted at the desk. (Chief physician)

**Assumption 5: The chief physicians are primarily responsible for the medical and financial policy**

It was assumed that chief physicians were responsible for the medical policy and finance of the medical departments. The assumption was largely shared by the respondents with regard to the medical policy (mean = 6.6, SD = 0.8, median = 7.0), but to some lesser extent with regard to the financial issues (mean = 5.4, SD = 1.2, median = 5.0). Survey results are presented in Figure 5.9.

Figure 5.9a: Medical responsibilities (N = 35\*)

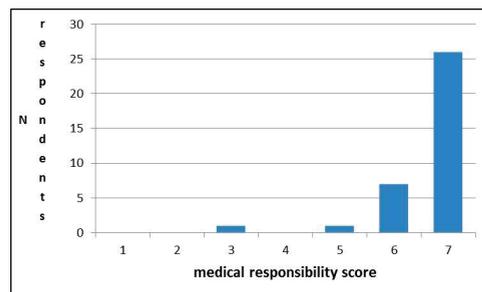
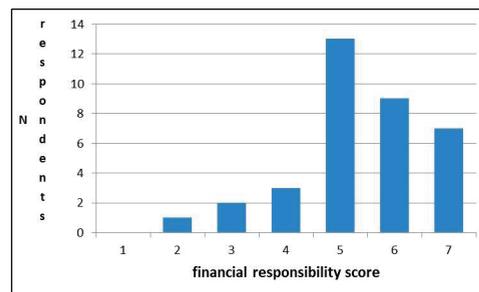


Figure 5.9b: Financial responsibilities (N = 35\*)



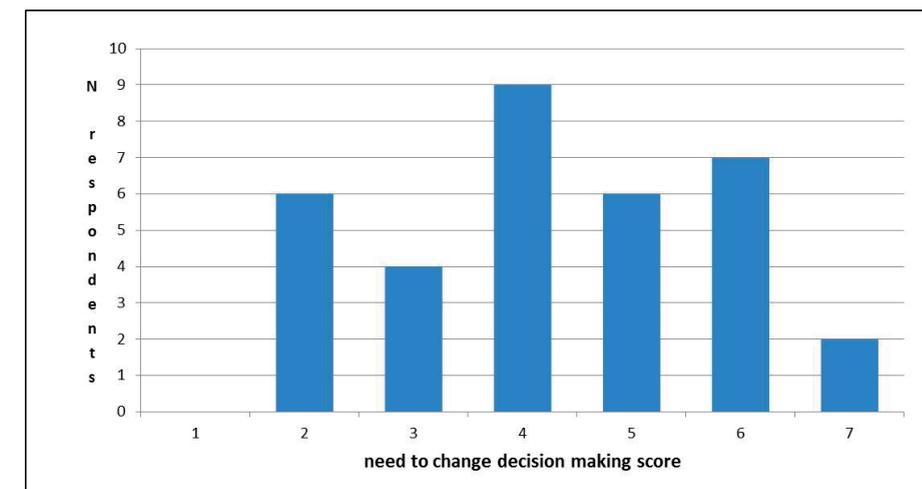
(\*) Participants were asked to indicate the extent to which they agree with the statement that it is right that the medical responsibility and financial responsibility has been assigned to the chief physicians. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

This result was further discussed during the interviews. All target groups thought that the chief physician was primarily responsible for medical policy, but the opinions of the financial responsibility varied. Some thought that the chief physician was responsible for finance; others thought this was the responsibility of the director of operations. The reason for this lack of clarity was probably that there were no clear job descriptions of chief physicians with committed tasks and responsibilities.

**Assumption 6: The target groups feel the need to change the way of making case-mix decisions.**

This assumption was based on the expectation that, because of the increasing competition and financial pressure, the target groups would feel the need to optimize the decision-making processes and make decisions more rational, and explicit. The assumption was to some extent shared by the respondents (mean = 4.3, SD = 1.5, median = 4.0), see Figure 5.10 (survey results).

Figure 5.10: Need to change the way of making case-mix decisions (N = 34\*)



(\*) N = 1 missing. Participants were asked to indicate the extent to which they agree with the statement that they feel the need to change. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

This result was further explored during the interviews. Frequently mentioned arguments in favor of this assumption were that many case-mix decisions were irrational, personal, unstructured, labor intensive, and debatable. Also the increase of competitive pressures and financial pressures were seen as arguments for changing their way of making decisions, see the quotation below:

It is necessary to change our way of decision-making because we still are not given the facilities to realize our core areas. We want everything but don't make choices. We never decided that we can't do everything. (Chief physician).

On the other hand, several respondents indicated that they were satisfied with their way of making case-mix decisions and they felt no urge to change this. Another argument was that, the AMC was considered as a rather political organization where many decisions were taken implicitly without using (hard) criteria or information, by ‘wheeling and dealing,’ and this would not change. Some wanted to keep it that way, for example, because it gave them freedom, others wanted to change this because they believed that this would improve the decisions and would create more equal opportunities for everybody.

#### 5.4.2 Results: reflection on the design and implementation factors

The design and implementation success factors related to [1] the design and quality of the CMI and [2] the implementation strategy (see Figure 5.5).

##### 1. Design of the CMI

###### *Quality of the case-mix information system*

Participants were asked to assess the quality of the different types of information in the Standard Reports and portfolio analyses with regard to relevance, reliability, detail, and presentation (Figure 5.11, survey results).

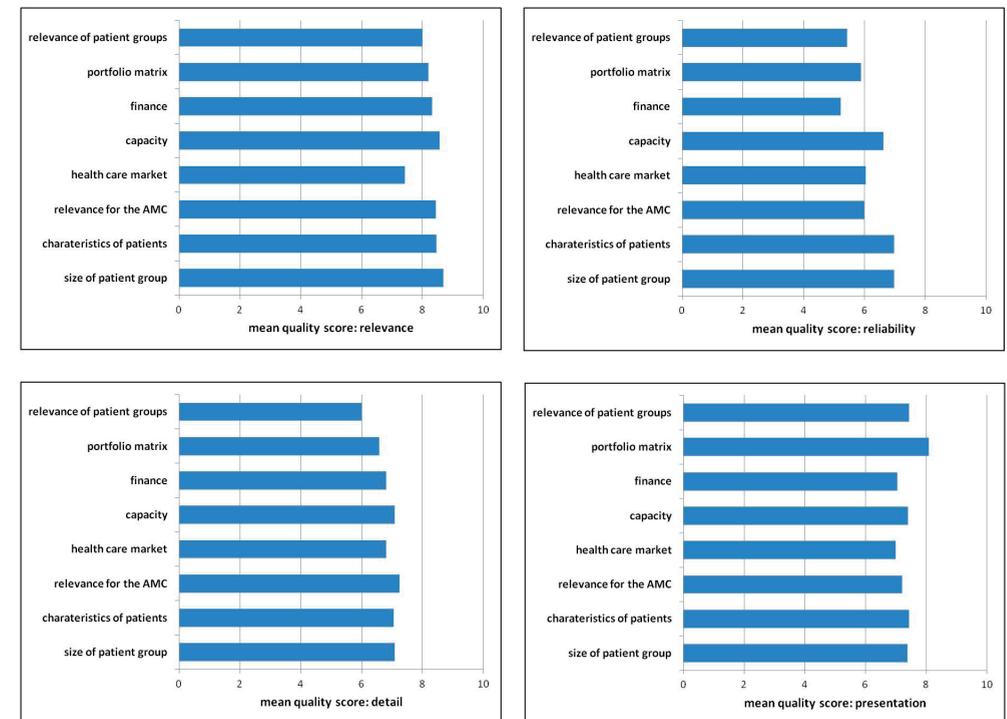
All presented types of information were considered relevant (median of the average relevance scores = 8.4), whereas the degree of detail (median of the average detail scores = 6.9) and presentation (median of the average presentation scores = 7.4) were generally rated as sufficient. However, the reliability of the CMI was judged more critically (median of the average reliability scores = 6.0). This matched with earlier findings by the pilot groups.

With regard to the DBC data, it was concluded that these data appeared to provide good opportunities for the design of the CMI. The DBC data gave insight into the type of care, such as the type of diagnosis or treatment. This was useful for the dialogue about the care provided and for the classification and valuation of patient groups.

The choice to have the patients classified into groups by the chief physicians was also supported by most medical managers, because it was consistent with the language of medical departments and with the strategic aims. Because of this, it became possible to define medical policy per patient group and to translate it in terms of volumes, capacity, and money. In other words, medical policy, logistical, and financial policy became connected. This was a strong improvement with respect to the previous instrument ‘*Patient Care Profiles*’. However, for some medical specialties the DBC product structure

did not represent the complexity of academic care enough. Additional data were needed.

**Figure 5.11: Quality of types of case-mix information (N = 26\*)**



(\*) N = 9 missing. The high non-response was partly due to the fact that respondents found it difficult to assess the actual quality of the CMI. Participants were asked to assess the different types of information with regard to relevance, reliability, detail, and presentation on an 11-point scale, varying from 0 (very poor quality) to 10 (excellent quality). More detailed analysis of the data is available on request.

to classify the patient groups, such as the AMC-diagnoses, a patient’s age, and specific medical procedures. Furthermore, several respondents doubted the quality of the underlying DBC data, partly due to the DBC system itself, partly due to the poor quality of the DBC registration, see the quote below.

The DBC-data are the ‘Achilles heel’ of the system, since they are not properly registered. The figures are insufficiently mature to make choices on. (Central manager)

With regard to the DBC system, the problems related to the fact that the DBC was considered by most respondents to be an artificial and administrative language, derived

from complex (accounting) algorithms that did not reflect the experience and language of the target groups. As a result one found it difficult to make the switch to this new language. So, these data were not recognized and understood by the (medical) managers and easily gave the perception that they were not reliable. Furthermore, the DBC related to the entire care process and could pass several medical departments and several calendar years. However, this did not match with the other regular management reports that were used internally (for example, with regard to finance or HR) where information was presented per medical specialty and per calendar year. In this way, the CMI was a stand-alone project. Another disadvantage mentioned was that the case-mix information gave a too simplistic view of reality.

If someone does not immediately recognize his or her activities in the Portfolio Matrix, then they feel they do not even exist. (Chief physician)

In my specialty, there exist hundreds of ICD codes, whereas in DBC language these are reduced to only two groups. So the doctor does not recognize it. (Chief physician)

Furthermore, the national DBC product structure and related tariffs (A-list DBCs) could change substantively per year, which made the data unpredictable. It also took a long time to reach agreement with health insurers about volumes and prices (B-list DBCs) of the care products and as a result the prices became available in the CMI late in the current year. Finally, the tariffs, or the A-list DBCs, were only used for administrative purposes, and did not determine the actual returns because these returns were still based on the budget system. Therefore, the presented returns of the A-list DBCs were only virtual and users could easily draw the wrong conclusions when making decisions. This reduced the usefulness of the CMI considerably, since it was not possible to determine the financial coverage per care product or patient group. Finally, chief physicians had no financial interest in a proper registration of the DBC data, because their budgets were still based on historical budget, and not on DBCs.

We don't know if some procedures have to be registered. We get no feedback. DBC information is not considered relevant because care is largely budget financed. We miss motivation and insight. (Chief physician)

With regard to the *cost data*, the respondents' perceived problems related to the fact that the data were the result of a complex process consisting of a large number of technical steps and assumptions that many chief physicians were not personally involved in. Furthermore, the costs for top referral care had to be excluded in the cost calculations, because these costs were covered by a separate, academic budget. In this

context, agreements were made with the Dutch Health Care Authority (NZA) and other university medical centers (UMC) on the way of doing this. Because of this, the costs as presented by the CMI were no longer only a reflection of reality, but also of a political process. Moreover, the presented costs did not match with the actual costs as registered in the ledger, because in the CMI, the costs per patient group could only be approximated by multiplying the volumes of the underlying care activities of the DBC trajectories by the unit costs. By this, an over or under-approximation of actual costs was created, called the *calculation fiction*. Although this effect was inevitable, the result was that the cost data were not recognized and easily experienced as subjective and unreliable. Finally it should be noted that perceptions about the quality of the DBC and cost data could differ from the actual quality in terms of timeliness and completeness. Through analyses with some departments, the actual quality of the DBC data turned out to be not as bad as they thought. In many cases, the data proved to be (technically) correct, but the managers did not know exactly how the data were generated.

Non-system data, such as the relevance and distinctiveness of care, and relevance of patient groups, was by definition considered unreliable, since these data were personal opinions or estimations of the chief physicians and not hard facts, but soft and subjective. Chief physicians could fill in this information strategically and influence the results of the Portfolio Matrix. Although the project group realized this in advance, they hoped that the chief physicians would provide the most realistic data and that these data would be discussed with division management. However, in practice this did not happen everywhere. Some chief physicians did not take this seriously and several division managers found it difficult to discuss this with them. In that case, the non-system data were not useful and it became difficult to compare the matrices between medical specialties.

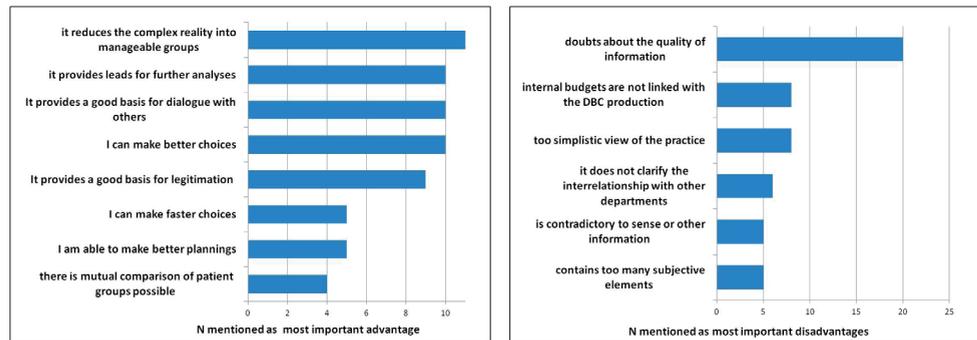
#### *Advantages and disadvantages of the CMI*

The participants were also asked what advantages or disadvantages they had experienced so far in the use of the CMI. In Figure 5.12 (survey results) these (dis)advantages are presented.

Frequently mentioned advantages of the information were that it reduced the complexity of patient care into manageable groups (compactness), provided a basis for further analyses and legitimization, formed a good basis for dialogue, and led to better decisions. These advantages were also expressed by respondents during the interviews.

In very limited time, you will quickly understand what your business looks like; you quickly learn to read this. The perspective from patient groups is very useful, so you work and think as a doctor. (Chief physician)

Figure 5.12a: Advantages of using the CMI (N = 21\*) Figure 5.12b: Disadvantages of using the CMI (N = 21\*)



(\*) N = 14 missing. The high non-response was partly due to the fact that participants found it difficult to establish direct relationships between the use of the CMI and perceived (dis)advantages). Participants were asked to indicate for a number of predefined (dis)advantages of the CMI if they had experienced them and to hierarchically rank them as: 1 most important (dis)advantage, 2 = second most important (dis)advantage, etc.

The Portfolio Matrix is interesting, as you can see how the department argues. You can understand why someone is doing something and you may or may not intervene there. You can discuss earlier in the process of decision-making or exchange of ideas instead of being confronted with the outcome afterwards. In this way, the situation gives you time to look forward so that you can start talking to each other and possibly intervene. (Central manager)

It helps in the thinking about the portfolio (why so much, why so expensive) and can be an incentive to start a conversation with a doctor. For example: why are you treating patient group X when they are not relevant and unprofitable. Doctors are intelligent people with whom you can discuss the use of resources. With the CMI you are able to show in detail how doctors deal with a medical issue and you get a tool to do something with it (this must change because everybody is doing it), Or: how many patients do you need for research? In this context it is a dialogue tool, not a decision tool. (Chief physician)

The CMI shows garbage in the registration that without it would remain. Our department looked and at the registration and found a lot of money missing. If you get money it also changes your position in the AMC. You reward yourself with a better appreciation by division directors and pay back at a later time. (Division manager)

In line with the earlier finding (Figure 5.11), doubts on the quality of the information were by far the most reported disadvantage. Other disadvantages mentioned relatively frequently were that the CMI provided a too simplistic view of the reality and it presented the situation of full (internal) DBC funding whereas this was not yet the reality. These

disadvantages were also expressed by a respondent during the interview.

The comparison of cost/ tariffs is nonsense to look at it because we are still lump sum financed. The only thing you are doing is creating fuzz. (Chief physician)

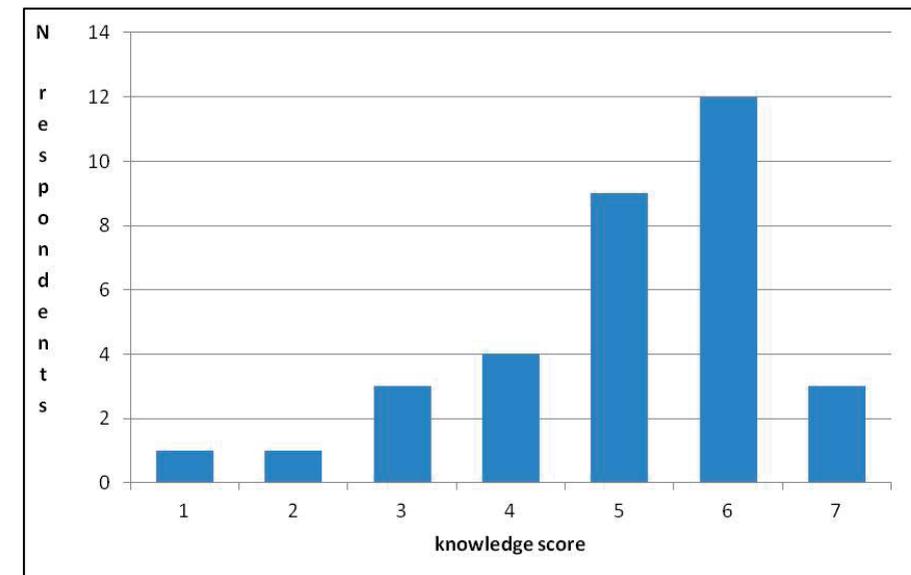
## 2. Implementation of the CMI

Participants also assessed the quality of the project organization in terms of available knowledge on implementing the CMI and the strategy used in the design and implementation process.

### The project organization

Twenty-four of the 33 respondents (73%) agreed to strongly agreed (scores  $\geq 5$ ) with the statement that the project organization had enough knowledge to implement the CMI successfully (mean = 5.0, SD = 1.4, median = 5.0), see Figure 5.13, survey results. Four respondents (12%) had a more neutral opinion (score = 4) about the project organization.

Figure 5.13: Knowledge of the project organization (N = 33\*)

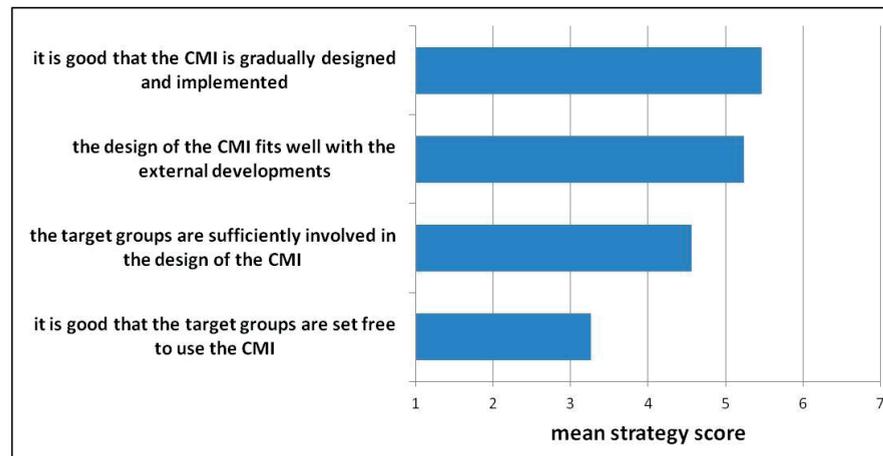


(\*) N = 2 missing. Participants were asked to indicate the extent to which they agree with the statement that the project organization has sufficient knowledge and skills to design and implement the CMI successfully. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

### Design and implementation strategy

In Figure 5.14, the participants' assessments of the design and implementation strategy are presented.

Figure 5.14: Design and implementation strategy (N = 34\*)



(\* N = 1 missing. Participants were asked to indicate the extent to which they agree with four statements about the design and implementation strategy of the project organization. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree). More detailed analysis of the data is available on request.

On balance, the strategy was assessed moderately positive (median of the average quality scores = 4.9). The participants largely disagreed with the statement that the target groups should be left free in the use of the CMI (mean = 3.3, SD = 1.5, median = 3.0). On the contrary, during the interviews, the respondents expressed the opinion that the use of the case-mix information should not be voluntary, in order to reduce the risk that people would keep using their own information system and would use the system opportunistically.

### 5.4.3 Results: reflection on the organizational and environmental factors

The organizational and environmental success factors related to the characteristics of [3] the (medical) managers, [4] the organization, and [5] the environment (see Figure 5.5).

For this research, some socio-demographic characteristics of the respondents were registered, such as sex, age, and years of experience. Furthermore, in the survey and during their interview, respondents were questioned about their management and financial knowledge and their case-mix decision making process. These characteristics

of the (medical) manager were selected because during the previous pilots (see Section 5.3) there were indications that these factors might have an influence on the success of the project.

### 3. (Medical) manager

#### Socio-demographics

The socio-demographic data of the respondents are presented in Table 5.7. Of the 35 respondents, 26 (74%) were male. Twenty-four managers (69%) were fifty years or older. With the exception of the division managers, on average the respondents had more than four years management experience. The chief physicians had the longest experience as manager and they also had a long experience as physician.

Table 5.7: Socio-demographics of the respondents (N = 35)

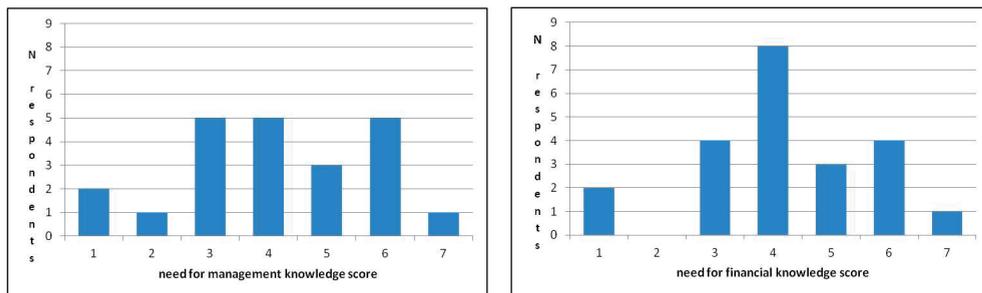
Characteristic	Chief physicians (N = 22)	Division managers (N = 7)	Central managers (N = 6)	Total (N = 35)
<b>Sex</b>				
Male	18	3	5	26
Female	4	4	1	9
<b>Age</b>				
< 40 years	0	2	0	2
40 - 50 years	6	1	2	9
50 - 60 years	12	4	4	20
> 60 years	4	0	0	4
<b>Background</b>				
Medical background	22	4	3	29
Financial background	0	3	3	6
<b><math>\bar{x} \pm sd</math> Years of Experience</b>				
as physician	21.2 (6.7)			
as (medical) manager	7.3 (4.4)	1.9 (1.2)	4.2(2.3)	5.6 (4.3)

#### Available management and financial knowledge

The chief physicians were asked to indicate whether they needed more management knowledge and financial knowledge to perform their role as manager well. The survey results are presented in Figure 5.15. With regard to the need for more management

knowledge, 9 of the 22 (41%) respondents agreed to strongly agree (scores  $\geq 5$ ) with this statement (mean = 4.1, SD = 1.7, median = 4.0). Five respondents (23%) had a neutral view (score = 4). Eight of the 22 (36%) respondents (strongly) agreed with the item regarding the need for more financial knowledge, and 8 respondents had a neutral opinion about this topic (mean = 4.2, SD = 1.5, median = 4.0).

Figure 5.15a: Need for management knowledge (N= 22\*) Figure 5.15b: Need for financial knowledge (N = 22\*)



(\*) Chief physicians were asked to indicate the extent to which they agree with the statement that they need more management knowledge (Figure 5.15a) and financial knowledge (Figure 5.15b). Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

During the interview, both topics were further discussed. Most chief physicians had followed some kind of management training, like leadership styles, financial courses, managing professionals, time management, communication, and intervision meetings, but on balance the amount of training was limited. Most considered management training as useful, but some were not so impressed and thought that one needed to have the skills by nature. Several chief physicians considered a financial course program as relevant. Some argued that this training was only useful when they had the possibility to influence costs and returns, see the quotes below.

I followed a financial training course for three days, but it was not useful. Conclusion was that if you grow in the B-list DBCs, you will receive extra money. Well, I haven't seen it. If management organizes such training sessions you expect that you get the opportunity to play with it. (Chief physician)

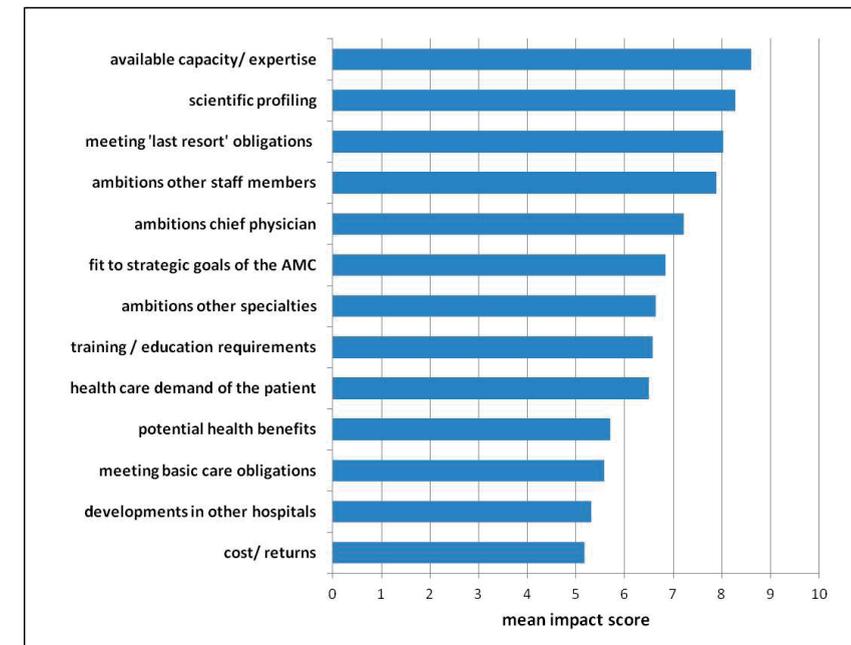
I did a financial course, but don't want to know everything. Someone explained the funding of the AMC but I thought: leave it, don't make me a financial expert! (Chief physician)

#### Relevant factors when making case-mix decisions

Respondents were asked to indicate for a number of predefined factors their impact on case-mix decisions. This question was meant to determine what type of management

information was required and to what extent this matched with the available CMI. The results could be used for the adjustment of the minimum data set and to determine whether it was necessary to customize the information products. In Figure 5.16, the survey results are shown.

Figure 5.16: Impact of factors on case-mix decisions (N = 33\*)



(\*) N = 2 missing. Participants were asked to indicate for a number of predefined factors the extent to which the factors have an impact on their case-mix decisions. Level of impact was scored on an 11-point scale varying from 0 (no impact) to 10 (much impact). More detailed analysis of the data is available on request.

The figure showed that in case-mix decisions, all factors played a role to some extent and most of them had a more or less equivalent impact (median of the average impact scores = 6.7). During the interviews, several respondents stated that many case-mix decisions were first taken intuitively and then accordingly were made rationally. The impact of factors could also change over the course of time, see the quotation below:

First we wanted to grow in basic care, especially because of financial reasons. This money was used for the core tasks of research and education. Now we focus more on top referral care. (Chief physician)

The *available capacity and expertise* was considered as the most prominent factor that determines the number and type of patients that could be treated. For example, surgical specialties are highly dependent on the available operating room and intensive care capacity. *Scientific profiling* was reported as a relevant factor too because UMCs are expected to do research and patients are the 'primary oxygen' for it. *Fulfilling the last resort obligations* was also perceived as relevant, because UMCs are the last option for patients with severe and non-routine diseases. The *expertise and ambitions* of chief physicians, physicians, and nurses determined what kind of patients could be treated, because they are the most important actors in the hospital and therefore have much power when making policy plans.

Doctors in the UMCs don't work for the money but for intellectual challenges and work pleasure. You get that by working with patients you are interested in. If you skip that you are losing the fundament of the department. (Chief physician)

Although *the fit to strategic goals* of the organization were considered as relevant, most respondents stated during the interviews that these goals were not very well known and too generally formulated. This made it difficult for them to translate these to their own policy. *The health care demand*, which is determined by several factors like socio-demographics, technology, etc., was mainly found relevant for long term planning. Meeting the *training and education requirements* was also found sufficient relevant, because these are the core tasks of an academic center. However, these obligations are often not so directly connected with specific patient groups but more with the total delivery of care. Furthermore, as stated by the respondents, this core task seemed to have less impact compared to complex patient care and research. *Potential health benefits* were to some extent taken into account when making case-mix decisions, but more implicitly for example when making appointments with patients or the use of an operating room. As long as there is a lack of capacity or money one has to set priorities. However, several respondents argued that potential *health gain* was a political and ethical issue for which doctors couldn't be expected to make these decisions.

Someone with 30% or 80% chance of survival, it does not matter. You just look where the patient can be treated; it is simply a social principle. (Chief physician)

The participants also felt the need to meet *basic care obligations* in the immediate region, but several respondents indicated that this type of care did not necessarily have to be done by a university hospital like AMC itself, but in cooperation with other hospitals. For example, the AMC had agreed with a general hospital in the region that some low-complexity surgery procedures could be executed there and the complex procedures

could be performed at the AMC. Most participants argued that policy decisions were not primarily determined by the financial *cost and returns*, but only in extreme cases. Several reasons were mentioned for this. First, some argued that there was insufficient financial pressure for money to be taken into account when making such choices. Second, several managers had the opinion that they could manage their cost and returns only to a limited extent (see the quote below) and there was insufficient relationship between the type of patient groups being treated and the costs and benefits of the medical departments. Also, if they made a profit, it would not go to them but to the division management.

We have no influence on the budget because we don't negotiate with the insurers. Also, we have no influence on new machines, such as a laser. You have to write a business plan, but we are no business plan writers, we are medical specialists. We have little influence on outpatient clinic staff, nurses, administrative staff, desk staff, etc. It is a big frustration for us. (Chief physician)

Third, funding was considered to be so complex that it was almost impossible to quantify the effects of decisions on patient groups. Fourth, some argued that the financial information was not reliable enough to use. Finally, some patient groups could be unprofitable for the AMC but not for the department. It could also be desirable to keep unprofitable patient groups because it was good for their reputation or because they belonged to their focus areas. The following citations illustrate how some managers think about the financial aspects of case-mix decisions:

Financial information is mainly relevant for central management so they know what they have to negotiate. We keep doing what we think we should do. (Chief physician)

Nobody will decide to start treating patients because of money. They do what they think they have to do. If we use financial information, you suggest that money makes the difference. When treating a patient we don't want financial barriers. (Chief physician)

Finance is secondary. We have a social function, and go for it. We do not deviate from the system but hope that the system adapts. (Central manager)

#### 4. Organization

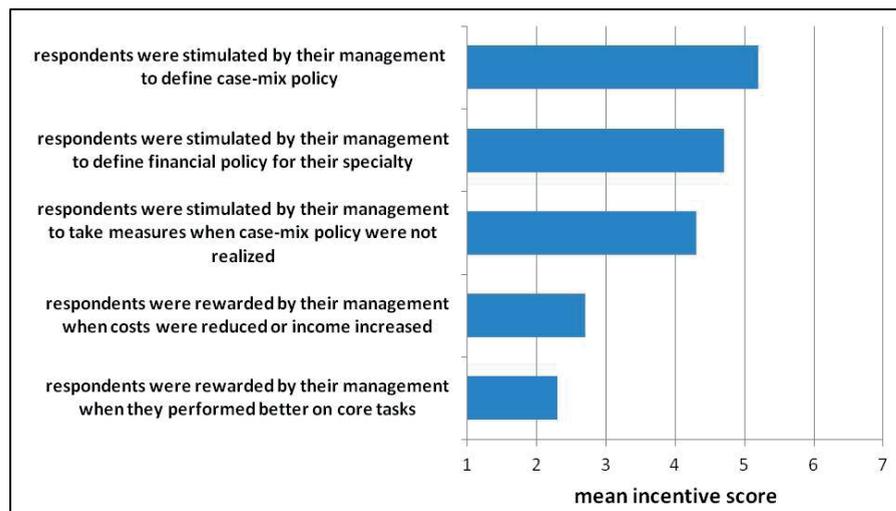
In 2008, it was concluded that up until then, the case-mix information had been mainly used for gaining insight and as a tool for conducting policy discussions about patient care at various levels, but it was insufficiently embedded into the decision-making processes of the chief physicians (see Section 5.3.3). As decision-making support was a key objective of the system, we needed more knowledge about the extent to which the chief physicians and division managers received incentives to make case-mix decisions

and to perform better on core tasks and finance.

*Incentives for policy making and improving performance*

In Figure 5.17, the survey results are presented with regard to the incentives received to define policy about patient groups and finance.

**Figure 5.17: Incentives received to optimize the case-mix (N = 28\*)**



(\*) N = 1 missing. Chief physicians and division managers were asked to indicate the extent to which they agree with the statements that they are stimulated and rewarded by their managers. Chief physicians are managed by the division managers, division managers are managed by the central managers. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly) agree.

In general, chief physicians and division managers seemed to be stimulated by their managers to define policy with regard to the case-mix (mean = 5.2, SD = 1.8, median = 6.0) and finance (mean = 4.7, SD = 1.7, median = 5.0), and to take measures when case-mix policy could not be realized (mean = 4.3, SD = 1.8, median = 5.0). Chief physicians and division managers seemed to be rewarded less when they performed better on core tasks (mean = 2.3, SD = 1.2, median = 2.0) and finance (mean = 2.7, SD = 1.6, median = 2.5). The quotation below illustrates that chief physicians missed (financial) incentives to take policy measures.

Division managers believe it is important that policy is made, but you are not rewarded. If you work hard to work more efficiently, you rather get told that you can do it with less. (Chief physician)

The division board thinks that it is important that policy choices are made but never check this. There is no performance incentive from the board. (Chief physician)

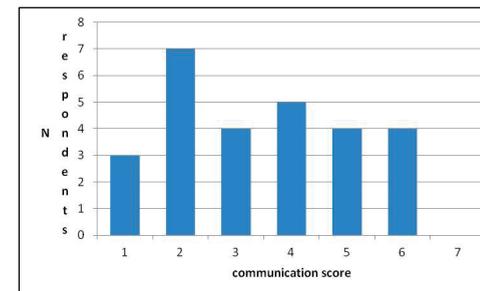
The most important costs are the internal transfer costs. We see them but don't know what to do with them. We never hear from division management that we have to do something about it. (Chief physician).

Until now there was great emphasis on finance and that is not surprising considering where we come from. Talks about the case-mix are still very marginal, but have to happen (Chief physician).

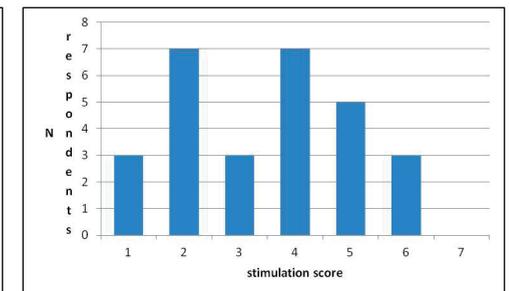
*Support of Board of Directors*

The chief physicians and division managers were also asked to indicate to what extent the Board of Directors communicated about the CMI and made them interested in using it (Figure 5.18, survey results).

**Figure 5.18a: Communication by Board of Directors (N = 27\*)**



**Figure 5.18b: Stimulation by Board of Directors (N = 28\*)**



(\*) Chief physicians and division managers were asked to indicate the extent to which they agree with the statements that the Board of Directors communicates well about the CMI (N = 2 missing) and stimulates them enough to use the CMI (N = 1 missing). Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

Eight of the 27 (30%) respondents agreed to strongly agreed (scores ≥ 5) with the statement that the Board of Directors communicated well about the CMI (mean = 3.4, SD = 1.6, median = 3.0), see Figure 5.18a. Five of the 27 (19%) respondents had a neutral view (score = 4). Eight of the 28 (29%) respondents agreed to strongly agreed (score ≥ 5) with the statement that the Board of Directors stimulated them enough to use the CMI (mean = 3.5, SD = 1.6, median = 4.0), see Figure 5.18b. Seven of the 28 (25%) had a neutral opinion.

During the interviews, the vast majority of the participants stated that the board

supported the project sufficiently in words but not in actions: the information was hardly discussed in quarterly meetings; the board used other control instruments, and accepted that the quality of (departmental) information was poor. This was partly to do with the fact that they applied the principle of ‘professional in the lead,’ providing the medical departments and divisions considerable decision-making freedom. A disadvantage of this principle was that the use of the CMI was voluntary, with the risk that it was used opportunistically. Another disadvantage was that divisions continued to design their own management information resulting in different types of available information on patient groups that often did not match with each other.

## 5. Environment

### *Financial and competition pressure*

The participants were asked to indicate to what extent they experienced financial pressure and competition pressure because the literature had shown that these environmental factors could affect successful implementation of innovations in organizations (see Section 3.4.4). The survey results are presented in Figure 5.19.

Figure 5.19a: Perceived financial pressure (N = 35\*)

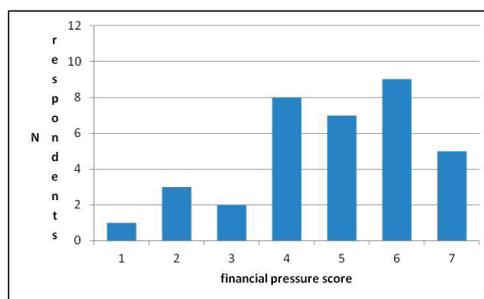
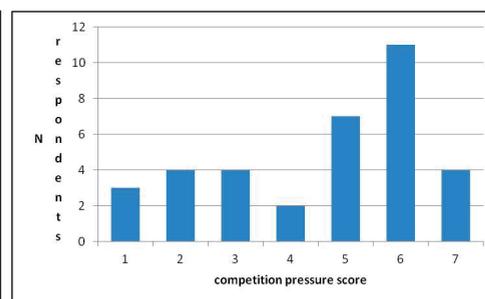


Figure 5.19b: Perceived competition pressure (N = 35\*)



(\*) Participants were asked to indicate the extent to which they agree with the statements that they experience financial pressure and competition. Level of agreement was scored on a 7-point scale varying from 1 (strongly disagree) to 7 (strongly agree).

Respondents experienced to some extent financial pressure (mean = 4.8, SD = 1.6, median = 5.0) and competition pressure (mean = 4.6, SD = 1.9, median = 5.0). During the interviews, most respondents stated that they expected the financial pressure to increase over the following years because of the growing production, cost of expensive drugs, budget cuts and increasing severity of illness of the patients, and the liberalization of health care. Furthermore, because the DBC system had many shortcomings, it was

expected that certain academic care would not be funded enough in the future.

Financial pressure is clearly present and the expectation is that it will increase more and more: the demand for care will continue to increase and thus the macro budget will be exceeded. This will lead to budget cuts. (Central manager)

Due to adverse effects of market mechanisms, the financial pressure has increased because general hospitals are shifting complex and expensive patients to the AMC earlier than before. The mechanisms that are really at play are different than those assumed theoretically. It seems better and safer for the patient to have patients regulated by the government and not by the market. (Central manager)

With regard to the pressure of competition, several respondents concluded that there were too many patients instead of too few and they welcomed new health care suppliers. However, there were differences observed between medical specialties; see the quotes of chief physicians below:

There is a lack of medical specialists. It is a lazy position; we don't have to do our best to attract patients. There is some competition in basic care but that is not our core business, we need these patient groups for training purposes. (Chief physician)

We experience competitive pressure from general hospitals with regard to basic care, not in top referral care. We try to be in harmony with other UMCs by being complementary. (Chief physician)

Competitive pressure was considered both positive and negative. The positive aspects were that it kept physicians sharp, it stimulated them to cooperate with other health care suppliers, and it gave them opportunities to leave some (basic) care to others. The negative aspects were that the respondents were afraid that because of the liberalization, other health care supply would focus on the profitable patient groups and the university hospitals would have to focus on the unprofitable patients, because they couldn't refuse them. For the upcoming years, it was expected that competitive pressure would increase slightly.

### 5.4.4 Results: reflection on the outcomes of the CMI

The outcomes of the CMI related to the [6] adoption, [7] use of the CMI, [8] effects of use, and [9] the overall success of the CMI project for the user (see Figure 5.5).

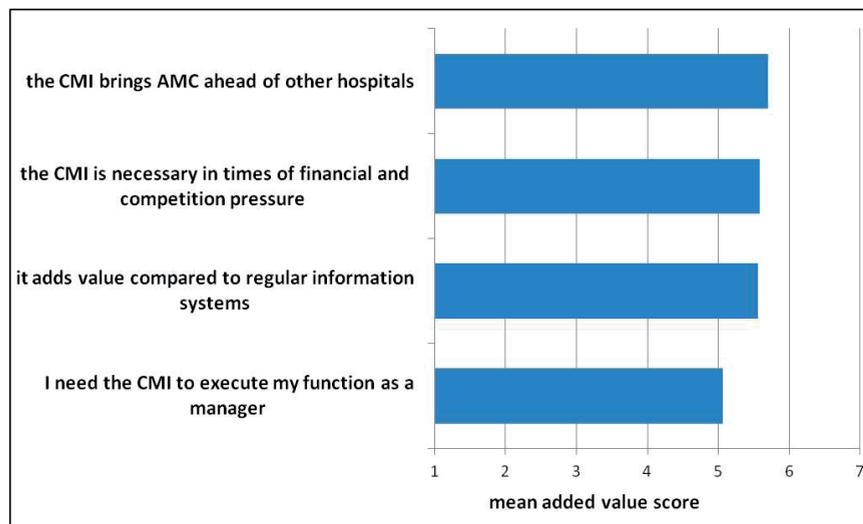
## 6. Adoption of the CMI

The questions regarding adoption issues focused on the extent to which the respondents perceived an added value of the CMI.

### *Added value of the CMI*

In general, the respondents agreed with the statement that the CMI had added value to the AMC and themselves (median of the average value scores = 5.6, see Figure 5.20), because the CMI brought the AMC ahead of other hospitals and that the AMC would need it anyway in times of financial pressure and market forces.

**Figure 5.20: Added value of the CMI (N = 34\*)**



(\* N = 1 were missing. Participants were asked to indicate the extent to which they agree with four statements about the added value of the CMI. Level of agreement was scored on a 7-point scale varying from 1 (strongly disagree) to 7 (strongly agree). More detailed analysis of the data is available on request.

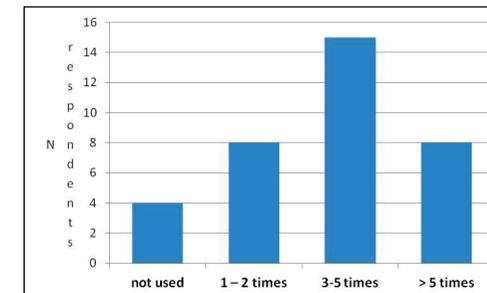
## 7. Use of the CMI

Participants were questioned on their use of the Standard Report Patient Care and the Portfolio Matrix (for further details of these products see Section 7.3.1 and 7.3.2. They were additionally asked for what purposes they had used these products. In Figure 5.21 the survey results are shown.

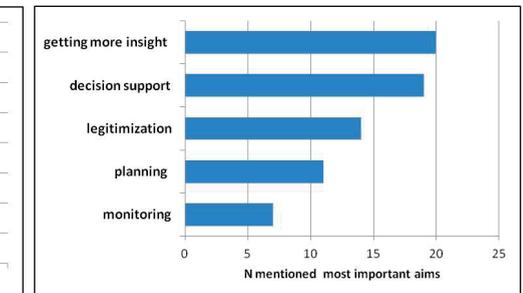
Thirty-one of the 35 respondents (89%) had used the CMI. All non-users were chief physicians. The majority of the respondents had used the CMI three to five times in the previous year. The case-mix information was most frequently used for gaining more

insight, decision-making support and legitimization, although to a lesser extent. These reasons were also noted during the interviews.

**Figure 5.21a: Use of the CMI (N = 35\*)**



**Figure 5.21b: Aims of use (N = 22\*)**



(\* Participants were asked how often they had used the Standard Report Patient Care and Portfolio Matrix that were sent to them in September 2006, Augustus 2007, and June 2008 (5.21a). They were also asked for which of the predefined aims they had used them and to hierarchically rank these aims (5.21b): 1 = most important aim, 2 = second most important aim, etc.; N = 13 missing (the high non-response was partly due to the fact that participants found it difficult to establish direct relationships between the use of the CMI and the predefined aims).

We used the case-mix information several times to show the staff members what the department is confronted with. We gave them an empty portfolio and asked them to put the patient groups in the quadrants so they started thinking about the costs. It was a nice discussion with different pictures and generated thoughts about what you can take into account when making decisions. (Chief physician)

I used the case-mix information very differently per division. At division X we used it mainly to demonstrate to the Board of Directors that the DBC structure and tariffs were not correct. At division Y, we had more substantive discussions and defined the core areas. At division Z, the discussions were much easier because most departments already had experience with the free market and had to make choices before. (Division manager who worked for several divisions)

We used the CMI to translate the strategic aims: are we doing the right things? The CMI makes this very visible for us. Although chief physicians are in the lead, we can support them to make the department better. However, we haven't discussed it yet with the medical departments, because it is not appreciated by them if we interfere with their content. (Division manager)

I presented the CMI at a meeting with CEOs of other UMCs. I showed how we made the medical environment visible to the medical professional. That we compare medical relevance with financial relevance, how dangerous that may be and that we use it not directly to make decisions on it but for consciousness and to detect remarkable things, for example, that we allocate less capacity to our core activities. (Central manager)

We discussed it with the Supervisory Board. These are experienced people with a scientific background and they looked at it more carefully. They are reluctant and fear that one focuses on the large patient groups and repels the small unprofitable patient groups. You should use it prudently. (Central manager)

The information was used relatively less for *planning* purposes (Figure 5.21b). Several reasons were mentioned for this in the interviews. First, the production of the medical department was very stable so it was more or less what they had done the previous year and did not require an advanced planning tool. Second, some departments used their own planning system and used their own data because the CMI data were not considered reliable enough to use. Finally, the quality of planning the capacity of staff was discussed.

We ask for more operating hours but the only response is lack of personnel. Once we calculated very precisely how many sessions we needed but we got our request back with the wrong definitions. They are not able to make good plans, so you don't need a sophisticated planning system. (Chief physician)

The case-mix information was only used for *monitoring* in the larger departments (Figure 5.21b). During the interviews it became clear that for smaller departments, the need for a monitoring instrument was limited because they already had a good awareness of the trends in patient groups because of the daily patient discussions and visits at the clinic.

There were several reasons why one was not using, or hardly using, the CMI. Some users found the CMI irrelevant, especially supporting departments (like radiology, clinical genetics) or for specialties that have their own information systems. Other argued that their division management had no interest in it, case-mix decisions had already been made, and one was not able to influence the case-mix because one has no power over the entrance of patients or one is not allowed by management to change patient groups.

I have not discussed the CMI with staff members because they are not interested. It was discussed a little with division management. Further, only a part of the (capacity) information is relevant to them. (Chief physician)

I have discussed it with the management team, but they don't understand the relevance scores. They recognize the material; it is just another way of putting your policy on paper. Only the costs are new, but they are not relevant for them. They feel no incentive to get a bulb in the Portfolio Matrix to another quadrant. It may change if costs become more important. (Chief physician)

We have our own information system and a daily patient discussion, so we already have quite a good understanding. It is good that information is generated 'upstairs'. Does it help in policy, decision-making? Theoretically, yes; in practice, no. This has nothing to do with the instrument but with the

way decisions are made 'upstairs': it is unclear; the department has never been asked something, many things are arranged between intimates (Chief physician).

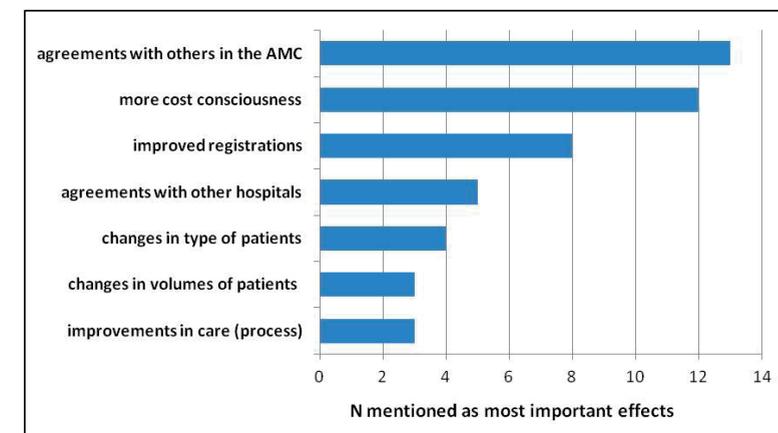
Another obstructing factor was that several medical managers lacked the knowledge and skills to use the CMI in a responsible way. One explanation for this could be that the majority of them were relatively old (see Table 5.7). This meant that they were mainly familiar with the era of fixed budgets without elements of a free health care market.

### 8. Effects of the CMI

Participants were questioned if they had noticed positive effects from using the case-mix information. These effects related to task performance, processes (registrations, care processes) and outcomes. The survey results are summarized in Figure 5.22.

With regard to the most positive effects, it was frequently mentioned that on the basis of the case-mix information, agreements had been made with others, sometimes by individual managers, sometimes in agreement with division management or other hospitals. Second, more cost consciousness was reported. The explanation for this is probably that before the introduction of the CMI, most respondents had never seen costs or income at such a detailed level as patient groups, diagnosis, or medical procedures. The financial information was therefore the most innovative part for users and had therefore added the most value.

Figure 5.22: Most important positive effects of using the CMI (N = 20\*)



(\*) N = 15 missing. The high non-response was partly due to the fact that participants found it difficult to establish direct relationships between the use of the CMI and positive effects. Participants were asked to indicate for a number of predefined positive effects if they had experienced them and if so to hierarchically rank these effects: 1 = most important positive effect, 2 = second most important positive effect, etc.

It has provided more insight into the type and number of patients and the importance we attach to it. Furthermore, it contributed to the choices we want to make in the free capacity. It helped in talking to chief physicians and division managers about patient flows, which rarely happened before. (Central manager)

The information has especially helped in the beginning by making clear what the focus points are in the research. Some had as many as twenty, others five. Furthermore, chief physicians had no idea of costs and now they have. (Division manager)

Some negative effects were also mentioned in the interviews. One chief physician had the feeling that unprofitable patient groups were avoided purely on economic grounds. A division manager indicated that the CMI had further undermined her faith in management information. Finally, it was mentioned that the CMI can result in undesirable discussions about care; for example, that other people think that some care does not belong in the AMC and make decisions based on it. Some managers experienced no effects from the CMI.

Has something changed? No, we didn't receive any more money. You have to fight for every cent, but we did this also before the CMI. (Chief physician)

## 9. Overall success of the CMI project

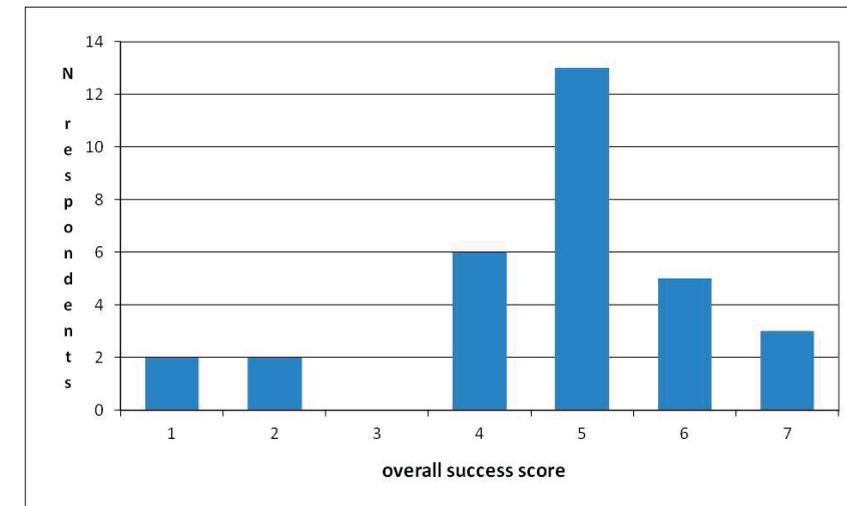
### *Overall success of the CMI project*

The 'overall success of the project' was selected as the primary outcome measure, because as mentioned in Section 5.4, 'success' was considered a general reflection of the various (interacting) success factors (such as environmental and organizational factors, quality of the CMI, design and implementation strategy) and outcome measures in terms of use, and effects of use of the CMI.

Participants were asked to indicate the extent to which they agreed with the statement that the CMI project was successful so far for them, taking all aspects into account. The survey results are presented in Figure 5.23.

The majority of the 31 respondents (21/31= 68%) perceived the CMI project as successful to very successful (scores  $\geq 5$ ) for themselves (mean score = 4.7, SD = 1.5, median = 5.0). However, the success scores varied to some extent. Six of the 31 respondents (19%) had a more neutral opinion about the general level of success (score = 4), indicating that they had experienced both advantages and disadvantages of the CMI project. The respondents were asked during the interviews to describe in own words when the CMI project would be a success for them. The different quotations below demonstrate that the expectations of the CMI were different. For example, some

**Figure 5.23: Overall success of the CMI project (N = 31\*)**



(\* N = 4 missing. Participants were asked to indicate the extent to which they agree with the statement that the CMI project was successful for them. The level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

expect the CMI to be an answering machine, others a dialogue machine, and others a budget generating machine.

The CMI project will be successful when...

... you recognize the data, it matches with the picture in your head, and you are able to discuss them. (Chief physician)

... the CMI is used hospital-wide and decision-making really changes. (Chief physician)

... expensive things are funded, if the budget matches with the core business. (Chief physician)

... the Board of Directors looks at it. (Chief physician)

... it has indicators to assess whether you have met your policy and when it is useful for planning. (Chief physician)

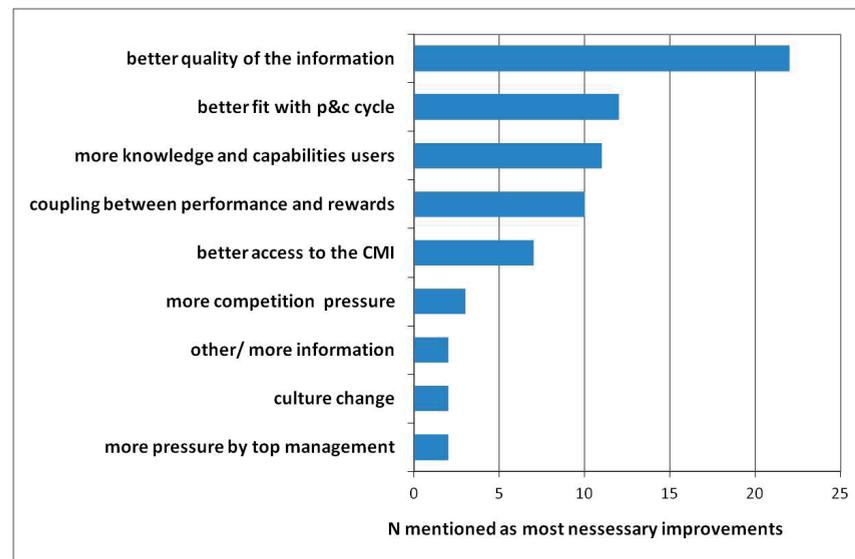
... there is general acceptance, when the information is available periodically, when it is included in the Standard Report, and when it has a formal status. (Central manager)

... you can retrieve all the data you want to know, for example, costs and patient satisfaction, and costs and quality targets, etc. (Chief physician)

It is already successful because we have thoroughly discussed the information already. (Chief physician)

Finally, the participants were asked what measures were necessary to improve the success of the CMI. The survey results are depicted in Figure 5.24. Improvement of the quality of information was most often reported as a necessary step for further development and implementation of the CMI.

**Figure 5.24: Necessary measures for improvement of the CMI (N = 26\*)**



(\*) N = 9 were missing. The high non-response was partly due to the fact that participants found it difficult to indicate which measures were needed). Participants were asked to indicate for a number of predefined measures of improvement which they find necessary and to hierarchically rank these improvements: 1 = most necessary measure, 2 = second most necessary measure, etc.

The necessary improvements were explored in-depth during the interviews and several suggestions were given. The most frequently mentioned suggestions are presented in Table 5.8. Based on these suggestions, a plan was drawn up for the following years, see Section 6.3.

**Table 5.8: Suggested measures for improvement**

Variables	Suggested measures for improvement
Design of the CMI	<p>Better quality of data:</p> <ul style="list-style-type: none"> <li>• The axes of the Portfolio Matrix (Y-axis) have to be discussed again.</li> <li>• More checks must be done on data before they are distributed.</li> <li>• Demonstrate that the data are correct.</li> <li>• Give departments (financial) interest in quality of data.</li> </ul>
Design & implementation strategy	<p>Better access to the CMI:</p> <ul style="list-style-type: none"> <li>• The CMI should become more widely accessible, both for managers and business analysts.</li> <li>• The case-mix information must be distributed more frequently.</li> </ul>
(Medical) manager	<ul style="list-style-type: none"> <li>• Structuring and standardization the process of making case-mix decisions (portfolio strategy).</li> <li>• The (medical) managers and business analysts have to be trained how to use the CMI.</li> <li>• The share of negotiable care must be increased (B-list DBCs).</li> </ul>
Organization	<p>Embedding the CMI in the Planning &amp; Control cycle:</p> <ul style="list-style-type: none"> <li>• The CMI must be embedded in the planning (budgeting) process</li> <li>• The internal budgets have to be based on DBCs.</li> <li>• The CMI must get more attention it in the yearly budget talks and quarterly meetings.</li> </ul> <p>Support of the Board of Directors/ division management:</p> <ul style="list-style-type: none"> <li>• The Board of Directors have to define a clear long term policy.</li> <li>• (Re) confirmation by the Board and division management that the CMI has high priority and this is propagated in the AMC.</li> </ul>
Environment	The DBC structure has to be improved for some medical specialties.

### 5.5 Interim conclusions

Based on the case study between 2006 and 2008 and the interim reflection, several interim conclusions can be drawn.

#### *Design and implementation variables*

The *patient groups*, as defined by the chief physicians, appeared to be a good ‘language’ to use in the CMI, because the types of patients were considered crucial for performance on all core tasks and for finance. The process of defining these patient groups was experienced as useful by the chief physicians since it stimulated them to think actively about their case-mix and to discuss the patient profiles with their staff members. Besides, through this process, the opinions of chief physicians were systematically collected around these patient groups; their ideas were now made explicit. The patient groups reflected the perceptions of the (medical) managers. Because of these patient groups, the contents of the care were automatically displayed. Also, the patient groups reduced management information to manageable units. This made it possible for the managers to discuss medical policy with the physicians.

The need for types of case-mix information varied across the (medical) managers, but there was quite a consensus between them about what types of information per patient group should be minimally provided in the CMI: volumes, patient characteristics, medical production, process, quality, finance, and healthcare market. The DBC data appeared to provide good opportunities to design these types of information. It became possible to identify and quantify the patient groups and to connect the strategy with medical, logistical, and financial policies. Thereby, the different ‘worlds’ between medical and financial professionals, which were previously widely separated, could be integrated. It also led to several types of new information, for example, about the content and complexity of care, the full cycle of care, the financial coverage of patients, and the relationship between types of data. It now became possible to define medical policy per patient group and to translate it in terms of volumes, capacity, and money. With regards to the information about the budget parameters, this was a big improvement. Some types of information, such as relevance and quality of care were not registered in systems and could only be obtained by asking the medical specialties; they were, therefore, by definition, considered as subjective.

The strengths of the Standard Report Patient Care and Portfolio Matrix were that they were ready-made, easily accessible, with standardized and highly aggregated information, and presented by powerful visualizations with clear explanations. It also turned out that the Portfolio Matrix had a good filter function for finding patient groups where specific analyses were needed. However, there was a widely spread perception of unreliable data,

in particular of the DBCs, cost data, and non-system data. With regard to DBC data, the problems related to the complexity of the DBC system (artificial and administrative language), the mismatch with the other regular management reports, the volatility and unpredictability of the data, and the lack of proper registrations. For some medical specialties, the DBC product structure did not sufficiently represent the complexity of academic care. It also took a long time to reach agreement with health insurers about volumes and prices (B-list DBCs) of the care products and, as a result, the prices became available in the CMI only late in the current year. Besides this, the tariffs of the A-list DBCs were only used for administrative purposes and did not determine the actual returns because these returns were still based on the budget system. Therefore, the presented returns of the A-list DBCs were only virtual numbers and users could easily draw the wrong conclusions when making decisions. This reduced the usefulness of the CMI considerably since it was not possible to determine the financial coverage per care product or patient group. Finally, chief physicians had no financial interest in a proper registration of the DBC data, because their budgets were still based on the historical budgets and not on DBCs.

With regard to the quality of the cost data, the problems related to the fact that the data were the result of a complex process consisting of a large number of technical and political steps and assumptions that many chief physicians were not personally involved in. Furthermore, the presented costs did not match with the actual costs as registered in the ledger because, in the CMI, the costs per patient group could only be estimated by multiplying the volumes of the underlying care activities of the DBC trajectories by the unit costs. Because of this, an over- or under-approximation of actual costs was created, called the *calculation fiction*. Although this effect was inevitable, the consequence was that the cost data were not recognized and easily experienced as subjective and unreliable. Finally, it should be noted that perceptions about the quality of the DBC and cost data could differ from the actual quality in terms of timeliness and completeness. Through in-depth analyses with medical specialties, the actual quality of the DBC data turned out to be not as bad as they thought. In many cases, the data proved to be (technically) correct, but the (medical) managers did not know exactly how the data were generated. The non-system data, such as the relevance and distinctiveness of care, were personal opinions or estimations of the chief physicians and not objective facts. Some chief physicians did not take this seriously and several division managers found it difficult to discuss this with them. In that case, the non-system data were not useful and it was difficult to compare the matrices between medical specialties.

Regarding the quality of the project organization and the design and implementation strategy, the respondents in the interim reflection were rather positive. One supported

the strategy of gradual design and implementation of the CMI in close cooperation with the target groups and thought this was the right time, given the internal and external developments. The discussions between the division managers and the chief physicians about the CMI were experienced as constructive and satisfactory. In general, the chief physicians and division managers indicated that the Board of Directors supported the CMI project sufficiently in words but not in action. This was partly due to the fact that the Board applied the principle of 'professional in the lead,' providing the medical departments and divisions considerable decision-making freedom. A disadvantage of this principle was that the use of the CMI was voluntary, with the risk that it was used opportunistically. Another disadvantage was that divisions continued to design their own management information resulting in different types of available information on patient groups that often did not match with each other.

#### *Organizational and environmental variables*

The CMI was designed primarily for the chief physicians, division managers and central managers, because it was assumed that they were the key decision makers of the AMC. This assumption was largely shared by the respondents in the interim reflection. Chief physicians had the most influence on case-mix decisions because of their hierarchical position and expertise. Also staff members had a lot of influence on the case-mix because part of their patient population was related to their specific field of clinical expertise. Division managers had a key position between the medical specialties and the Board of Directors. The division management got the budget and therefore had the means to allocate it. They also assessed the annual plans of the medical specialties.

For the design of the CMI, it was assumed that the chief physicians, division managers, and central managers had much decision-making power. However, the interim reflection revealed that this assumption was only partly true as the chief physicians experienced serious barriers to actually manage their case-mix, costs, or returns. For example, the possibility to manage the case-mix turned out to be related to the type of medical specialty. If a specialty treated relatively many acute or chronic patients, the chief physicians saw few opportunities to manage the type and volumes of patients. Furthermore, no drastic case-mix decisions by the medical management could be expected because the case-mix was a result of accumulated expertise and infrastructure that did not change overnight. With regard to costs and returns, the (medical) managers lacked some decision-making power, for example, concerning the appointment of staff members, expensive materials, and making investments. They also had no direct influence on the budget, since the budget was still determined through historically-defined budgets rather than the DBC revenues. There were also no clear job descriptions with committed tasks and responsibilities.

Almost all (medical) managers supported the design of the CMI. Because of the increasing competition and financial pressures, they expressed the need to make case-mix decisions in a more rational and explicit way and expected that the CMI would support this. On the other hand, several respondents indicated that they were satisfied with their way of making case-mix decisions and they felt no urge to change this. Besides, the interim reflection demonstrated that there are limitations of CMIs in supporting the case-mix decision-making process. In case-mix decisions, many factors are relevant for the (medical) managers, but several factors can not be supported by the CMI, because they are qualitative in nature or there is no underlying data available. It was also argued that the philosophy of the CMI did not match with the organizational culture of the AMC where many decisions were taken implicitly without using (hard) criteria or information, by 'wheeling and dealing,' and the CMI would not change this culture. Another obstructing factor was that several medical managers lacked the knowledge and skills to use the CMI in a responsible way. One explanation for this could be that the majority of them were relatively old. This meant that they were mainly familiar with the era of fixed budgets without elements of a free health care market.

#### *Outcomes of the CMI project*

The interim reflection showed that the majority of the managers supported the aims of the CMI project and used the information regularly. The CMI was most frequently used for getting more insight, decision-making support and, although to a lesser extent, legitimization. Frequently mentioned advantages of the information were that it reduced the complexity of patient care into manageable groups (compactness), provided a basis for further analyses and legitimization, formed a good basis for dialogue, and led to better decisions and registrations. The CMI helped the (medical) managers to identify the possible case-mix changes and to provide the appropriate arguments. Furthermore, on the basis of this information several agreements were made about patient care, cost consciousness was increased and registrations were improved, see Figure 5.22. However, the users also experienced several obstructing factors to making case-mix decisions directly on the basis of CMI data. The CMI was also used less for planning purposes. Reasons mentioned for this were that the production of the medical specialty was rather stable over the years and did not require an advanced planning tool and that some specialties used their own planning system and used their own data because the CMI data were not considered reliable enough to use. Some negative effects were also mentioned in the interviews such as the fear that unprofitable patient groups were avoided purely on economic grounds and the fact the (perceived) poor quality of the data had undermined the faith in management information. So far, two thirds of the respondents had perceived the CMI project as (very) successful for themselves.

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# Chapter 6

Case study AMC 2009 – 2014

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## Abstract

In the period from 2009 to 2014, the liberalization of Dutch hospital care gradually expanded. The percentage of free negotiable care increased and in 2012, a performance-based reimbursement replaced the budget system while the DBC system was replaced by the DOT system at the same time. Furthermore, the growth of expenses in the Dutch hospital sector was limited to 2.5% per year. For the AMC, these developments implicated that competition and financial pressure further increased and it was concluded that the strategic aims could only be realized by setting priorities in the case-mix and further cost reductions. To support the top (medical) management, the existing Standard Report Patient Care and Portfolio Matrix (as well as other information products) of the CMI were redesigned. In addition to this, new information products were developed, such as the Interdependency Analysis, Portfolio Checklist, and Benchmark Analysis Resource Use Profiles. During this period the number of users of the CMI increased significantly. The CMI was increasingly embedded in the strategic management cycle and was used for gaining insight, conducting a dialogue on portfolio choices, external legitimization, process optimization, cost reduction, and cost-effectiveness studies. However, the replacement of the DBC system by the DOT system in 2012 had a major negative impact on the CMI project. It meant not only a major technical change of the CMI, but also a substantive change as users had to understand this new system and related case-mix information. Furthermore, it still took much time to negotiate about volumes and prices with the health insurers and this meant that during the year essential data were missing and the CMI could not be used to gain insight into the actual financial coverage per care product or patient group. Although the DOT system certainly had advantages, the data were still perceived as unreliable, even more so than the DBC data. This reduced the number of possible applications and the use of the CMI in several ways, for example in the use of case-mix decisions and budgeting. Because of this, the managers lost the interest to optimize their case-mix and their interest in case-mix information. Other obstructing factors were that managers still experienced several legal and practical barriers in managing the case-mix and that new priorities arose at the AMC such as the implementation of the electronic patient system and the proposed administrative merger with VUmc. In 2014, the CMI was technically completed and it was concluded that the highest possible aims had been achieved and the project could end.

## 6.1 Introduction

This chapter describes the second phase of the case study at the AMC in the period from 2009 to 2014. In this phase, the CMI was redesigned and completed on the basis of reflection on the success of the existing CMI in 2008 (Section 5.4) and unexpected developments in the Dutch hospital sector and the AMC (Section 6.2). In Section 6.3, what was (re)designed, and why and how, will be explained. A distinction is made between the periods from 2009 to 2011 and from 2012 to 2014. The reason for this is that in 2012 a fairly new period begins because of the transition from the DBC to the DOT system (see also Section 2.5) and the replacement of the national budget system by a new performance-based reimbursement system. In Section 6.4, several interim conclusions are drawn. In Table 6.1, an overview is given of the most relevant research-related developments between 2009 and 2014.

## 6.2 Developments in the Dutch hospital sector and the AMC

In the period from 2009 to 2014, several unexpected developments in the Dutch hospital sector and the AMC took place, which had an impact on the design, implementation, and use of the CMI.

### Developments in the Dutch hospital sector

In 2009, the Dutch Health Authority evaluated the developments in the hospital care market (NZa, 2009<sup>1</sup>). They concluded that overall, the positive developments of the liberalization of care were apparent: quality played an increasing role in health care purchasing, waiting times had stabilized, the volume of production remained steady, and there was a substitution of clinical admissions to outpatient treatment. As a result the liberalization of the Dutch hospital care continuously expanded. In the period from 2009 to 2014 the percentage of B-list DBCs was increased from 34% to 70%. In the period from 2009 to 2011, hospitals' revenues for patient care were still determined in two ways: by the budget system (A-list DBCs) and the free market (B-list DBCs).

In 2011, an official committee concluded that the Dutch hospital sector was 'stuck in the middle' and caught between a supply and a regulated demand-driven system (Inspectie der Rijksfinanciën, 2010). On the one hand, hospitals already had had more freedom; on the other hand, the current hospital budgets provided too few incentives for quality and innovation (VWS, 2011<sup>2</sup>; Asselman & Snijders, 2010). Therefore, it was concluded that the switch from supply-driven to demand-driven health care had to be made as soon as possible and it was announced by the Minister of Health that in 2012 performance-based reimbursement would be implemented (i.e. the abolition of the budget system) and the new DBC product structure (DOT) would be implemented

Table 6.1: Overview of most relevant developments for this research, 2009 - 2014

Dutch hospital sector	Year	AMC			
		General event	Evaluation of the CMI	(Re) Design of the CMI	Implementation of the CMI
34% B segment (free negotiable care)	2009		Expert meeting about the Portfolio Matrix	<u>Redesign:</u> Minimal dataset, Standard Report Patient Care, Portfolio Matrix, Intranet Page Management Information <u>Design:</u> Interdependency Analysis, Management Game, Data Cube Care Products (Cognos)	Further embedding of the CMI in the Planning & Control cycle
	2010	New chairman of Board of Directors Raid by the Dutch Competition Authority	Evaluation pilot III	<u>Design:</u> Portfolio Checklist	The CMI was used for specific business cases, the improvement of registrations, external legitimization and cost effectiveness studies
National hospital budget cuts of 314 M euro, growth of expenses capped at 2.5%	2011	Announcement of internal output budgeting in 2012		<u>Design:</u> Standard views (Cognos)	Organization of Management Games and Computer Training
Replacement of the DBC by the DOT structure	2012	New vice chairman of Board of directors	Evaluation pilot IV	<u>Redesign:</u> Standard Report Patient Care, Portfolio Matrix, Data Cube Care Products, Intranet Page Management Information <u>Design:</u> Benchmark Resource Use Profiles, Data Cube Care Activities, Data Cube Market Shares, Forecasting model, Top Referral Care Model, Information Policy	Implementation of the Standard Report Patient Care, Portfolio Matrix, and Data Cubes with the provisional DOT data
Reimbursement on basis of DOT with safety net (95%),		SLIM project to reduce costs structurally by 65 M euro		Use of the Benchmark Analysis Resource Use Profiles for the SLIM project	
70% B segment <sup>15</sup> (free negotiable care),		Abandonment of internal output budgeting			

Table 6.1: Overview of most relevant developments for this research, 2009 - 2014 (cont.)

Dutch hospital sector	Year	AMC			
		General event	Evaluation of the CMI	(Re) Design of the CMI	Implementation of the CMI
Reimbursement on basis of DOT with safety net (70%)	2013	Introduction of A3 methodology, selection electronic patient system, proposed administrative merger with VUmc			Integration of the CMI information in the A3 score card
Reimbursement on basis of DOT, no safety net	2014	New member of Board of Directors	End reflection	Completion of the CMI	Use of the CMI for the preparation of the administrative merger with the VUmc  CMI nominated for the Porter prize 2014

(i.e. the abolition of the budget system) and the new DBC product structure (DOT) would be implemented (see Section 2.5). To reduce the systematic risks of the transition, for each hospital a 'transition amount' was determined by comparing the turnover of the hospital under performance-based reimbursement (DOT turnover) and the turnover equal to the production it would realize under the existing hospital budget system. The transition amount was then multiplied by a transfer rate decreasing in 2012 to 95% and in 2013 to 70%.

To ensure that the structural expenditure in hospital care remained within the national budget, 'additional security measures' were taken. For example, it was established by law that when the macro budget of hospitals was exceeded because of the changes in the reimbursement, the budget of all hospitals would be cut in proportion to their market share. As a result, in 2011 the total budgets of the hospitals were reduced by 314 M euro because of the excess of the macro budget in 2009 (VWS, 2010<sup>1</sup>). Furthermore, in 2011 a Gentleman's Agreement was signed by the Minister of Health, hospitals and health

<sup>15</sup> These are average percentages for all hospitals in the Netherlands. However, for university medical centres, these percentages were significantly lower because they provide relatively more complex care of whose care products are in the regulated segment (A-list DBCs).

insurers that would limit the growth of expenses in the Dutch hospital sector to 2.5% (excluding wage and price adjustments) for the period from 2012 to 2015 (VWS, 2011<sup>1</sup>). Also, in parallel with this, between 2012 and 2014 the financial risks for insurers further increased by phasing out certain compensation payments. As a result, the insurers tried to limit their risks by making agreements with hospitals about the maximum turnover (turnover ceiling) and sharper negotiations about prices and volumes.

In July 2013, the Minister of Health concluded that, although the transition model had contributed to a careful transition to performance-based reimbursement, the combination with the introduction of the DOT system had made it complex (VWS, 2013). As a result, it took a long time for the contracting between hospitals and insurance companies and the extra time needed for the annual accounts of hospitals. The Minister strived to further accelerate contracting in the coming years.

### Developments in the AMC

The increasing competition and the financial pressure were serious challenges for the AMC; they had to do more for less money. As a result, in 2010 the AMC redefined their *strategic goals* for 2011 to 2015. The emphasis was put on strengthening the clinical functions and top referral, cooperation in the region, patient safety, innovation in education and training, as well as quality improvement, and focus on research (AMC, Strategic Goals 2011 - 2015). Regarding academic cooperation in the region, the existing collaboration with the Free University Medical Center (VUmc) was expanded and in 2013, the Boards of Directors of the AMC and VUmc signed an agreement for a proposed administrative merger. It was concluded that the strategic aims could only be realized by setting priorities in patient care and cost reductions.

Setting priorities was promoted by putting more and more focus on the content of care policy (rather than the budget parameters) in the *Planning & Control cycle*. As in the previous years, divisions were asked to define their medical policy for each patient group, not only by indicating what the desired volumes were, but also to how to motivate this and to explain how they thought to achieve it. To ensure that scarce resources were used for the defined focus areas; in 2011 a more explicit link was established between the desired medical substantive policy and the allocation of capacity and money. This meant that when allocating scarce capacity, such as operating rooms, the relevance of patients to the performance of the core tasks and the profiling of the AMC, would be taken into account. It was also announced that in 2012 internal budgeting would be linked to external funding, i.e. the DOT care products, but the Board of Directors decided to abandon these plans because the DOT data were too volatile. It took, for example, almost a year to obtain the first DOT data and accordingly it took a long time to make agreements with health insurers about volumes and prices of the care products.

Cost reductions were realized by reducing the budgets of the divisions and services year by year and by initiating projects to improve efficiency and quality. In 2012 these projects were bundled into one central program: SLIM (meaning: SMART). The purpose of SLIM was to reduce costs structurally by 65 M euro in 2014, to realize the strategic aims by making the right choices and improving the processes and quality. Furthermore, in 2013, the so-called 'A3 methodology' was introduced, which is a change agenda for an entity in which new activities or desired improvements in quality and efficiency are defined. The aim of this was to work and manage in a more result-oriented way. Divisions were asked to define measurable indicators in their annual plan and also to formulate objectives for them. The A3 year plans replaced the previous year's plans. With the A3 year plans, the 'A3 meetings' were also introduced where two times a year the Board of Directors and divisional managers talked about the progress on the outcomes on the indicators and about the future. The outcomes concerned different topics such as finance, human resources, and patient care and could be related to each other. To monitor the outcomes, an 'A3 dashboard' was designed containing qualitative information (annual plan in words) and quantitative information (outcomes on indicators) per entity (division or medical specialty).

Finally, in 2013, the decision was made to purchase a new electronic patient system (called EPIC). This system would replace almost all existing computer systems related to patient care and was a major change program. The implementation was scheduled for October 2015.

### Impact of the developments on the (re)design of the CMI

The external and internal developments had an impact on the (re)design and use of the CMI in several ways. The further increase of pressure on competition (because of the liberalization) and finance (because of cost reductions) strengthened the need for more detailed case-mix information, for example, about the complexity of care, care processes, and finance. This meant that the existing information products had to be extended (see Section 6.3). Also, more external data were needed, such as market shares (for case-mix decisions and sales strategy) and benchmark data per care product (for process optimizing). The announcement that internal budgets would be linked to the DOT products in 2012 meant that users of the CMI needed insight into the financial impact of this for their division and medical specialty. For this purpose, also new figures had to be designed in the Standard Report Patient Care.

The replacement of the DBC structure with the DOT structure had a huge impact on the CMI. First, the existing information products had to be technically redesigned because the DOT data were generated in a different way and based on different sources

than the DBC. Second, the DOT product structure implicated a substantive change: the contents and terminology of care products were different from the DBC, which meant that users of the CMI had to be trained to understand the DOT system and to interpret the related case-mix information. Third, as a result of the technical and substantive change it took about nine months before the first DOT data became available and agreements could be made with health insurers about volumes and prices. This implied that in 2012, the prices became available late in the current year in the CMI. This reduced the usefulness of the CMI considerably, since it was not possible to determine the actual financial coverage per care product or patient group. Fourth, as with the DBC product structure, the DOT product structure changed continuously. As a consequence the volumes, costs, and prices per care product fluctuated considerably. This made the data unpredictable and strengthened the perception of the users of the unreliability of the data and made them reluctant to use the CMI. Finally, the fact that the Board of Directors decided to abandon their plans to link the internal budgets to the DOT production, but to retain the historical budgets, meant that the medical managers lacked the incentives and opportunities to optimize their case-mix which reduced their need for case-mix information.

With the 'A3 dashboard,' a new management information tool was introduced at the AMC, which also contained information regarding patient care. This not only meant that the information in the CMI had to match with the information as presented in the 'A3 dashboard,' but also that it became possible to link the case-mix information to other information, such as finance and human resources. For the CMI the implementation of the new electronic patient system also implied that in 2015 all data sources would have to be replaced and the existing information products had to be redesigned. Moreover, the new system would provide opportunities for new types of case-mix information, because new and better data were recorded in the system. On this basis, in 2013 it was decided that until then no more large investments would be made in the CMI.

Finally, there were some other developments which had an impact on the CMI, but in a more indirect way. Between 2010 and 2014, all members of the Board of Directors were replaced. This was relevant to the CMI, since the former chairman had been the initiator and thus a major sponsor of the project. It was uncertain what the change of these members meant for the support of this project. Furthermore, in 2010, the Dutch Competition Authority (NMa, Nederlandse Mededingings Autoriteit) conducted an "unannounced visit" to the Free University Medical Centre (VUmc) and the AMC, because they suspected them of making forbidden agreements. The NMa investigation focused on the exchange of statistical data including patient flows and actual production data. The NMa saw competition risks because the hospitals could change their strategic

behavior as a result of the exchange and could use the information in negotiations with health insurers. The hospitals promised to adjust their exchange of information. The NMa accepted the commitment and closed the investigation. This event was relevant for this research project, because several medical managers incorrectly saw this as a signal that apparently they were legally not allowed to manage patient groups and therefore it made the case-mix information less relevant for them (see also Sub-Section 6.3.1).

### 6.3 The regulative cycle of the AMC

In the period from 2009 to 2014, the existing CMI was redesigned, expanded, and completed. Most of the measures of improvement as suggested in the interim reflection (see Table 5.8) were realized. The design and implementation of the CMI still took place by passing through the regulative cycle, but for several reasons, not so frequently and strictly as it did in the period from 2006 to 2008. First, since 2009 the CMI increasingly became embedded in the processes and minds of the users and its innovative character diminished. Second, in consultation with the Board of Directors the project group had decided to create a more stable period where not too many innovations were implemented and the organization was not burdened too much with evaluations. Therefore, in the next sections several years are grouped together. A distinction is made between the period from 2009 to 2011 and from 2012 to 2014. The reason is that in 2012 substantial changes were made to the CMI because of the transition from the DBC to DOT product structure and a fairly new era began.

#### 6.3.1 2009 to 2011

In this section, the phases of the regulative cycle which were passed through between 2009 and 2011 are described.

##### 1. Evaluation of the CMI.

Between 2009 and 2011, several formal and informal evaluations of the project took place. Some were a follow-up of the interim reflection on the success of the existing CMI (see Section 5.4); others were caused by new developments (see Section 6.2).

##### *Evaluation of the Portfolio Matrix*

In 2009, the Portfolio Matrix (see Figure 5.1) was evaluated because the interim reflection had shown that several users perceived the quality of the axes as unreliable (Section 5.4). An expert meeting with several users<sup>16</sup> was organized to (re)discuss the axes of the Portfolio Matrix. With regard to the medical relevance (Y-axis of the Matrix)

<sup>16</sup> The meeting was attended by 10 persons consisting of chief physicians and delegates of the Research Council, directorate patient care and the F & C department.

it was discussed how the different relevance scores (e.g., relevance for the clinic, research, training, and education) could best be weighed. In the current method all scores were weighted equally (see Table 5.4). According to the participants, the advantages of the current method were the simplicity and the fact that all key tasks were involved. However, a disadvantage was that the core tasks of training and education were weighted too heavily in relation to the other tasks and therefore in some cases the wrong patient groups were shown as the most relevant. Consequently these patient groups got too much attention in the debate. In the end, it was decided to arbitrarily weigh training and education by half.

It was also discussed whether the relevance scores could be more objectified, for example, by complementing them with quantitative data (about the complexity of care, number of publications, etc.) or by a critical review by division managers or other chief physicians. It was concluded that these methods also had disadvantages. With regard to the use of data, it was argued that it was often difficult to link some data to specific patient groups. Critical reviews by colleagues were not seen as an option because it was expected that other managers would not have the knowledge to do this or would not do this seriously because they were colleagues. Eventually, it was decided not to further quantify because one agreed that by definition it involved opinions rather than facts; further quantification might mistakenly suggest that ‘the truth’ was represented.

With regard to the financial relevance (the X-axis of the Matrix) it was argued that finance could dominate too much in the discussions. Moreover it was questioned if this information was relevant to the patients in the A-list DBCs, because for this part the AMC was still budgeted (See also Section 2.5). Despite these objections, it was decided to maintain the current axis, because it contributed to cost awareness and made the possible consequences of the new performance-based funding visible.

#### *Evaluation of the use of the CMI in making case-mix decisions (portfolio strategy)*

In 2010, the use of the CMI in making case-mix decisions was evaluated because the interim reflection had shown that users experienced obstructing factors to making these decisions directly on the basis of this information (Section 5.4). A new pilot (pilot group III) named ‘From analysis to decision’ (also called “the portfolio strategy”) was launched with the aims of investigating how the process of making case-mix decisions could be optimized, what (case-mix) information was necessary for this, and to what extent the current CMI met the requirements. First, there was an inventory of how the processes of defining portfolio strategy took place at the pilot specialties<sup>17</sup>. All specialties defined

<sup>17</sup> Nine medical specialties participated in the pilot: Gastroenterology, Orthopaedics, ENT, Ophthalmology, Neurosurgery, Neurology, Obstetrics, Radiotherapy, and Rehabilitation. Two meetings were organized with this pilot group III, consisting of 13 persons people, such as chief physicians, director of operations, business office assistant, and employees of the F & C department.

their portfolio strategy in long term plans, generally every three to five years. However, there were significant differences between the departments in the process and contents of the plans. All specialties had used the CMI as a support for their portfolio strategy. The pilot group discussed the factors that promoted or obstructed the use of the case-mix information so far. The results are summarized in Table 6.2 (AMC, 2010).

**Table 6.2: Success promoting and obstructing factors of the CMI**

Variable	Promoting factors	Obstructing factors
Design of the CMI	<ul style="list-style-type: none"> <li>Provides insight into DBC structure, case-mix, registrations, calculations</li> <li>Combination / presentation type of data</li> <li>Support the dialogue, decision making</li> <li>Fast access to detailed data at patient level</li> <li>Leads to a change of mind</li> </ul>	<ul style="list-style-type: none"> <li>Quality of DBC system</li> <li>Quality of information</li> <li>Inaccessible information</li> <li>Difficult to work with Cognos</li> <li>Information relates to the past only</li> </ul>
Design & implementation strategy	<ul style="list-style-type: none"> <li>Involvement medical departments</li> <li>Phased implementation</li> <li>Voluntary use of the CMI</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient involvement of business offices</li> <li>Voluntary use of the CMI</li> </ul>
(Medical) manager	<ul style="list-style-type: none"> <li>Need for more/ better information</li> <li>Much competition/ much financial pressure</li> <li>Much decision autonomy</li> </ul>	<ul style="list-style-type: none"> <li>Lack of knowledge / experience/ time</li> <li>Little competition/ little financial pressure</li> <li>Little decision autonomy</li> </ul>
Organization	<ul style="list-style-type: none"> <li>The size and complexity of AMC</li> <li>Lack of alternative information systems</li> </ul>	<ul style="list-style-type: none"> <li>Lack incentives for performance improvement</li> <li>Lack of clarity / absence strategy</li> <li>Management information from other initiatives</li> <li>Culture of ‘wheeling and dealing’</li> <li>Barriers between divisions and specialties</li> </ul>
Environment	<ul style="list-style-type: none"> <li>Competition pressure</li> </ul>	<ul style="list-style-type: none"> <li>Continuously changing conditions (policy plans)</li> <li>Bottlenecks in DBC structure</li> <li>Legal barriers to manage on patients</li> </ul>

These findings largely matched with the results from the interim reflection (Section 5.4) and a number of necessary improvements, as defined in Table 5.8, were already planned to tackle the obstructing factors. But there were also new findings, as a consequence of increased experience with CMI including the new information products in Cognos, and of new events that had occurred since then.

First, it was concluded that the design of the CMI was based on several assumptions that were theoretically correct but did not correspond to the practice of the AMC. For

example, the assumption that patient groups were the central carriers of management information was supported by most medical managers (see Section 5.4.1), but in practice management talks still focused on the traditional budget parameters and finance. This confirmed the need for patient groups to get more attention in the Planning & Control cycle and in the quarterly meetings. Another assumption was that case-mix decisions were made on the basis of objective criteria and information. This was supported by most medical managers, but in practice, many decisions were still made on the basis of ‘wheeling and dealing’ between people. The pilot group concluded that the process of defining the portfolio strategy had to be more structured and standardized, with objective decision criteria and information, and that the CMI could well support this.

Second, the raid of the NMa in 2010 (see Section 6.2) was seen by some chief physicians as a signal that they were *legally not allowed* to manage patient groups and therefore it made no sense to think about portfolio strategy (“we must obviously accept every patient”). During the meeting it appeared that the knowledge about the options to manage patient groups, both practically and legally, strongly varied per medical manager and it was concluded that users of the CMI had to be better informed about this, for example through training. Third, the experiences with the information products designed in Cognos (see Section 5.3.3.) were mixed. Advantages that were mentioned were that the CMI provided access to detailed data at the patient level and the data had become widely available, also for the business administrators. However, several chief physicians found Cognos too complex, even after they had received training. This was a relevant finding, because until then the project group was of the opinion that all medical managers had to be able to work with Cognos, since it was the prevailing business intelligence tool. It was decided that user training had to continue, but a distinction had to be made between training for medical managers and for business analysts because these users had different roles in the strategic management cycle and therefore had different needs and skills with regard to the CMI.

#### *Evaluation of the use of the CMI in the Planning & Control cycle*

In 2010, the use of the CMI in the Planning & Control cycle was evaluated by the F & C department because at the interim reflection it was concluded that the CMI should be better embedded in this cycle (The F & C department concluded that the CMI could support the planning process in several ways. First, with the CMI, relations between medical substantive policy and logistical / financial policy could be established in a more systematic and concrete way. Second, the CMI could be used to translate the policy plans of the medical portal specialties to the supporting specialties, such as the operating room and diagnostic departments. Until then, the departmental plans were often very global as the content of care was hardly taken into account. Third, the CMI

made it possible to quantify the impact of policy plans on capacity and money. As a result, it was decided to take the patient groups (type and number) of the AMC as a starting point in the planning process and to use the CMI for their quantification.

#### **2. Process design**

Based on the results of the interim reflection and the new developments, in 2009, a plan was drawn up for the (re) design and implementation of the CMI in the following years. With regard to the target groups, pilot group III was asked to structure the process of making case-mix decisions and to determine what adjustments to the CMI were necessary to support this. Regarding the Planning & Control cycle, it was decided to deploy the possibilities of the CMI much more, both for the divisions and for the F & C department. As concerned the CMI, several measures were planned for improving the quality of the data, such as the increase of automated checks in the processes of data collection and distribution, the validation of the data by the internal audit department and the organization of an expert meeting to discuss the quality the Portfolio Matrix. The Minimal Dataset would be revised on the basis of the interim reflection and the new pilot project. Finally, to increase access and the analytical capabilities of the CMI for the business analysts, data cubes would be designed in Cognos<sup>18</sup>. With reference to the implementation strategy, it was planned that the case-mix information would be available earlier for the users so they could use them for the budgeting process.

#### **3. Object design**

Between 2009 and 2011 both for the (medical) managers and the business analysts existing products were redesigned and several new information products were designed.

#### *Redesign of the existing information products in the CMI*

The *Minimal Data Set* (see Section 5.3.1) was extended several times. The extensions related to the complexity of care (including the health condition of surgical patients), characteristics of the patient (socio-economic class, age, and gender), more detailed cost data (cost components), and the link between patient groups and focus points of the AMC. Data had been collected over several years and trend data became available. These data were added to the existing data warehouse and Standard Report Patient Care. Regarding the Portfolio Matrix, the overall relevance score was now determined by weighing training and education by half. Finally, in the course of time, the ‘Intranet Page Management Information Patient Care’ (see Section 7.4.4) was further improved and expanded on the basis of feedback from the users.

<sup>18</sup> Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management. The software is designed to enable business users without technical knowledge to extract corporate data, analyse it, and assemble reports.

*Design of new information products*

In 2009, an *Interdependency Analysis* (see Section 7.3.3) was designed for the (medical) managers with the aim of providing insight per medical specialty about the extent to which the treatment of patients groups was related to patient groups of other specialties. This analysis was designed because the interim reflection had shown that medical managers needed this insight when making policy choices. It gave insight into which departments and patient groups were affected when changes occurred with respect to the type and volume of patient groups. The F & C department also used this analysis to assess the consistency of the defined volume trends per patient group between medical departments.

Also in 2009, the project organization designed a *Management Game* (see Section 7.5.2). The game was a response to the (medical) managers' need for education about the use of the CMI. This game related to a fictional case where case-mix decisions had to be made and operationalized, supported by case-mix information. The aims of this game were to learn to interpret and use the case-mix information that was available at the AMC, dealing with different roles and interests and shared decision-making.

For the business analysts, in 2009 a *Data Cube Care Products* was designed in Cognos (see Section 7.4.1). This cube was designed because the interim reflection clearly indicated that business analysts needed better access to the underlying data of the Standard Report and Portfolio Matrix to support the medical managers. Because of this a unique set of data was created that could be used for different purposes. The advantages of the cube were that appropriate analyses could be made at various levels (AMC-wide, per division, per patient group, per diagnosis, etc.); data could be easily selected, combined (e.g., the relationship between the origin of the patient and the diagnosis) and presented. Additionally, in 2011 *Standard Views*<sup>19</sup> on this data cube were designed for them so that users no longer required advanced Cognos skills.

In 2010, a *Portfolio Checklist* was designed for the (medical) managers, see Section 7.3.5. The aim of this product was to support them in assessing their case-mix in a systematic way on the basis of the different types of case-mix information, and translating their outcomes to decisions relating to the case-mix and the underlying care processes. The Portfolio Checklist was designed because the interim reflections had shown that several managers felt the need to structure and standardize the case-mix decision-making process. The Checklist contained a generic set of twelve standards that might be relevant to assess their current portfolio. Based on the checklist, the medical managers could assess whether their case-mix was 'in balance' and whether actions were necessary to optimize this.

<sup>19</sup> A standard view is a specific selection of the data cube that can be stored.

*Design process*

The project management defined the specifications for the (re)design of the Minimal Data Set and information products. The specifications per information product related to the layout, contents, definitions, sources, and which checks had to be made. They had to decide what information would be made available through the Standard Report Patient Care and what through the Data Cubes. The dilemma was that some managers needed a lot of detailed data and others did not. It was decided to add data to the Standard Report only if the majority of the users asked for it. The concern controller instructed the ICT department to design the products to conform to the specifications. The prototypes were presented to and tested by some end users, at an early stage.

The Interdependency Analysis was designed by the project management on the basis of DBC data. As each patient was recorded for what diagnosis and by what medical specialty he or she was treated, it was possible to calculate the degree of interdependence between medical specialties on the basis of data over several years and to visualize this. Prototypes of the Interdependency Analyses were designed and tested with several medical specialties.

The Portfolio Checklist was designed by pilot group III. This pilot focused on the optimization of the phases analyzing, (case-mix) decision-making and implementation of the strategic management cycle of the AMC (see Section 2.8), because these phases were considered by the participants as the most relevant, but also the most difficult. First, the pilot group defined what criteria were relevant for making case-mix decisions. As a basis for discussion, a quadrant model for portfolio strategy<sup>20</sup> was used. In this model it is assumed that in the portfolio strategy of hospitals four quadrants are relevant: professional, social, market, and business. The objective for the (medical) managers was to keep these quadrants 'in balance' as much as possible. Accordingly, the pilot group defined three generic standards per quadrant that they considered as relevant and useful for the assessment of their case-mix. Defining these 12 standards was experienced by the participants as useful: it was a way to gain more insight into the performance of the department, and it forced them to reflect better and make appropriate decisions. Then, for each standard the pilot group determined what type of information was needed in order to test whether one complied with the standard. It was also discussed what the source of this information should be and how it could be monitored if the portfolio met the standards. Accordingly, the checklist was designed as a tool to systematically assess the portfolio on the basis of the scores on the 12 standards.

Finally, the members of the pilot group tested the checklist by using it for the assessment of their own case-mix. Based on the outcomes, the group defined measures to optimize

<sup>20</sup> This model was designed by an external consultancy office (Zorgconsult)

their portfolio and underlying care processes. As a result of this, the whole process from analysis to decision-making was completed. Although this checklist was experienced as useful by the pilot group and led to some real policy decisions, the medical specialties involved in the pilot were reluctant to implement it corporate wide. One reason for this was that it proved impossible to apply generic standards for each medical speciality and these standards had to be customized per type of speciality. It was therefore difficult to implement this checklist corporate wide. But there was also some fear among chief physicians that division managers or the Board of Directors would use the checklist to assess them and thus their decision-making power would be limited.

#### 4. Implementation of the CMI

##### *Implementation of the information products*

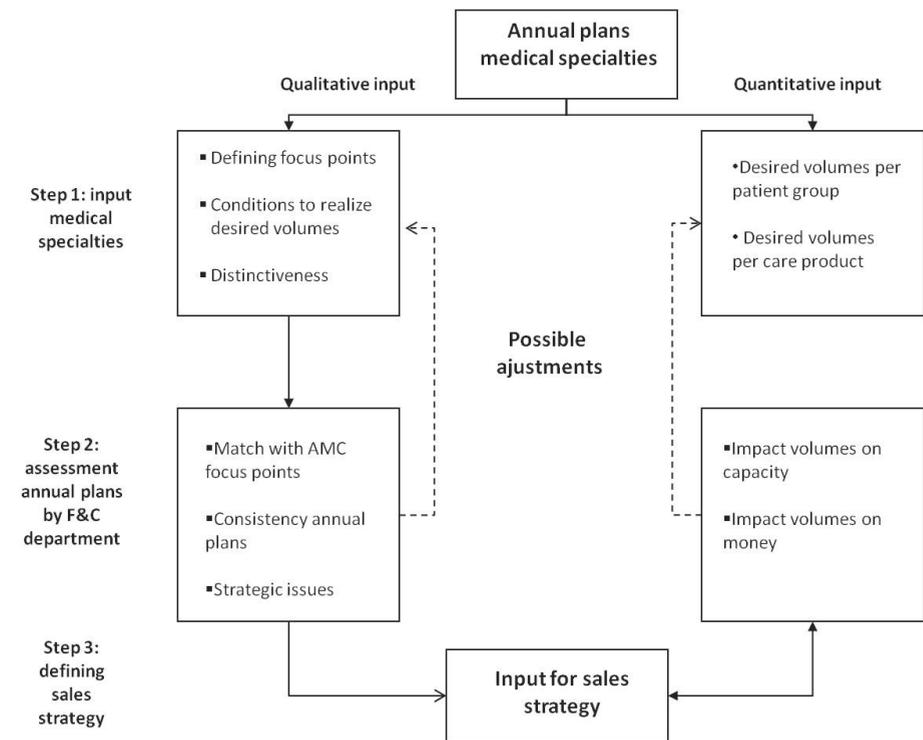
In the course of time, the redesigned and new information products were implemented, i.e. became available for the authorized users. At every implementation, users were informed by email about the available information products, about how to use them, and about the content of the changes compared to the previous versions. Furthermore, users were requested to validate their own data, to read the manuals, and to provide feedback about their findings, questions, and suggestions to the project organization. In addition, the project organization planned meetings with all medical specialties to discuss the information personally.

##### *Use of the information products*

Between 2009 and 2011, the CMI was further embedded in the Planning & Control cycle by establishing the relationships between medical, logistical, and financial policy in a systematic way, see Figure 6.1.

For the *planning phase*, the medical specialties were asked to indicate the desired volumes per patient group and to provide qualitative input, such as focus points and distinctiveness (step 1). For this step, the chief physicians and divisional managers used the Standard Report Patient Care, Portfolio Matrix, and Interdependency Analysis to get insight in their current case-mix and the relations with other specialties. Accordingly, the F & C department used the CMI to assess the annual plans (step 2). They checked the content of the plans, such as the fit of the desired volumes with the strategic aims and consistency of the plans, using the Interdependency Analysis. Furthermore, they calculated the impact of the medical plans on capacity (logistical) costs and returns (financial policy). On the basis of this assessment it was determined whether adjustments of the annual plans were necessary or not. The final annual plans served as input for the sales strategy (step 3). The F & C department attempted also to rationalize the allocation

Figure 6.1: Use of the CMI in the budgeting process



of operating room capacity to the medical specialties on the basis of CMI data but this failed. Reasons for this were the perceived poor quality of the data, but also because of political and historical influence in the budgeting process. The Board of Directors was afraid that budget changes would lead to discussions between divisions.

For the *control phase*, the chief physicians and division managers used the Standard Report Patient Care during the year to monitor if the actual volume trends matched with the desired volume trends. Twice a year, the divisional managers were asked to report to the Board of Directors about possible significant differences between actual and desired volumes and to explain these differences and what action would be taken.

Furthermore, the CMI was used for other purposes such as specific business cases, the improvement of registrations and external legitimization. For example, in 2011 the Dutch Health Care Authority presented the DOT product structure and the maximum tariffs per care product (regulated segment) for 2012. On the basis of the CMI the AMC was able to demonstrate that for various specialties (Pediatrics, Cardiology and Neurosurgery) the rates by far did not cover the actual costs and objected to these rates.

As a result, the rates were significantly increased. Finally, in the context of health care efficiency research the AMC Clinical Research Unit repeatedly used the CMI database to perform cost-effectiveness studies which were published in scientific journals (Dijksman et al, 2008; Saltzherr et al, 2013; Bartels, S. et al; 2011). The CMI project management hereby advised of the availability and quality of the data and how these data could be used, for example, regarding the unit cost data.

#### *User training*

Several training sessions were organized for the target groups of the case-mix information. In 2009, the developed Management Game (see Section 7.5.2) was played at the yearly strategic conference for the top managers, consisting of the Board of Directors and divisional management. The game was played by 35 (medical) managers and was experienced as successful by them. For all chief physicians, in 2010 a training session was organized, called 'Optimization of Care.' In this training session, the current CMI system was presented. Examples of how this information could be used for portfolio strategy and process optimization were given. After the implementation of new versions of the information products in Cognos several Computer Training sessions (see Section 7.5.2) were organized for the business analysts. During these sessions there were demonstrations of how the information could be used in practice and how it could be interpreted. The training sessions were positively evaluated by the participants and the evaluations showed that the training had increased their skills, knowledge, and willingness to use the CMI.

### **6.3.2 2012 to 2014**

In this section, the phases of the regulative cycle which were passed through between 2012 and 2014 are described. In this period all existing information products were redesigned because of the introduction of the DOT product structure and earlier reflections on the success of the CMI. Furthermore, several new information products were designed. In 2014, it was concluded that the design of the CMI was completed and that the highest possible aims of the system has been achieved.

#### **1. Evaluation**

##### *Evaluation of all existing information products*

In 2012, all existing products of the CMI were re-evaluated. The main reason was that in 2012 the DBC product structure was replaced by the DOT product structure and a new internal budgeting system had to be implemented (Section 6.2). Other reasons were that there was still the need to improve and extend the current information products. Some needs were already identified at the interim reflection (Section 5.4);

others emerged as result of new projects such as SLIM and the A3 methodology (see Section 6.2). For this purpose, the F & C department decided to start the project 'Revision Management Information Patient Care.'<sup>21</sup> The project group concluded that all existing information products had to be technically redesigned. Furthermore, the content of the existing information products had to be adjusted in several ways. Standards in management information should be incorporated and there should be more visualization. Furthermore, benchmark data per care product were needed (for the SLIM project). Finally, new useful data became available. For example, with the introduction of the DOT, all hospitals were required to register the type of referrer of the patient (general practitioner or other hospital). This provided new and interesting information, because the type of referrer reflects to some extent the complexity of care.

##### *Evaluation of the use of data and management information in the AMC*

In 2012, a project group 'Data Management' was formed<sup>22</sup>, because various problems with regard to the use of data and management information in the AMC had been identified, not only in the field of patient care, but also in finance and HR. The problems related both to the quality and the organization of data. Much data were difficult to access and not formally validated. Some data were also conflicting and there were problems with the availability of data. Moreover, there were no clear procedures for designing and implementing management information, Clear procedures were also lacking with regard to access, privacy and confidentiality of data. 5. To solve these problems, the project group concluded that a formal policy with regard to management information in the AMC had to be developed.

##### *End reflection*

In 2014, a second and final extensive end reflection on the project took place by surveying 53 (medical) managers. They were asked to complete a comprehensive questionnaire about the final CMI, the perceived outcomes and the factors that promoted or obstructed its success. The results of the end reflection are presented in Chapter 8.

<sup>21</sup> The project group 'Revision Management Information Patient Care' was managed by the F & C department and consisted of 19 people including chief physicians, division managers, employees of the F&C department, business analysts and DBC consultants.

<sup>22</sup> The project group 'Data Management' consisted of 10 people including the concern controller, directors IT, advisors of the F & C department, and the department of Quality Process and Innovation.

## 2. Process design

Based on the results of the project 'Revision Management Information Patient Care,' (RMIPC) there were plans about what had to be (re)designed and when. Priority was given to the information products that were needed for Planning & Control and sales, such as the Standard Report Patient Care and underlying Data Cubes in Cognos. The reason for this was that because of the introduction of performance-based reimbursement the revenues of the AMC were determined by the production and delivery of DOT products rather than budgets. Therefore accurate information about volumes and turnover was required. The RMIPC-project group 'defined the specifications for the (re)design per information product in terms of layout, contents, definitions, sources and checks. The concern controller instructed the ICT department to (re)design the products in line with the specifications.

## 3. Object design

In this phase, the existing information products Standard Report Patient Care, Portfolio Matrix, Cognos Data Cube Care Products and Intranet Page Management Information were redesigned again. In addition to this, new products were designed. The products consisted of information products (Benchmark Analysis Resource Use Profiles, Cognos Data Cube Care Activities and Cognos Data Cube Market Shares), intermediate products (Forecasting Model, Top Referral Care Model). Finally, an Information Policy was defined.

### *Redesign of the existing information products in the CMI*

In 2012, the *Standard Report Patient Care*, *Portfolio Matrix* and *Cognos Data Cube Care Products* were based on the new DOT data instead of DBC data. Furthermore, other adjustments took place.

With regard to the Standard Report Patient Care, new types of information were added (such as type of referrer, waiting times, forecasts, and market shares) and several standards were added (for example, budgets and waiting times). Some figures were included by the project management because they were convinced that this was in the interest of the organization, for example, figures related to the quality of the registration and financial coverage in the course of time. They tried to make the (medical) managers more aware of their role in the administrative process, to increase cost awareness for the full cycle of care and to improve registrations. Next, the Standard Report was not only made available per medical specialty, but also per division and at corporate level. The Standard Report at corporate level showed information per division, the report for the divisions per medical specialty and at the medical specialty per patient group. Third, at the request of the chief physicians, the Standard Reports for the medical departments Internal Medicine and Pediatrics were divided by sub-specialty (such as Oncology, Infectious diseases, and

Pediatric surgery). Finally, the Standard Reports could be downloaded by the users at any time and at any organizational level (AMC, division or medical specialty) by means of a selection menu on the Intranet Page Management Information (see Section 7.4.4). This increased the timeliness and accessibility of the Standard Report significantly. In 2014, the Standard Report was adjusted again on the basis of the end reflection (see Section 8.2).

As concerned the *Cognos Data Cube Care Products*, several new types of data were included with respect to the old Data Cube For example, the names of the referring general practitioners and hospitals were added to provide insight on who referred the patients to the AMC for what diseases. Furthermore, the names of the treating physicians were added. As a result, it became possible to show the production per physician and to create new combinations of data, for example, between physician and internal transfer cost for the use of imaging, see Section 7.4.1. This additional information was requested by the chief physicians because it enabled them to discuss with physicians about their productivity and cost reductions.

The *Intranet Page Management Information Patient Care* was significantly expanded and professionalized. Download menus were designed that allowed users to download the Standard Reports Patient Care, as well as detailed data from the server of the ICT Department. The advantage of this was that users could generate this data themselves and were no longer dependent on ICT capacity. Furthermore, the intranet page contained links to all available information products with regard to patient care and the associated manuals.

### *Design of new information products*

A *Benchmark Analysis Resource Use Profiles* was designed for the medical managers that showed per DOT product or diagnosis what care was delivered against what costs, and compared this information with other UMCs (see Section 7.3.4). This analysis was designed because all managers had to reduce costs structurally to realize the strategic aims of the AMC and meanwhile also had to improve the quality of their care processes (see Section 6.2). The aims of the analysis were to examine the current efficiency by comparing costs and activities per care product with other UMCs and by trying to explain possible deviations. A summary of the Benchmark Analysis was sent to the medical managers. The full database with detailed data could be retrieved via a download menu on the Intranet page.

Furthermore, a *Cognos Data Cube Care Activities* was designed for business analysts with detailed data on medical activities), such as the type of activity (outpatient clinic, clinic, laboratory, etc.), type of related care product and diagnosis, patient characteristics, and

finance (see Section 7.4.2.) These data were needed to get a complete financial picture in the Standard Report Patient Care, because there were many medical activities that were charged separately to insurers (for example intensive care days, expensive drugs) and not through care products. Furthermore, there was a great need by business analysts for this type of information so that they could perform specific analyses for example at doctor level or medical specialty level.

The *Cognos Data Cube Market Shares* was also designed (see Section 7.4.3). This Data Cube contained the number of care products at the AMC compared with other UMCs, top clinical hospitals, and general hospitals<sup>23</sup>. With this cube, insights could be obtained about the market share per type of care product and about diagnoses. This was considered relevant for making case-mix decisions and for the sales strategy. The market shares per patient group were incorporated in the chapter on the health care market of the Standard Report Patient Care. At a more detailed level, it also provided insight into how the patient characteristics (age, gender) and treatment setting of the AMC differed from other hospitals.

#### *Design of intermediate products: Forecasting Model and Top Referral Care Model*

Data with regard to forecasts and percentages of top referral care were added to the Standard Report and Data Cubes. However, these data were not registered in the computer systems, but had to be calculated. To realize this, calculation models were developed. Regarding the forecasts, a *Forecasting Model* was designed by which the volumes and turnover of care products and care activities could be predicted. This model was based on extensive statistical analyses. To measure the percentages referral care, a *Top Referral Care Model* was designed. Since there were no clear national definitions about what top referral care was, the AMC used its own definition based on patient's travel distance and type of referrer.

#### *Design of an Information Policy*

On the advice of the project group 'Data Management', in 2013 an *Information Policy* was completed (see Section 7.5.3). It contained topics such as principles for management information and responsibilities of parties involved in the process of providing and using management information. Important principles were that the F & C department was in control of the design and prioritization of management information, that the central Standard Reports (such as A3, Standard Report Patient Care) were the focus in the quarterly meetings and that these reports should be validated by the internal audit service to ensure quality. Because of this, the Standard Report Patient Care was given a more formal status in the management meetings.

<sup>23</sup> Data are made freely available to all Dutch hospitals by a national organisation by the Dutch Hospital Data.

#### *Design process*

In June 2012, the Standard Report Patient Care, Portfolio Matrix, and Cognos Data Cube Care Products were redesigned and tested by the RMIPC-project and several other managers. However, at that time there were no actual data available with regard to DOT production and selling prices. For several reasons, the replacement of the DBC product structure by the DOT structure was more complex and extensive than expected. First, it took about nine months before the first DOT production data became available. The reasons for this were that the computer algorithms did not work properly and that essential data for deriving the DOT care product were missing. Second, since the DOT data were generated in a different way by different computer algorithms and in different systems, a test grouper of the Dutch Health authority (NZa) had to technically examine how these data could be collected. Third, since the DOT care products differed considerably from the DBC products in terms of content and terminology, it had to be examined how the content of the data could be interpreted, what the quality of the data was, and what this meant for the design and implementation of the CMI. Fourth, the introduction of the DOT also implicated that, as in previous years, it still took a long time to complete the negotiations with the insurers). As a result, until then the agreements about volumes and selling prices were missing in the CMI and no cost / benefit analyses could be carried out. Finally, because of the introduction of the DOT, it was in many respects no longer possible to compare data from previous years, so much trend data was lost. The (re)designed information products were filled with provisional data<sup>24</sup> to be tested by the RMIPC-project group. On the basis of their findings, the products were technically completed in June 2014.

With regard to the Standard Report Patient Care, it was chosen to provide clear explanations on used sources and selections and on the interpretation of the figures. The dilemma was that the more explanation that was given, the more likely it was that it would not be read or that the figure would be mistrusted. Therefore it was decided to keep the notes in the report as short and powerful as possible. Another dilemma was that the presented revenues still did not match with the actual revenues of the divisions because the internal budgets were, contrary to earlier announcements, not linked to the DOT production. This led to heated discussions, both within the F & C department and between the F & C department and users as to whether this information should be displayed or not. Opponents argued that this information should not be displayed because they feared that wrong conclusions could be easily drawn.

<sup>24</sup> The DOT production for the period January to June 2012 was sent to a *test grouper* of the Dutch health authority (NZa), with the result that about 70.000 provisional DOT products were derived. With the largest health insurers provisional agreements were made about volumes and selling prices of the care products.

Also the sales department objected to displaying this information, but for other reasons. They negotiated the selling prices and made strategic choices herein. As a result the selling prices did not reflect the real costs. By giving insight into the revenues, they feared discussions with the medical departments. Proponents argued that displaying this information was useful, because they expected that in the future the link between internal budgets and DOT revenues would be established anyway, and because they thought that users needed to understand the current financial coverage of health care products to increase cost awareness and quality of registrations. In the end, the decision was made to continue displaying the information with regard to revenues but in combination with explanations. Finally, the decision that the Standard Report for the medical departments 'Internal Medicine' and 'Pediatrics' were divided by sub-specialty, meant that for each sub-specialty the patient groups had to be redefined by the sub-chief physician and non-system data had to be collected again (such as relevance scores). This also implied that new users of the case-mix information emerged: the sub-chief physicians, who had to be trained on the use of this information. This was a major operation and resulted in a high use of the capacity of the ICT and F & C department which was not actually available.

The Benchmark Analysis Resource Use Profiles was designed by the F & C Department in cooperation with an external organization which maintained the DOT product structure ('DBC onderhoud'). The benchmark was based on production data of all Dutch hospitals in 2010. During the design of the benchmark, several choices were made. For example, it was decided to benchmark the Resource Use Profiles at the most detailed level (i.e. per diagnosis and care product), because we expected that we needed these details for the further discussions with the medical specialties. The Cognos Data Cubes Care Activities and Market Shares were designed by the ICT department in line with the instructions of the concern controller.

The Forecasting Model was also designed by the F & C department through extensive statistical analyses. With the DBC product structure it was quite difficult to make accurate forecasts. Because of the closing rules of the DBCs (see Section 2.5) it could take a long time before it was known what the definite care product of the DBC trajectory would be. This was especially true for follow-up DBCs, which were often closed after one year. Furthermore, due to major changes in the product structure, for several care products the statistics of the previous year were of very limited usability. The F & C department faced the problem that in 2012 there was no historical DOT data available. It was expected that in the course of time, the model could be improved more and more on the basis of production data and new insights.

The Top Referral Care Model was designed by the F & C department to calculate the percentage of top referral care per care product. This information was needed to gain

insight into the complexity of care and monitor if the actual percentage met the norm as defined in the A3 methodology, see Section 6.2. Since there were no clear national definitions about what top referral care was, F & C used their own definition and designed business logics to quantify top referral care. The outcomes of the model were discussed with a small number of chief physicians and on the basis of their findings the model was refined. The percentages of top referral care were weekly calculated for the care products and could be broken down into each desired level, such as patient group, diagnosis, and medical specialty. The percentages were presented in the Standard Report Patient Care and Cognos Data Cubes. It should be noted that this was an initial and global approach that certainly had limitations. First, the outcomes were largely determined by the quality of the registration of referrers. Second, several other criteria might also determine whether care is regular care or top referral care. Factors such as the interaction between care and research and the use of specific (high tech) procedures are also relevant. During this project, a more advanced model was designed by all UMCs together. This model consisted of eight different labels to determine the level of top referral care. Interestingly, the outcomes of the pragmatically oriented AMC model were very much in line with the outcomes of the more advanced model.

#### 4. Implementation of the CMI

As mentioned before, the further increase of pressure on competition (through liberalization) and finance (because of performance-based reimbursement) strengthened the need for more, and better, case-mix information. When in mid-2012 there were still no DOT production data and selling prices available, the project organization decided to implement the redesigned Standard Report Patient Care, Portfolio Matrix, and Data Cubes with the provisional data, which had been tested earlier, to all authorized users. The project organization thought that it could not withhold this information any longer from the users. With the introduction of the DOT, a detailed understanding of these care products, underlying activities, revenues, and costs was necessary. Chief physicians and division managers needed this information to gain insight into their DOT production for 2012, the quality of the registration, and the preparation of the yearly plans for 2013. The Concern Controller needed this information for the negotiations with health insurers. F & C needed feedback from the users to validate the quality of the data and to further improve the information products. Because the data of the information products were incomplete and not validated, there were risks in using this information. For these reasons, the project organization determined for what purposes the CMI could be used (getting insight in DOT production, registrations, cost awareness) and not be used (taking case-mix decisions directly based on the CMI). These were described in *disclaimers* and were added to the information products.

### *Implementation of the Standard Report Patient Care*

In the second half of 2012, the redesigned *Standard Report Patient Care* was discussed with all chief physicians, division managers, central managers, and business analysts. These meetings were used to explain the new report, to collect comments, and to actualize the classification of patient groups and the non-system data. Although users reacted positively on the new types of information, there was a wide frustration that no actual production data were available. Furthermore, several chief physicians and division managers indicated that the financial figures were still less relevant to them, because the presented revenues did not match with their budgets that were still not linked to the DOT production. Moreover, within the types of information the relevance and usefulness of information varied per medical specialty. Surgical departments needed management information about operating rooms, such as delays, minimum interventions and surgery hours. Clinical departments needed information on the length of stay, and number of (day) admissions and outpatient visits. Medical specialties that make considerably use of supporting medical departments (laboratory, imaging) needed management information on the internal transfer costs. So, although a standard set of management information was available hospital-wide, there was a strong desire of the users to adapt and modify the standard information to their specific needs.

During 2013, more and more DOT production data became available and the Standard Report Patient Care was further improved. The improvements particularly concerned the layout and explanations of the figures in the reports and the forecasts of volumes and returns of the DOT products. Furthermore, several figures in the Standard Report were incorporated in the 'A3 dashboard' (see Section 6.2) to give insight into trends and to give possible explanations for the performance of care indicators. In this way, the CMI and A3 methodology were connected and it became possible for users to relate care indicators to other performance indices, for example the number of staff. The integration of the CMI information in the A3 dash board made the CMI no longer a standalone system. It was now embedded in the Planning & Control cycle. Because of this, the CMI information got more attention in budget talks and quarterly meetings.

At the end of 2013, the final version of the Standard Reports Patient Care were sent to all chief physicians, division managers and Board of Directors, including a summary of the most relevant findings for their entity. Through this, it was explained to them how the figures in the report could be interpreted, what conclusions could be drawn, and what actions could be taken. Although this was a very labor-intensive operation, it provided several new insights. As of 2014, the Standard Report Patient Care was sent automatically to chief physicians, division managers, central managers, and business offices on a monthly basis.

### *Implementation of other information products*

In 2012, the outcomes of the Benchmark Analysis Resource Use Profiles were made available to all managers and business analysts through the intranet page. However, the analyses were not actively promoted, because the project management had noticed that it was very labor intensive to discuss the outcomes of the analyses with the medical specialties in a responsible way. The decision was made to use the analyses for the SLIM project and to focus only on the four medical specialties where the costs of the care products were significantly higher than the average of the other university medical centers. In this way, most efficiency gains could be expected.

The redesigned Intranet Page Management Information and the new designed Data Cube Care Activities and Data Cube Market Shares in Cognos were implemented in 2012 for the business analysts. All users were informed about the contents of these products, of the changes compared to previous versions, and disclaimers.

Between 2012 and 2014, the CMI was still used in the Planning & Control cycle, but in a different way than before. For the *planning* phase, the medical departments were still asked to indicate the desired volumes, but per care product rather than per patient group. The reason for this was that as of 2012 the negotiations with health insurers had become more detailed and patient groups were too aggregated for this discussion. For this first step in the cycle, the chief physicians and division managers used the Standard Report Patient Care, Portfolio Matrix and Interdependency Analysis with provisional data to gain insight in their current case-mix and the relation with other medical specialties.

For the *control phase*, the chief physicians and divisional managers used the Standard Report Patient Care during the year to monitor if the actual volume trends matched with the desired volume trends. However, it was not possible to monitor if the actual DOT volumes and turnover matched with budgets, because F & C had not allocated the budgets to the medical specialties and divisions.

The outcomes of the Benchmark Analysis Resource Use Profiles were discussed with four medical specialties. Per specialty, three meetings took place with the chief physicians, the medical staff and members of the SLIM project team. During these meetings, participants discussed the possible causes of the differences in costs between AMC and other UMCs. In addition, internal benchmark analyses were conducted revealing variation in provided care per physician. Finally, several actions were defined in order to optimize the care processes and to reduce costs, such as the admission of the patient on the surgery day (rather than the previous day) and weekly discussion about the average length of stay on the departments. These meetings were experienced as useful by the

participants and demonstrated that efficiency gains really could be realized, particularly by sharing knowledge between physicians and by standardizing care processes. On the other hand, there was also criticism on the Benchmark Analyses. For example, it was unknown if the registrations and types of patients of the AMC were similar to those of the other UMCs and if the data were actual. For the latter, it was decided that the benchmark analyses had to be updated first, before implementing it actively AMC-wide.

Furthermore, the CMI database was used by the department of Quality, Process & Innovation to analyze the care processes of a selected number of surgical patient groups. The bottlenecks in the processing times and the degree of variation within the process were examined. For these patient groups, the corresponding DBC data were obtained from the CMI, for example information on diagnoses and care activities. Finally, the CMI was used for the preparation of the administrative merger with the VUmc. To draw up the plans, AMC and VUmc were allowed to exchange DBC data from the previous years. The classification of the AMC's patient groups formed the basis to cluster the DBC data of both UMCs in the same way. Because of this, insight was gained about which patient groups overlapped or which complemented each other's activities. The classification of AMC patient groups turned out to be very usable for the chief physicians of the VUMC and was only minimally adapted to identify specific patients of VUmc.

#### *User training*

In 2012 and 2013, several user training sessions were organized. For the managers, a new management development program was launched that was meant for chief physicians, work place managers, and head nurses. For this program, a Web Seminar was recorded in which managers received explanations about external and internal developments and about the available case-mix information to fulfill their roles as managers. The big advantage of this webinar was knowledge sharing. The Management Game was also played at several training sessions. For the business analysts, several computer training sessions took place in which participants were informed about the available information products and learned to interpret and use the new case-mix information.

#### *End of the CMI-project*

At the end of 2013, the Board of Directors and the project management concluded that the design of the CMI was ready and that the aims were sufficiently achieved, given the restrictions. With the total set of products, information with regard to patient care was available from a variety of perspectives: from strategic to operational, from historical to prospective, from standard to ad hoc, and from internal information to information from other hospitals. A presentation was sent to all authorized users with an overview of

all available information products and examples of use in practice. After this, the project that started in 2006 formally ended.

In 2014, several actions were taken to secure the CMI for the future, such as the embedding of ownership of the CMI in the organization and to ensure that the case-mix information would be kept available in 2015 when the new electronic patient system (EPIC) would be implemented. At the end of 2014, the AMC's CMI project was nominated for the European Porter prize<sup>25</sup>. According to the Jury report, the CMI showed great potential for cost effectiveness within the full cycle of care and was on the right track to increasing patient value by balancing between patient outcomes and costs (Porter prize, 2014).

### **6.4 Interim conclusions**

Several interim conclusions can be drawn based on the second part of the case study (2009-2014). Some conclusions were a confirmation or adjustment of earlier conclusions, others were new perspectives.

#### *Design and implementation variables*

In the period from 2009 to 2014, the CMI was redesigned, expanded, and completed on the basis of reflections on its success against the background of new developments. During this period, the number of users increased and more experiences were gained with existing and new information products. In the meantime, several major developments took place, both in the hospital sector and in the AMC, which had an impact on the design, use, and effects of the CMI (see Section 6.2).

With regard to the *design of the CMI*, several conclusions could be drawn. First, the DBC data still appeared to be very useful. Since the product structure had both a medical and financial component, these data could well be used for the steps in the Planning & Control cycle, such as preparing and assessing the annual plans and allocating budgets (see Figure 6.1). The replacement of the DBC product structure by the DOT product structure in 2012 had also some positive effects. For some specialties, the academic care of severely ill patients was in this way better reflected, and new data had to be registered, such as the type of referrer. Because of this, relevant information could be designed, such as the percentage of top referral care.

Second, the design and use of the new information products led to new insights. For example, the Interdependency Analysis appeared to be useful too since it visualized how the medical specialties were interrelated and where coordination of medical policy was

<sup>25</sup> The Porter prize is intended to give additional recognition to inspiring initiatives in health care that provide both excellent treatment outcomes and optimal patient orientation and involvement.

needed (see Section 6.3.1). The design of the Portfolio Checklist showed that the process of design itself was already useful because it forced managers to actively think about which factors were relevant for their case-mix (see Section 6.3.1). This proved that, similar to the process of defining patient groups (see interim reflection I), the process of designing the CMI produces positive effects, regardless of the use of it. However, it appeared to be difficult to implement this checklist corporate-wide, since several generic standards of the checklist needed to be specified per medical specialty. The Benchmark Analysis Resource Use Profiles showed that these analyses could seriously contribute to a dialogue about medical practice, efficiency gains, and cost reductions (see Section 6.3.2). The strengths were that the practice of the AMC was compared with the other UMCs only (rather than general hospitals) and the outcomes were presented at a detailed level. Unfortunately, the quality of the data was unknown and turned out to be outdated, which made it possible to reject the results of the analyses. The Data Cubes in Cognos increased the accessibility of the CMI and analysis capabilities significantly. However, it was concluded that Cognos was too complex for (medical) managers to use and the Cubes did not match their needs (see Section 6.3.1) This was an important finding, because until then there had been the company principle that all managers in the AMC must be able to work with Cognos, since it was the prevailing Business Intelligence tool. This meant that for the redesign of the CMI a distinction had to be made between information products for management and for business analysts.

Third, there was a persistent perception of poor quality of the data and it even deteriorated when the DBC system was replaced by the DOT system in 2012. Explanations for this were that the DOT data were generated by (more) complex computer algorithms and therefore less recognized and understood; the lack of actual data (volumes, selling prices) and the continuous changes in products structure, rates, and calculation models made the data unpredictable. As a result, many (medical) managers judged the quality of the DOT data as even more unreliable than the DBC data. This reduced the possible applications of the CMI significantly. The Board of Directors decided in 2012 to abandon the plans to link the internal budgets to DOT production. Because of this, an important aim of the CMI could not be achieved and reduced the need to use it. Although understandable from a management perspective, this was a major setback for the project because through this decision the relevance of the DBC information to the divisions and medical specialties decreased substantially. Besides, this was seen by several (medical) managers as a confirmation that the Board of Directors had also lost their confidence in the DOT data and therefore the CMI.

Also, other obstructing factors, which were identified earlier, still existed. For example, until 2011 the tariffs or the A-list DBCs were only virtual and did not represent the actual returns (see Section 2.5). The presented costs were therefore not recognized because of the complexity of the calculation process and calculation fictions. Furthermore, it still took much time to negotiate about volumes and prices with the health insurers and this meant that during the year essential data were missing and the CMI could not be used to gain insight into the actual financial coverage per care product or patient group. Also, there was a persistent perception that qualitative (non-system) data such as the relevance scores were of poor quality, despite the various measures taken to improve it. Suggestions from the project organization to objectify the qualitative data by supplementing it with quantitative data or by validation by colleagues were discussed during an expert meeting but rejected because the qualitative data were considered to be opinions and not facts. As a result nothing changed and the qualitative data remained debatable. The case study showed how complex it was to use qualitative, non-system data in the CMI, especially for medical managers who are used to guiding their clinical work by objective facts.

As concerning the *implementation of the CMI*, the project organization experienced major problems after the introduction of the DOT, because no reliable data were available. At the same time, the need for information was high because external performance-based reimbursement was introduced and financial risks had increased. As a result, it was decided to implement the information products based on the DOT data, but with provisional and non-validated test data, because we could not withhold this data any longer from the users. Because of this, users got their first insights into their DOT productions and their registrations and measures of improvement could be taken. However, the negative effects of this incomplete dataset were that there were risks of using this information and disclaimers had to be added to the information products. For example, a warning not to make case-mix decisions on basis of the CMI. Furthermore, the case study demonstrated that for the implementation of the redesigned information products (Standard Report Patient Care) and new information products (Interdependency Analysis and Benchmark Analysis Resource Use profiles), substantial support from the project organization was required.

#### *The organizational and environmental variables*

With regard to the (medical) managers, it was concluded that, in line with earlier findings, the increase of competition pressure and financial pressures increased their need for case-mix information. This was evidenced by the fact that more and more managers became interested in the CMI, such as the sub-chief physicians of the medical specialties Pediatrics and Internal Medicine. Most information needs were related to the formulation of austerity measures, better arguments in their discussions with staff

members about their productivity and transfer costs, and to the negotiations with health insurers. Also the business analysts needed better access to the underlying data of the CMI to support the medical managers.

Pilot group III (see Section 6.3.1) demonstrated that many managers found it difficult to analyze and translate case-mix information into case-mix decisions or underlying care processes. Explanations for this were the detailed level and perceived poor quality of the information, and the legal and practical barriers to managing the case-mix. It was also concluded by this pilot group that, in line with the interim reflection, the value of case-mix information should not be overestimated. Not all factors could be expressed with data and in the practices in the AMC many decisions were still taken on the basis of 'wheeling and dealing' between people. Several examples illustrated that the principles of the CMI did not always match with the organizational culture of the AMC. For instance, Pilot group III concluded that the design of the CMI was based on several assumptions that were theoretically correct, but did not correspond with the practice of the AMC. The assumption that the *patient groups* had to be the central focus in management meetings was supported by most (medical) managers (see Section 5.4.1), but in practice these meetings still focused on the traditional budget parameters and finance. The intention that case-mix decisions should be taken on the basis of objective criteria and information was agreed on by most medical managers as well, but several attempts to operationalize rational decision making in practice failed. The implementation of the Portfolio Checklist with objective and measurable standards to assess the portfolio in a uniform manner did not succeed because the chief physicians were afraid to lose autonomy and the decisions would be made for them by the division managers of central managers rather than by themselves. Also endeavours to objectify the relevance scores of the Portfolio Matrix with the use of quantitative data failed, with the argument that this had to remain an opinion, not a fact (see Section 6.3.1).

Attempts to link the annual plans of the medical specialties directly to operating room budgets were unsuccessful too because the Board of directors was afraid that it would lead to discussions between divisions (see Section 6.3.1). Furthermore, a number of (medical) managers still perceived barriers to managing patients, capacity, and finance. Concerning the management of patients, there were experiences not only of practical barriers (because of the type of patients, functional organization structure, allocated budgets, etcetera) but also of legal barriers. The NMA's raid in 2010 (see Section 6.2) was also seen as a confirmation that they were not allowed to 'really' manage patients. With regard to the management on capacity and finance, the responsibilities and decision-making power of chief physicians and division managers remained unchanged. Budgets on capacity and finance were still determined by the F & C department, were quite

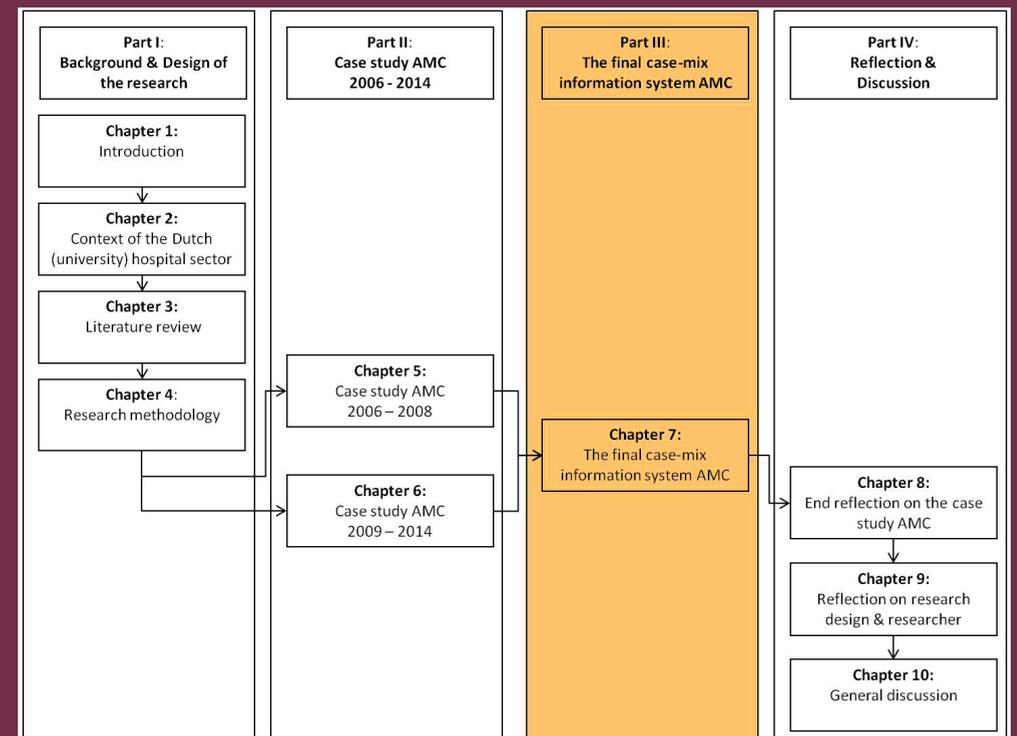
fixed, and historically based. In the course of time, the budgets had shrunk more and more due to budget cuts. These barriers implied that changes in the case-mix were smaller than previously thought and therefore the expectations about the value of the CMI had to be tempered.

The support of the CMI by the Board of Directors decreased during the course of time. Quarterly meetings between division managers and the Board still focused on the traditional budget indices and not on case-mix. The Board did not want to rely on the DOT data and revisited the old budget parameters (such as number of outpatient visits, nursing days) to monitor the care production in a global way. The focus on costs increased because of the urgency to reduce costs. However, the cost information provided by the CMI could not be used for the management meetings because reimbursements related only to patient care (not the other core tasks) and it represented only approximate costs that did not match with the general ledger. Also, new developments such as the proposed merger with the VUmc and the introduction of the electronic patient system, led to a shift of focus in the management meetings.

#### *The success of the CMI*

The CMI improved and expanded with several information dimensions (forecasts, benchmarking) and redesigned and new information products. Also, the number of users increased significantly because of the inclusion of the sub-chief physicians as users and the design of the data cube in Cognos for the business analysts. The CMI was further embedded in the Planning & Control cycle by establishing the relationships between medical, logistical, and financial policy in a systematic way. There were also new developments that promoted the use of the CMI, such as the (persistent) announced internal performance reimbursement, the SLIM project, and the preparation for the administrative merger with the VUmc. Furthermore, the CMI appeared to be useful for other purposes such as specific business cases, the improvement of registrations, external legitimization and to conduct cost-effectiveness studies. However, there were still several factors that obstructed the success of the CMI. The replacement of the DBC system by the DOT system had a major negative impact on the CMI project. Other obstructing factors were that managers still experienced several legal and practical barriers in managing the case-mix.

# PART III: THE FINAL CMI OF THE AMC



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# Chapter 7

The final case-mix information system of the AMC

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## Abstract

In this chapter the designed and implemented information products of the CMI system are described. The end products were divided into information products designed for the (medical) managers and products primarily designed for the business analysts because these users have different needs and skills with regard to information. The information products targeting the (medical) managers were: the Standard Report Patient Care, Portfolio Matrix, Interdependency Analysis, Benchmark Analysis Resource Use Profiles, and Portfolio Checklist. Some information products were implemented corporate wide, other products were only implemented for some of the medical specialties or were still in the pilot phase. The information products supporting the business analysts were: the Data Cube Care Products, Data Cube Care Activities, Data Cubes Market Shares, and Intranet Page Management Information Patient Care. All products expressed their information in a common clinical language, namely the patient group, which made it possible to connect and compare information with each other. Other products that directly originate from the design and implementation processes are also described, namely the classification and valuation of patient groups, the user training modules, and the information policy. The chapter concludes with a global presentation of the technical infrastructure of the CMI.

## 7.1 Introduction

In this chapter the designed and implemented end products of the CMI are presented. In section 7.2 the functions and target groups of the CMI are described. In Sections 7.3 and 7.4, an overview is given of the key information products and their characteristics. It is also explained how these products are connected to each other. In Section 7.5, we focus on the information products that directly originate from the design and implementation processes. Finally, Section 7.6 presents, in global terms, how the information products were constructed (technical infrastructure).

## 7.2 Functions and target groups of the CMI

The case-mix information system (CMI) of the Academic Medical Centre was iteratively designed and implemented. The CMI was primarily designed to support the top managers in the different stages of the strategic management cycle, which included gaining insight, decision-making, planning, implementation, monitoring, and legitimization (see Section 2.8). The top managers were chief physicians of the clinical specialties, division (or cluster) managers, and central managers. They were selected as the primary target groups of the CMI because they were considered the key decision makers of the AMC, (see Section 5.4.1). Within the strategic management cycle, different types of top managers fulfilled different roles at different stages. The final CMI served multiple functions for multiple users at the same time. To serve these functions, several products were designed and implemented in close cooperation with the different users. Some information products were implemented corporate wide (Standard Report Patient Care, Portfolio Matrix, Interdependency Analysis), other products were only implemented for some of the medical specialties (Benchmark Analysis Resource Use Profiles) or were still in the pilot phase (Portfolio Checklist).

### *Gaining insight, decision-making, implementation*

Since the management principle of 'professional in the lead' was used (see Section 2.8), the chief physicians and division managers were in the lead at the first stages (gaining insight, decision-making) and implementation. For this project, the focus was on medical policy decisions with regard to the case-mix (type and volume of patient groups) and underlying care processes, and related to the longer term. The case-mix was put centrally, because our research showed that the type and number of patients in the hospital treated had a significant impact on the performance on core tasks and finance (see Section 5.4.1). At this stage, insight was needed in (trends in) the case-mix from different perspectives (such as medical, capacity, financial, health care market), for exploring and evaluating strategic alternatives. To fulfill these functions, several information products were designed which were ready-made and contained information at a highly aggregated level, see Section 7.3.

The Standard Report Patient Care (see Section 7.3.1) was designed to give an extensive insight into the most relevant topics with regard to the case-mix (volumes, patient characteristics, production, processes, finance, and health care market) contained 39 figures. The Portfolio Matrix was designed to give a quick insight into the medical and financial relevance per patient group and to conduct the dialogue about the portfolio. The Interdependency Analysis was designed to give insight into what the interdependency was between medical specialties and where coordination of medical policy was necessary. The Benchmark Analysis Resource Use Profiles product was designed to define cost reduction measures with regard to the care processes by comparing costs and activities per care product from the AMC with other UMCs. The Portfolio Checklist was designed as a tool to assess the current portfolio of the medical specialties on the basis of the previously mentioned information products and to translate the outcomes to policy measures.

During these stages, the chief physicians and division managers were supported by the business analysts from the business offices. They gave explanations about the background and interpretation of the case-mix information and made in-depth analyses. So, the business analysts had a different role in the strategic management cycle with different needs and skills with regard to CMI (see Section 5.3.2). To fulfil this, the Intranet Page Management Information Patient Care and several data cubes in Cognos<sup>26</sup> were designed, such as the Data Cubes Care Products, Care Activities and Market Shares. The Intranet Page contained extensive background information about the CMI (manuals, FAQ), and download menus, and gave access to all the information products. The Data Cubes contained the detailed data of the Standard Report Patient Care and had options to drill down in the data to patient level and correlate medical data, patient data, and financial data.

#### *Planning and legitimization*

*Central managers* (the Board of Directors, concern controller) were in the lead in the stages of planning (budgeting) and legitimization (such as negotiations with health insurers). During these stages they were supported by the business analysts from the F & C department. They assessed the policy plans at the corporate level, fixed the budgets, and made agreements with the funders. For these stages, the relationships between medical policy, logistical, and financial policy had to be established. To fulfill these functions, several information products were designed in Cognos such as data cubes and standard views (see Section 7.4). These information products made it possible

<sup>26</sup> The AMC used Cognos as management information system. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management. The software is designed to enable business users without technical knowledge to extract corporate data, analyse it and assemble reports.

to quantify the impact of the medical policy plans into capacity and money, and could be used as input for the negotiations with the health insurers.

#### *Monitoring*

Monitoring took place by all types of managers. The chief physicians and division managers needed to monitor the extent to which the medical policy was realized during the year, for example, with regard to volumes, top referral care, waiting times, length of stay, financial coverage, and where adjustments were needed. The central managers and F & C department needed to monitor the extent to which the forecasted DOT volumes and revenues matched with the agreements with the health insurers. To fulfill this function, a Forecasting Model and Top Referral Care Model were designed and the outcomes of these models were included in figures in the Standard Report Patient Care and the Cognos Data Cubes.

Table 7.1 presents a summary of what information products were designed, for whom, and with what functions.

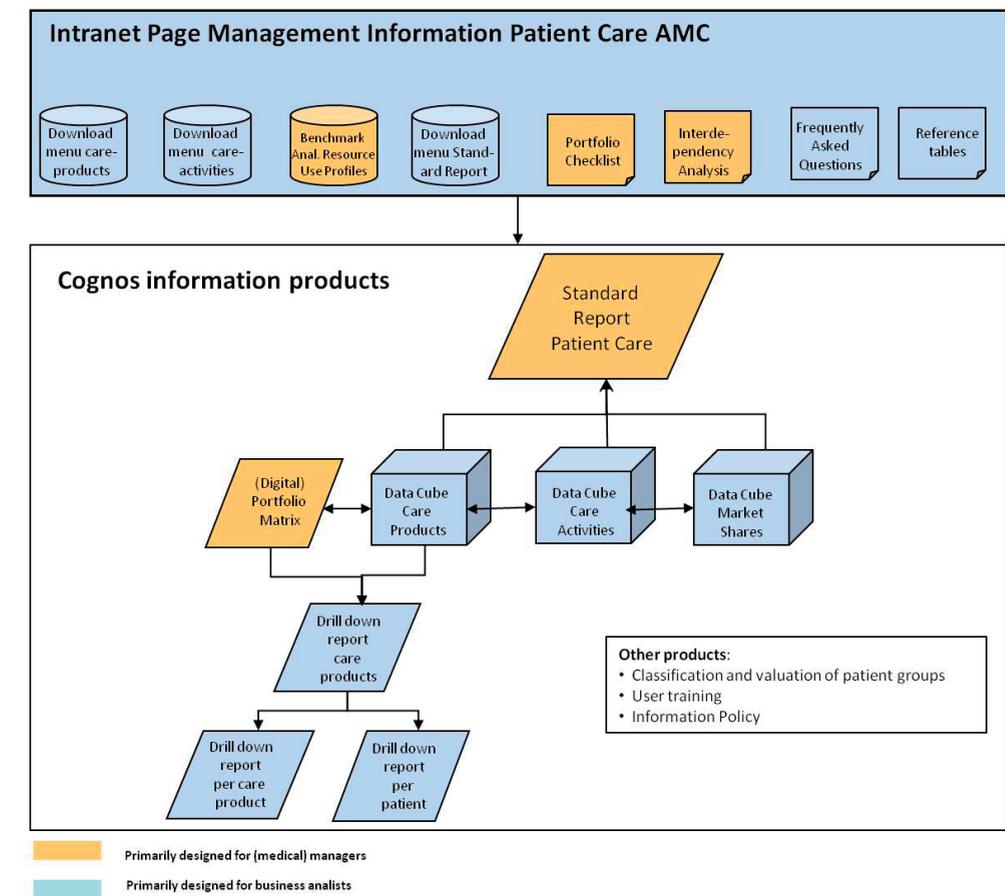
Table 7.1: Functions and target groups of the CMI

Information product	Section	Description	Function of the CMI in the strategic management cycle					
			Analyzing	Decision making	Planning	Implementation	Monitoring	Legitimization
<i>Primarily designed for (medical) managers</i>								
Standard Report Patient Care	7.3.1	report per medical specialty, division and AMC wide about the key topics with regard to the case-mix	X	X	X	X	X	X
Portfolio Matrix	7.3.2	matrix per medical specialty in which the medical and financial relevance per patient group are summarized	X	X		X		
Interdependency Analysis	7.3.3	analysis per medical specialty in which the interdependencies between patient groups and medical specialties are summarized	X	X	X	X		
Benchmark Analysis Resource Use Profiles	7.3.4	analysis per diagnoses/ care product in which the activities and cost of the AMC are compared with other UMCs	X	X		X		X
Portfolio Checklist	7.3.5	checklist to assess the portfolio on the basis of standards and translate the outcomes to policy measures		X	X	X		
<i>Primarily designed for business analysts</i>								
Cognos Data Cube Care Products	7.4.1	data cube with detailed data with regard to the DOT care products	X		X	X	X	X
Cognos Data Cube Care Activities	7.4.2	data cube with detailed data with regard to the care activities (procedures)	X	X	X	X	X	X
Cognos Data Cube Market Shares	7.4.3	data cube with detailed data with volumes per care product of AMC and other Dutch hospitals	X	X				X
Intranet Page Management Information Patient Care	7.4.4	intranet page with background information about the CMI and portal to all information products	X					

Integrated information system

All information products were part of the CMI and what they had in common was that the information was expressed in the same language, namely the patient group. This made it possible to connect and compare information with each other. Furthermore, for all products, the same sources and definitions were used as much as possible. The difference in products mainly related to the type of the information and the level of detail. The number of different information products was minimized as much as possible and they were designed in such a way that they could be used for multiple purposes. In Figure 7.1, an overview is presented on how the different information products were integrated into the CMI.

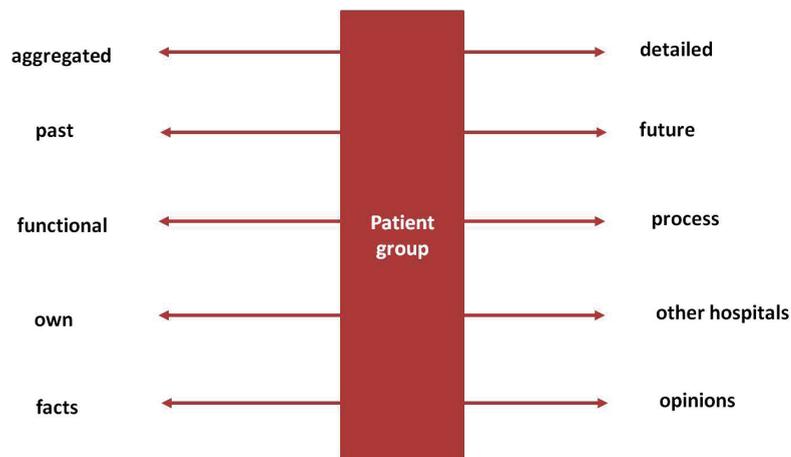
Figure 7.1: The final CMI of the AMC



Information dimensions

With the total set of information products, the case-mix information was available from a large number of different dimensions (see Figure 7.2): aggregated and detailed, pre-perspective (past) and pro-perspective (future), at functional level (per specialty, department, or division) and process level (per disease or patient group), own organization and other (university) hospitals, facts and opinions. Because of this, the CMI had a broad scope of information and was quite flexible. It could serve different functions for different types of users (managers and business analysts) at the same time.

Figure 7.2: Information dimensions of the CMI of the AMC



7.3 Information products for (medical) managers

For the chief physicians, division managers, and central managers, the following information products were designed: a Standard Report Patient Care, a Portfolio Matrix, an Interdependency Analysis, a Benchmark Analysis, and a Portfolio Checklist.

7.3.1 Standard Report Patient Care

The Standard Report Patient Care was designed for the chief physicians, division managers, and central managers in order to serve multiple functions. First, it could give insight into the developments of the most relevant topics of patient care. It provided an extensive information set in the context of learning, because the uncertain decision-making context in the AMC required information that was much broader than the narrow financially-oriented data provided by traditional management accounting systems (Kurunmäki, 1999). This insight could be used accordingly in the strategic management cycle to conduct the dialogue with the medical specialties and divisions, to

make decisions with regard to the case-mix and to optimize the underlying care processes. Second, the Standard Report could serve the monitoring function by providing the most accurate information compared to standards (such as budgets, quality standards). Third, the Stand report could be used for internal legitimization purposes. The design of the Standard Report took place in close cooperation with the managers by pilot groups. The Standard Report was available on three levels: corporate (one), division (eight) and medical (sub) specialties (forty-seven).

Figure 7.3: Example of A Standard Report Patient Care for the division Surgery (in Dutch)

<b>Standaardrapportage patiëntenzorg</b>	
<b>Chirurgische Specialismen</b>	
<b>201306</b>	
DIC-en Toerengegevens bijgewerkt t/m: 22-jul-2013 OIC-gegevens bijgewerkt t/m: 8-jul-2013 Xcare-gegevens bijgewerkt t/m: 30-jun-2013 Filing-gegevens bijgewerkt t/m: 01-aug-2013 Printdatum rapportage: 1-aug-2013 17:59:03	
Vragen / opmerkingen / suggesties: <a href="mailto:mc@amc.uva.nl">mc@amc.uva.nl</a>	
<b>Inhoudsopgave standaardrapportage patiëntenzorg</b>	
<b>Volumes</b>	
Figur 1.1 - prognose volumes DIC's versus begroting	3
Figur 1.2 - aantal geplande DIC-opnamen afgevoerd 12 maanden	4
Figur 1.3 - aantal geplande intake DIC's afgevoerd 12 maanden: gegroefde en organistructure zorg	6
Figur 1.4 - aantal poliklinische patiënten per maand	6
Figur 1.5 - aantal geplande intake DIC-opnamen AMC opgelopen	7
Figur 1.6 - intake en prognose intensieve	8
<b>Patiëntkenmerken</b>	
Figur 2.1 - verdeling patiënten huid/jaar	9
Figur 2.2 - maximum gemiddelde revalidatie patiënten afgevoerd 12 maanden	10
Figur 2.3 - % topverrekte zorg per maand	11
Figur 2.4 - nationale medische patiënten per gemeente huid/jaar 1 t/m 12 maanden	12
Figur 2.5 - nationale nationale patiënt naar gemeente afgevoerd 12 maanden	13
Figur 2.6 - gemiddeld aantal behandeld DIC opnamen per patiënt	14
<b>Productie</b>	
Figur 3.1 - maximale productiviteitsniveau huid/jaar t/m huidige periode	15
Figur 3.2 - maximale productiviteitsniveau afgevoerd 12 maanden	17
Figur 3.3 - operatiecentrum: gemiddelde afgevoerd 12 maanden (klikken en openen)	18
<b>Proces</b>	
Figur 4.1 - polikliniek, gemiddelde toegankelijkheid polikliniek huid/jaar	19
Figur 4.2 - polikliniek, gem. toegankelijkheid polikliniek afgevoerd 12 maanden	20
Figur 4.3 - kniek, gemiddelde tijd voor patiënt per maand	21
Figur 4.4 - operatiecentrum: gemiddelde wachttijd voor (verpleeg en dagbureau)	22
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Figur 4.6 - operatiecentrum: gemiddelde wachttijd afgevoerd 12 maanden	24
Figur 4.7 - polikliniek, gemiddeld aantal poliklinische per DIC	25
Figur 4.8 - polikliniek, gemiddeld aantal poliklinische per DIC per maand	26
Figur 4.9 - kniek, aantal opgenomen patiënten per maand	27
<b>Financien</b>	
Figur 5.1 - prognose omzet patiëntenzorg huid/jaar	28
Figur 5.2 - prognose omzet versus begroting patiëntenzorg divisies	29
Figur 5.3 - top 5 zorgproducten met afwijkingen prognose versus begroting	30
Figur 5.4 - totale kosten en opgenomen gemiddelde zorg per maand	31
Figur 5.5 - portfolioanalyse patiëntenzorg - recente versus financiële dekking DIC's	32
Figur 5.6 - financiële draagkracht AMC: gemiddelde zorgproducten en financiële verhouding	33
Figur 5.7 - financiële draagkracht AMC: gemiddelde zorgproducten per organisatie	34
Figur 5.8 - Top 5 zorgproducten qua positieve financiële draagkracht	35
Figur 5.9 - Top 5 zorgproducten qua negatieve financiële draagkracht	36
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Figur 5.15 - gemiddelde kosten horizontaal verkeer per patiënt huid/jaar	40
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<b>Marketinggegevens</b>	
Figur 6.1 - marketing AMC t.o.v. AMU en Nederland 2009	42
Figur 6.2 - marketing AMC per regio	43

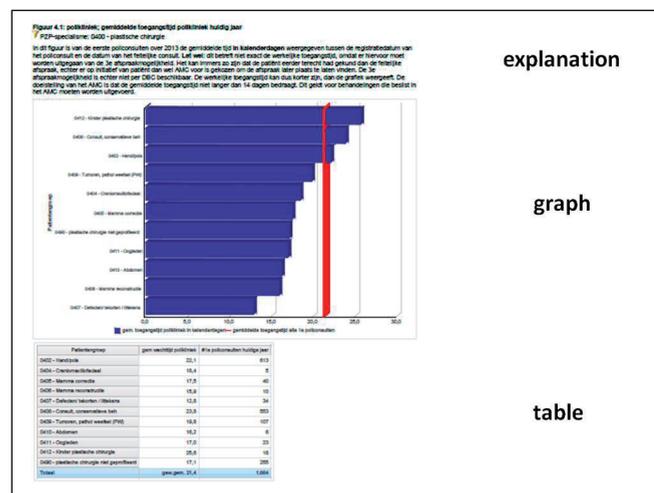
In the Standard Report at corporate level, the information was presented per division, for the divisions it was presented per medical specialty, and for the medical department it was presented per patient group. Due to limited resources, choices need to be made in the case-mix. The Standard Report simply highlighted the trade-offs of those choices. The data were updated weekly. The report could be downloaded from the Intranet Page Management Information at any time and was automatically emailed monthly as a PDF file to the (medical) managers.

The Standard Report Patient Care consisted of six chapters:

1. *Volumes*: information about volumes of care products and patients. The volumes were presented in different ways like trends (past twenty-four months), forecast, distinction between new and existing patients, and focus points and non-focus points, etc.
2. *Patient characteristics*: information about the characteristics of the patients treated, such as travel distance to the hospital, age, referrer, and number of medical specialties involved. These characteristics were selected because they could be indicators for complexity of care.
3. *Production*: information of key production like number of outpatient visits, (day) admissions, nursing days, and operating time. It gave insight into what production was done and how it was divided between organizational levels and patient groups.
4. *Process*: information about the process of care like average length of stay, average number of outpatient visits, and waiting times for the outpatient clinic and surgery.
5. *Finance*: financial information about the care products, like costs, returns, top five profitable/ unprofitable care products, and types of costs.
6. *Health care market*: information about market shares per medical specialty or patient groups in the region or the whole country.

In total, the Report contained 39 different figures, see Appendix 1. Most figures consisted of an explanation (about data sources, definitions, how to use it), a graph, and a data table, see Figure 7.4.

Figure 7.4: Example of figure regarding the waiting time for the outpatient clinic, in Dutch (\*)



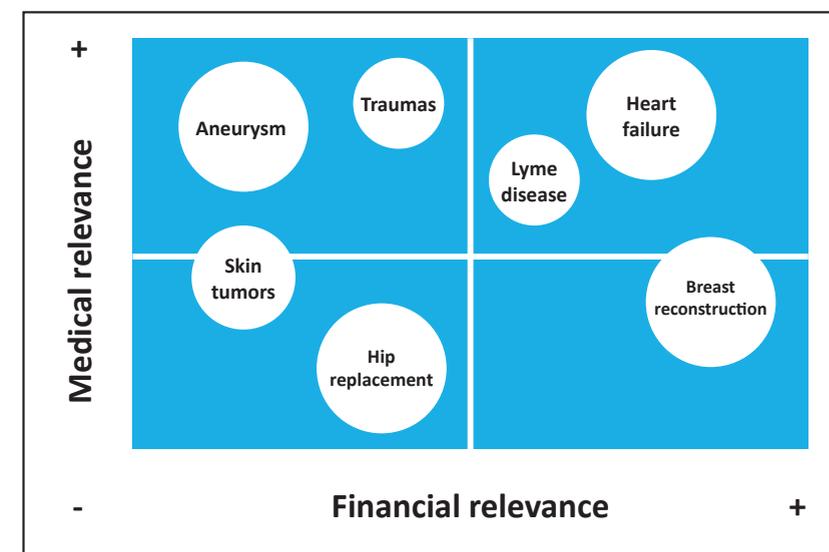
(\*) Figure contains fictitious data

Several types of graphs were used, such as time series graphs, (stacked) bar graphs, and maps, dependent on the subject. *Time series bars* were used for showing trends over a time period (twelve or twenty-four months), for example, with regard to volumes, financial coverage, waiting times, and length of stay. *Bar graphs* were used to compare values to each other, for example, per patient group, which enabled the exploration and evaluation of strategic alternatives. *Stacked bar charts* were used to emphasize the total, for example the use of (scarce) capacity and cost per patient group. *Maps* were used for showing the origin of patients. Also, in the report, several standards were used, for example, with regard to turnover, top referral care, waiting times and timeliness of registrations. The standards were derived from the strategic aims, the patient manifesto, and agreements with insurers. Because of this, deviations between reality and standards could be monitored. In Appendix 1, the figures of the Standard Report are presented.

### 7.3.2 Portfolio Matrix

The Portfolio Matrix was designed for the chief physicians and division managers to provide for each medical specialty a quick insight into the medical and financial relevance of their patient groups (see Figure 7.5). The matrix served as a starting point to support the dialogue on making (strategic) policy choices regarding the case-mix and the implementation of efficiency measures.

Figure 7.5: Portfolio Matrix of the AMC (\*)



(\*) Figure contains fictitious data

The idea of a Portfolio Matrix originates from the Boston Consultancy Group and was primarily developed for the commercial industry. Portfolio Matrix is a group of related techniques for classifying current or new businesses (or products) into categories on the basis of their rankings in two or more dimensions of performance (Walker & Rosko, 1988). Portfolio Matrix can help for putting focus, and the distribution of scarce resources, on the provision of care (Zijlstra & Dröge, 2010).

The AMC adjusted the Portfolio Matrix to the setting of an UMC by replacing the measures on both axes: medical relevance (Y-axis) and financial relevance (X-axis).

The *medical relevance* was determined per patient group once in a year by the chief physicians on the following criteria: relevance for the clinic, research, training, and education. The relevance was quantified by percentages that indicated what share of the patient group was relevant to these criteria. To calculate the medical relevance per patient group, the percentages for training and education were weighted as half because the impact of patient groups on these core tasks was less direct and they were considered as less relevant than the other core tasks, see Section 6.3.1 The horizontal grid line (cut off point) presented the average medical relevance for that medical specialty.

The *financial relevance* was determined by comparing the estimated costs and selling prices of the underlying care products. The vertical grid line represented the breakeven point: patient groups to the right of this grid line had a positive financial coverage, to the left side, a negative financial coverage. The financial data were updated weekly. The size of the bulbs was determined by the number of patients per year. The Portfolio Matrix report was automatically emailed monthly as PDF file to the (medical) and there was a digital version available in Cognos. The advantages of this digital version were that users were able to drill down to the underlying data when clicking on the bulb of a specific patient group and find quickly explanations for the financial relevance. The Portfolio Matrix could lead to two different outcomes, see Figure 7.6a.

Accordingly, for each quadrant of the Portfolio Matrix, policy measures could be defined to optimize the portfolio, see Figure 7.6b. For example, if the portfolio was not optimal in terms of composition, one could decide to change the type or volumes of patient groups. In the situation that the portfolio was optimal in terms of composition, but unprofitable at that time, one could decide to stabilize the volumes, but focus on process optimization and investigate if there was any opportunity of increasing the selling price.

### 7.3.3 Interdependency Analysis

The Interdependency Analysis was designed for the (medical) managers in order to provide insight in the interdependency between patient groups and medical specialties. These insights were needed because the AMC mainly supplied tertiary and top-

Figure 7.6a: Possible outcomes of the Portfolio Matrix

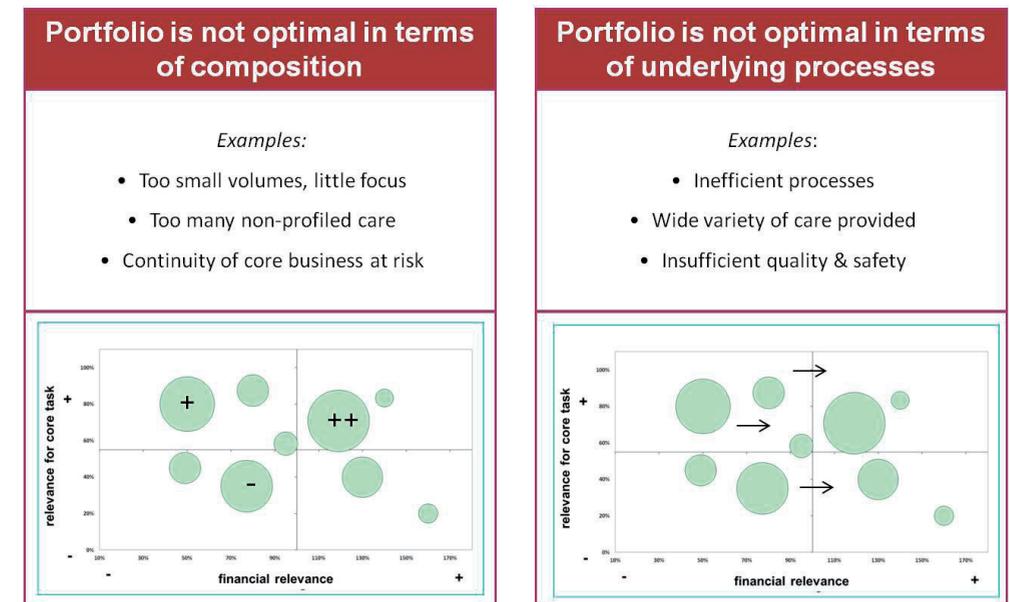
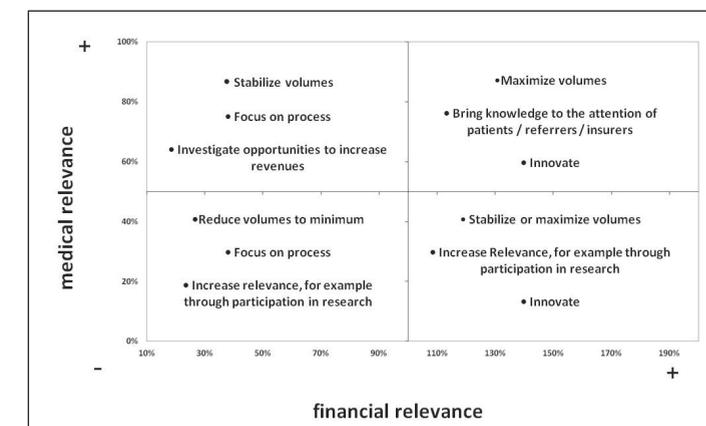


Figure 7.6b: Possible policy measures per quadrant of the Portfolio Matrix



specialized care. This care often required costly infrastructure, personnel, (small) sub-specialties and an intensive multidisciplinary approach, see also Section 2.7. The degrees of interdependence were determined by statistical analyses on the basis of the DBC data per patient over several years. The analysis showed which medical specialties and patient groups were affected when changes occurred with respect to the type and volume of patient groups (see Figure 7.7).

Figure 7.7: Example of Interdependency Analysis of the medical specialty Internal Medicine - Oncology (\*)

		internal medicine - oncology				
		Patient group	malignancy digestive system	breast cancer	malignancy female genitalia	
related medical specialties						
Division	Medical specialty	Patient group	# patients per year	1.099	141	140
A	Gastro-enterology	esophagus / cardia malignancy	542	21%		
A		pancreato-biliary diseases	855	24%		
A1	Thoracic surgery	team meeting / ICC	1.513			
A1		thoracic surgery other	1.061			
B	Surgery	esophagus	412	19%		
B		pancreas	633	18%		
B		breast cancer	501		57%	
CE	Obstetrics and gynecology	cervical malignancy	390			45%
CE		uterine malignancy	236			15%
CE		ovarian malignancy	433			28%

interdependency 0- 5%
interdependency 5- 10%
interdependency 10- 25%
interdependency 25- 50%
interdependency 50- 75%

(\*) Figure contains fictitious data

In this figure, an Interdependency Analysis of the medical specialty Oncology is shown. The columns show the patient groups of this specialty, such as ‘malignancy digestive system’ and ‘breast cancer.’ In the rows, the patient groups of related specialties are presented. In this example, 57% of the patient group ‘breast cancer’ had also been treated by the medical specialty surgery. These insights could be used by the chief physicians and division managers to determine where coordination of medical policy between specialties was necessary when making and implementing case-mix decisions. These analyses could also be helpful to identify the risk of miscommunication in patient care; the more medical specialties and specialists are involved in a short time, the more risk of miscommunication. Finally, these analyses could also be utilized by the central managers to assess the consistency of the different annual plans. The Interdependency Analyses were generated at different levels: at medical specialty, diagnosis, or AMC level. The analyses at diagnosis level were useful for specific business cases. The analysis at the AMC level could be used for the planning of activities after the administrative merger with the VUmc, because it showed which groups of medical specialties were inextricably linked to each other.

### 7.3.4 Benchmark Analysis Resource Use Profiles

The Benchmark Analysis Resource Use Profiles was designed to optimize the care processes in the AMC by comparing costs and activities per care product with other hospitals. The benchmark was based on production data from all Dutch hospitals in 2010. The Benchmark Analysis showed per diagnosis and care product, the average type and number of care activities (such as outpatient visits, nursing days, lab tests) and unit costs at the AMC, compared to other types of Dutch hospitals (UMCs, top clinical hospitals and general hospitals), depending on the type of care. It provided a view on clinical practice that highlighted variances between the performances of clinical specialties. This technique is also called *physician profiling*: a report that compare a physician’s resource consumption to a benchmark figure (Evans et al, 1995). In Figure 7.8, an example of a Benchmark Analysis of a fictitious care product of Surgery is presented. The example shows that the AMC care product contains on average more outpatient visits and nursing days than the benchmark hospitals, but less CTs and lab tests.

Figure 7.8: Example of Benchmark Analysis Resource Use Profiles of a care product of Surgery (\*)

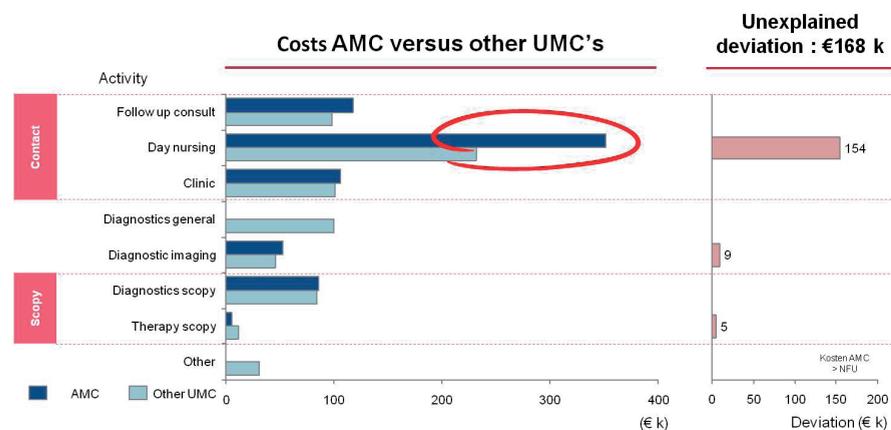
Division	Medical Specialty	Class of activity	Care activity	AMC		Benchmark	
				Avg. volumes	Avg. Unit cost	Avg. volumes	Avg. Unit cost
B	Surgery	Outpatient clinic	Outpatient visits	3,2	35	3	32
B	Surgery	Clinic	Nursing days	5,4	350	5,3	360
B	Surgery	Imaging	CT scans	0,6	43	0,8	45
B	Surgery	Laboratory	Lab tests	2,6	2,2	3	2,5

(\*) Figure contains fictitious data

The aims of the Benchmark Analysis were to analyze if the care provided matched with the clinical guidelines and to identify the deviations from other UMCs. Accordingly, the outcomes could be discussed with medical specialties and broken down to causes, such as differences in registrations, patients’ characteristics, and efficiency. As a result, policy measures could be defined in order to optimize the processes of care and to reduce costs. From this perspective, it was an attempt to influence doctors’ behavior towards ‘normal’ work practices through the comparative application of performance information (Chua & Degeling, 1993).

Benchmark data require a careful explanation of their use, and must be discussed with the medical specialties concerned, in order to validate the conclusions and to achieve acceptance of the results. Medical specialists can possibly explain outliers and other results and should therefore be involved in drawing conclusions from these data. The SLIM project team (see Section 6.3.2) organized workshops for four medical specialties<sup>27</sup> where the costs of the care products were significantly higher than the average of the other UMCs and most efficiency gains were expected. During the workshops the benchmark and additional analyses were presented by figures and discussed, see for example Figure 7.9.

**Figure 7.9: Benchmark Analysis of the medical specialty Gastroenterology, Crohn's disease (\*)**



(\*) Figure contains fictitious data

In this figure, an example of outcomes of the Benchmark Analysis regarding Crohn's disease is presented. This figure was discussed with the department of Gastroenterology. The Benchmark Analysis showed that both the average number of day nursing and associated costs were significantly higher at the AMC than at the other UMCs. As the deviation could not be explained by a difference in complexity of care, several measures were taken to reduce unnecessary activities and costs, such as lowering prescription drugs costs by better following the clinical guidelines.

### 7.3.5 Portfolio Checklist

A Portfolio Checklist for the chief physicians was designed to assess the performance of the current portfolio (case-mix) by means of the available case-mix information

<sup>27</sup> Gastroenterology, Cardiology, Othopedic Surgery and Intervention Radiology.

(Standard Report Patient Care, Portfolio Matrix, Interdependency Analysis, and Benchmark Analysis Resource Use Profiles) and to translate their outcomes to policy decisions with regard to the case-mix or underlying care processes. The Portfolio Checklist was developed because several (medical) managers felt the need for a tool to assess in a more structured and evidence-based way whether their portfolio was 'in balance' or not (see Section 6.3.1) and to set priorities fairly. It offers useful guidance for developing fair and publicly accountable priority-setting processes under resource constraints (Gibson et al, 2004). The checklist contained a set of priority-setting criteria and generic oriented standards that might be relevant to determine whether the current care portfolio was optimal. These criteria and standards were defined from different perspectives: professional, social, market, and business (see Figure 7.10). The standards were selected on the basis of the criteria of relevance and measurability. The aim was to optimize the portfolio as much as possible by identifying deviations from the standards and taking measures where necessary. Although this Portfolio Checklist was experienced as useful by the pilot group and led to some real policy decisions, it has not been implemented corporate wide yet. One reason for this was that several standards would need to be further developed and validated per medical specialty in consultation with the profession and the management.

### 7.4. Information products for business analysts

Business analysts supported the managers at different stages of the strategic management cycle. The business analysts of the business offices of the divisions supported the chief physicians and division managers, for example, by answering questions, conducting in-depth analyses, and advising them on strategy and business operations. The business analysts from F & C department supported the Board of Directors and concern controller by drawing up the budget letter, assessing the annual plans of the medical specialties and divisions, fixing the budgets, and making agreements with the funders. To fulfill this function, several Data Cubes in Cognos<sup>28</sup> and an Intranet Page Management Information were designed for them. The Data Cubes allowed multidimensional data analysis with drag-and-drop features. Rows and columns could be switched and drill-up and drill-down could be used to get a deeper understanding about the sources of the information used in the analysis. The Data Cubes also served as a source for the generation of the Standard Reports Patient Care, the Portfolio Matrix and Interdependency Analysis. Because of this, the data in the information products for the (medical) managers matched exactly with the information products for the business analysts. In 2014 about 40 business analysts used these products regularly.

<sup>28</sup> The AMC uses Cognos as management information system. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management.

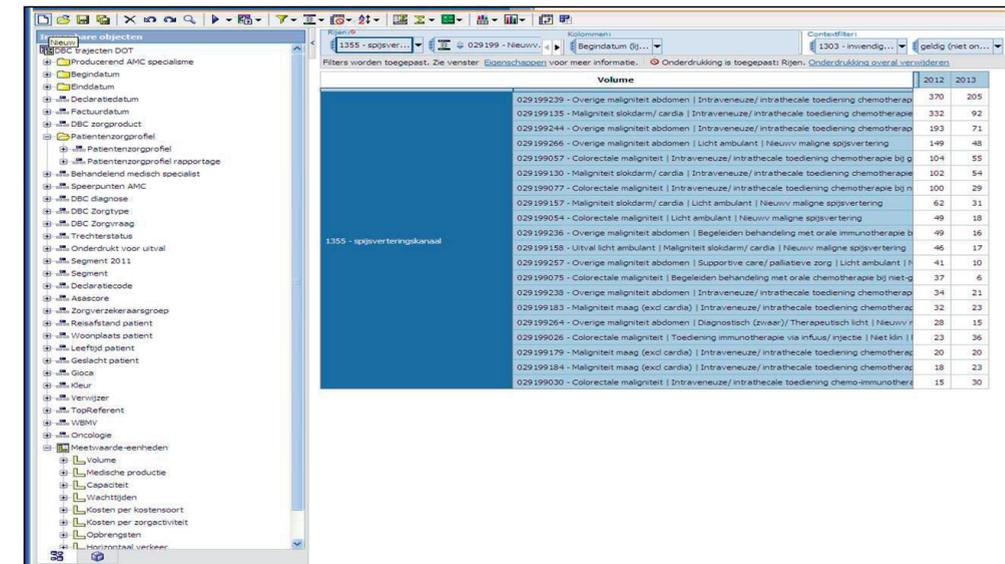
Figure 7.10: Example of the Portfolio Checklist

Professional standards	Information needed	Available case-mix information	Score	Policy decision
there are sufficient patients per patient group to be treated in order to meet the requirements of quality, efficiency and training	numbers of patients per year	Standard Report Patient Care, Portfolio Matrix	Red	Yellow
at least minimum 85% of the patients is enrolled in research	patients enrolled in research	Standard Report Patient Care	Green	Yellow
the care processes match with the clinical guidelines and are efficient	care profiles per diagnosis/ care product	Benchmark Analysis Resource Use Profiles	Green	Yellow
Social standards				
the average access time for out-patients may not exceed 2 weeks	average waiting time outpatients	Standard Report Patient Care	Red	Yellow
the average waiting time for the operating room for cancer patients should not amount to more than 3 weeks	average waiting time OR cancer patients	Standard Report Patient Care	Red	Yellow
the proportion of top referral care should be at least%	% top referral care	Standard Report Patient Care	Green	Yellow
Market standards				
the focus points must be demonstrably distinctive from other providers (technology, quality, etc)	market position, quality	Standard Report Patient Care	Red	Yellow
the market share within the NFU is for the department at least ....%	market share within UMCs	Standard Report Patient Care	Green	Yellow
the market share within the Netherlands is for the department at least ....%	market share within The Netherlands	Standard Report Patient Care	Green	Yellow
Business conduct standards				
there is sufficient connection to the focus points of related medical specialties	share of care belonging to AMC focal points	Interdependency Analysis	Red	Yellow
the budgeted production are realized	budgeted production versus realization	Standard Report Patient Care	Green	Yellow
on balance, a positive financial coverage of ...% must be realized to make new policy	costs & revenues of care	Standard Report Patient Care, Portfolio Matrix, Benchmark Analysis Resource Use Profiles	Red	Yellow

### 7.4.1 Cognos Data Cube Care Products

The Cognos Data Cube Care Products were designed for the business analysts to enable them to make a wide range of in-depth analyses on the DOT care products at different levels of aggregation, such as division, medical specialty, and patient groups. In Figure 7.11, an example of the data cube is presented.

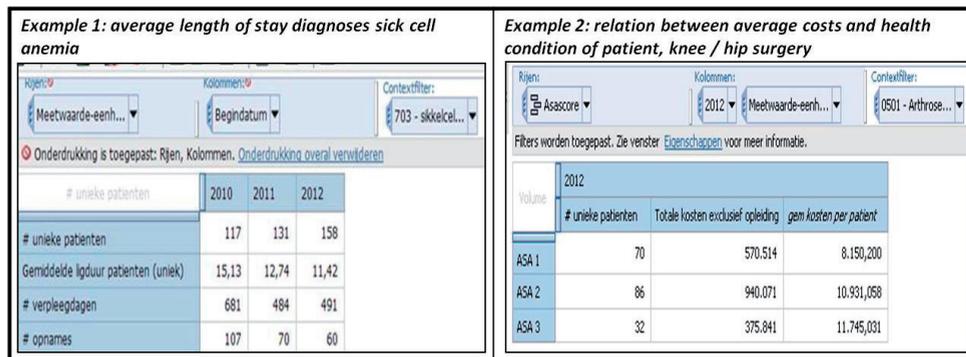
Figure 7.11: Example of the Cognos Data Cube Care Products (in Dutch) (\*)



(\*) Figure contains fictitious data

On the left side of the cube, a range of data dimensions and measures are presented; the *data dimensions* relate to the medical data (diagnosis, specialty, and health status), patient data (sex, age, postal code) and the care product data (type of care products, segment, and insurer); the *data measures* relate to the volumes (number of care products, patients), use of capacity (outpatient visits, nursing days, surgery time), relevance of care, and finance (costs, revenues). The dimensions and measures could easily be correlated and presented. On the right side of the cube, the outcomes of the selected dimensions and measures are shown. Since 2012, about 750.000 care products had been registered, so it was an extensive database. In Figure 7.12, two possible analyses with the data cubes are presented.

Figure 7.12: Examples of analyses with the Cognos Data Cube Care Products (in Dutch) (\*)



(\*) Figure contains fictitious data

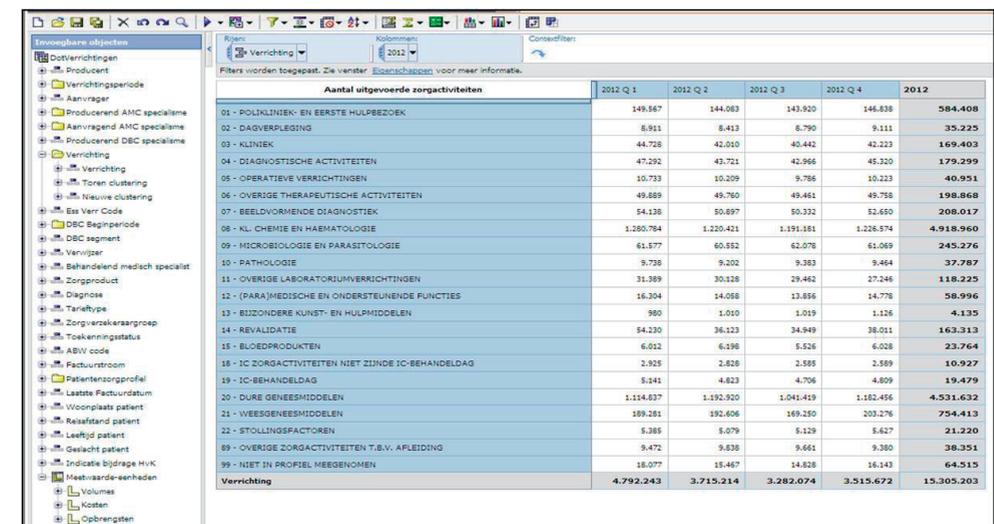
In example 1, the average length of stay was calculated for patients with a specific diagnosis (sickle cell anemia), over the period 2010 to 2012. It provided insight into how the length of stay in this time period. This analysis could be performed for any given diagnosis. Example 2 shows the relationship between the average costs per patient for hip/ knee surgery and the health status of the patient in terms of an ASA score. This type of analysis could be useful for making price agreements with insurers (legitimization) or for planning and monitoring purposes. With this data cube it was also possible to drill-down to the level of the patient ID and a specific care product. For this aim, several types of *drill-through reports* were designed for the cube DBC care products. A drill-through report was designed with core data for the selected DBC IDs (product ID, patient ID, capacity, and finance). This report could be exported to Excel and further analyzed. Within this drill-through report, there could be further drill-through by product ID or patient ID. The drill-through report per care product ID showed details about the underlying care activities (type, volumes, producing department, and costs). The drill-through report per patient ID showed what care products and diagnoses were registered by what medical specialty. It gave insight into the medical history of the patient.

#### 7.4.2 Cognos Data Cube Care Activities

The Cognos Data Cube Care Activities were designed to make a wide range of in-depth analyses on the care activities (i.e. medical procedures such as outpatient visits, nursing days, and lab tests) at different levels of aggregation, such as division, medical specialty and patient groups. Most care activities are associated with DBC care products that together make up the *DBCs resource use profile* (see Section 2.5). There was a great need by business analysts for this type of data to make specific analyses possible, for example, per physician or per medical department. The data per physician could, for instance, be used to get insight into the productivity and applied diagnostics with associated costs.

These data were also needed to get a complete financial picture, because there were many care activities that were charged separately to insurers (such as intensive care days, expensive drugs) and not through care products. The data per medical department could be used to gain insight into what medical departments produced for what diagnoses and medical specialties. An example of the data cube is presented in Figure 7.13.

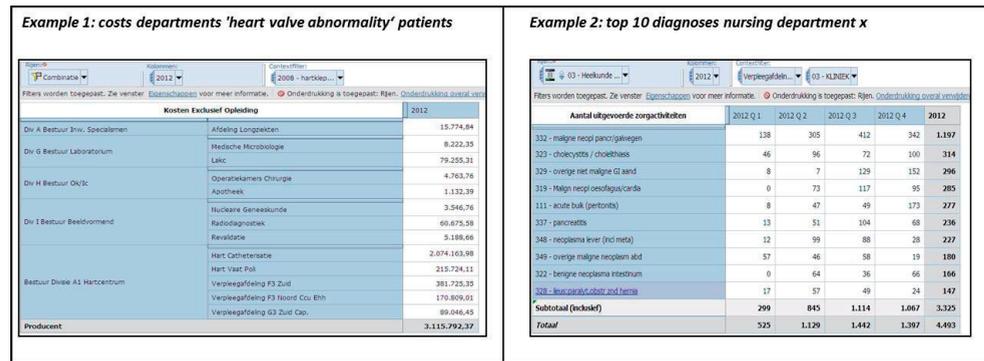
Figure 7.13: Example of the Cognos Data Cube Care Activities (in Dutch) (\*)



(\*) Figure contains fictitious data

On the left side of the cube, a range of data dimensions and measures are presented. The *data dimensions* relate to the medical data (diagnosis, specialty, and health status), patient data (sex, age, postal code) and the care product data (type of care products, segment, and insurer). The measures relate to the volumes (number of care activities) and finance (costs, revenues). The dimensions and measures could easily be correlated and presented. On the right side of the cube, the outcomes of the selected dimensions and measures are shown. Since 2012, about 15 million care activities were registered, so it was an extensive database. In Figure 7.14, two possible analyses with the Data Cubes are presented.

Figure 7.14: Examples of analyses with the Cognos Data Cube Care Activities (in Dutch) (\*)



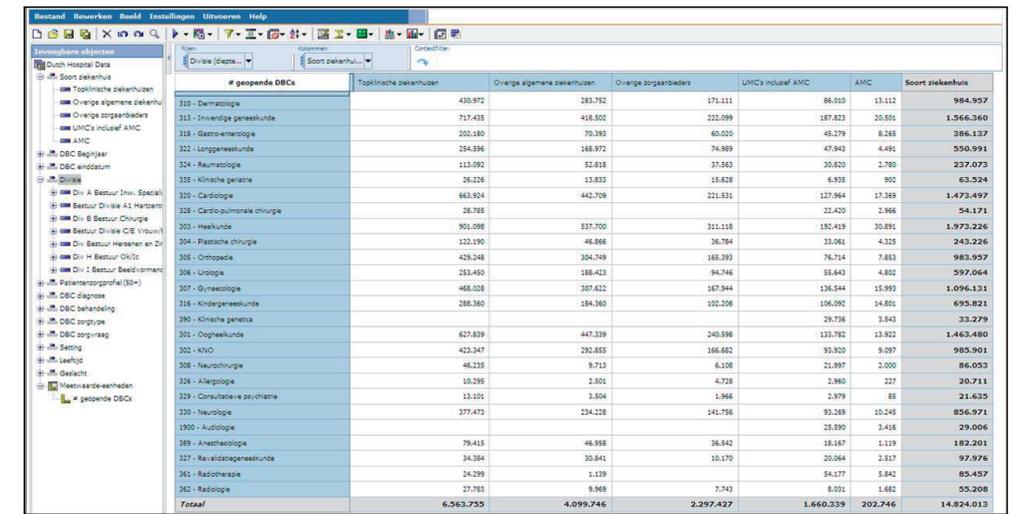
(\*) Figure contains fictitious data

Example 1 shows which divisions and departments were AMC-wide involved in the treatment of patients with 'heart valve disease' and at what cost. This analysis provided insight into the interdependencies between medical departments and could be used for planning purposes. Example 2 shows per time period the most prevalent medical diagnoses of patients admitted to a certain nursing department. This kind of information could be useful for the dialogue about the complexity of patient care and nurse staff planning.

### 7.4.3 Cognos Data Cube Market Shares

The Cognos Data Cube Market Shares contained the number of care products and diagnoses of the AMC compared to other UMCs, top clinical hospitals, and general hospitals. With this Data Cube, insight could be obtained into the market share which was considered as relevant for making case-mix decisions and the sales strategy (see Section 6.3.2). The Data Cube Market Shares enabled the business analysts to make a wide range of in-depth analyses on the market shares, patient characteristics, and type of treatment of the AMC in comparison with other Dutch hospitals. In Figure 7.15, an example of a Data Cube Market Shares is presented.

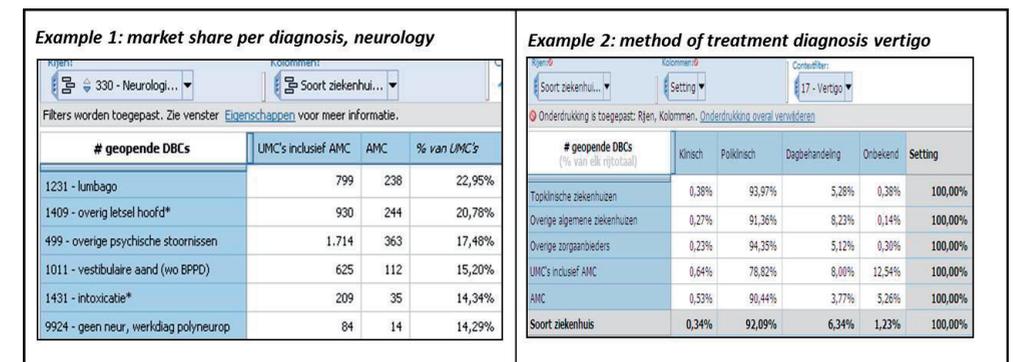
Figure 7.15: Example of the Cognos Data Cube Market Shares (in Dutch) (\*)



(\*) Figure contains fictitious data

On the left side, all different data dimensions and measures are shown. The *data dimensions* relate to the medical data (diagnosis, specialty), patient data (sex, age) and the care product data (type of care products, segment) and type of hospital. The measures relate to the number of DBCs. On the right side of the cube, the outcomes of the selected dimensions and measure are shown. The DBC data were made available by a national organization, Dutch Hospital Data, and were freely accessible for all hospitals. The AMC enriched these data with their own data (e.g., patient groups, organizational structure) to integrate them into the other information products of the CMI. In Figure 7.16, some possible analyses with the data cube are presented.

Figure 7.16: Examples of analyses with the Cognos Data Cube Market Shares (in Dutch) (\*)



(\*) Figure contains fictitious data

Example 1 shows the market share per diagnosis of the medical specialty neurology. This analysis could be used for making policy choices and negotiations with health insurers. Example 2 shows that in the AMC fewer patients were treated in day care for the diagnosis of vertigo than in other hospitals. This type of analysis could be used for optimizing the care processes.

#### 7.4.4 Intranet Page Management Information Patient Care

The Intranet Page Management Information Patient Care was designed for the business analysts to provide extensive background information about the CMI (using manuals and FAQ), to give access to the information products of the CMI, and to enable them to download detailed data. To fulfill these functions, several blocks were designed on this intranet page (see Figure 7.17).

Figure 7.17: Print screen of the Intranet Page Management Information Patient Care

The *blue block* contained background information in the format of ten FAQs / FAQ's, such as: what kind of information is available, for what purposes can this information be used, and how are the costs and returns of patient care calculated? These questions were those most asked by users in the course of the design process. Regarding the calculation of costs, detailed explanations were given about the quality and the content of the cost model and the underlying assumptions. As concerned the calculation of revenues, there was an explanation of how the negotiations with health insurers took place. The *blue block* also contained links to frequently used documents, such as unit costs per procedure, selling price per product, and websites. In the *dark red block*, the Standard Report Patient Care could be downloaded by selecting an organization level: AMC, division, or medical specialty. Authorized users had access to all reports, including from other entities. The report could be downloaded in either HTML or pdf format. The *orange block* contained links to the Data Cubes in Cognos and related manuals. The *green block* contained download options. With selection buttons, several tables with detailed information could be downloaded from the server of the ICT department.

## 7.5 Other products

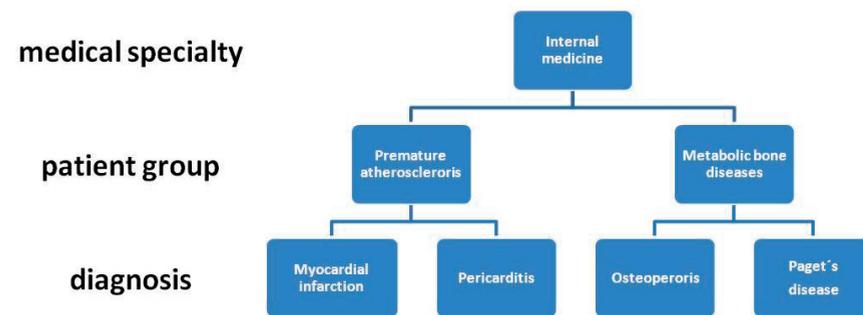
Several other products directly originated from the design and implementation processes of the CMI, namely the classification and valuation of patient groups (Section 7.5.1), user training modules (Section 7.5.2) and information policy (Section 7.5.3).

### 7.5.1 The language of patient groups

#### Classification of patient groups

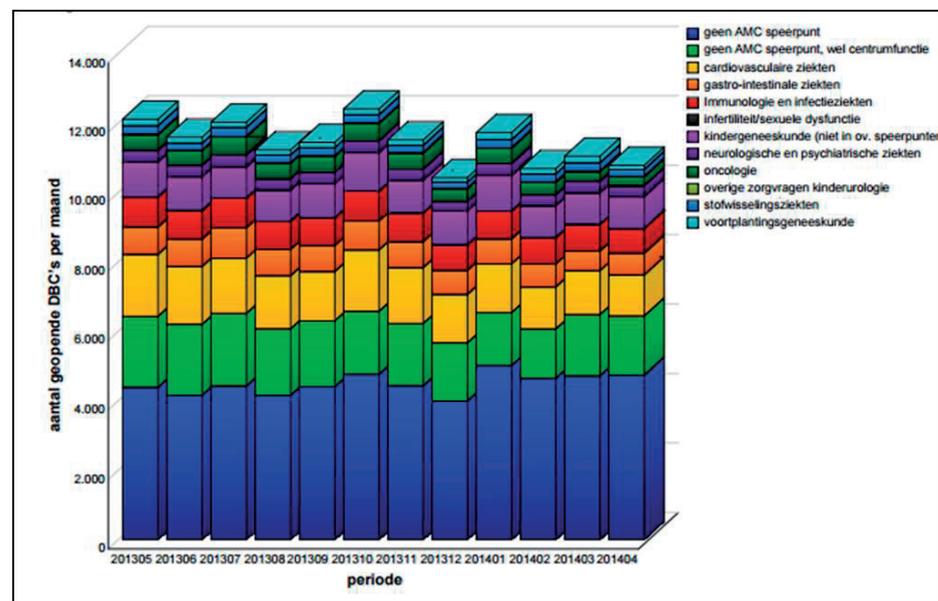
In the CMI, the patients were put centrally because they had much impact on the performance on core tasks and finance of the organization (see Section 5.4.1). The chief physicians of the medical specialties categorized their patients into groups (see Section 5.3.1). With the classification of patient groups, a *new language* was created, which made it possible to focus the case-mix information on the content of care and to reduce the complex world of patient care to manageable groups. The principles used were that the classification had to match with the language and perceptions of the medical specialty as much as possible. The number of patient groups per specialty was limited to a maximum of 15 groups of average size, at least 80% of their patients had to be classified, and the patient groups had to be traceable in the computer systems. In Figure 7.18, an example of the classification of number patient groups of Internal Medicine is shown.

Figure 7.18: Example of classification of a number of patient groups of Internal Medicine



In total, 47 medical (sub) specialties defined their patient groups. Most specialties used the DBC diagnoses as criteria, but several specialties used additional criteria like more detailed diagnoses (for specific top referral diseases), care products (for specific procedures) and age of the patient (adult or child). In total, 530 patient groups were defined, but there was much overlap between them. Accordingly, the opened DBCs per patient groups were linked to the focus points as defined in the strategic aims 2011 to 2015 (see Section 6.2) to get insight whether the provided care matched with the strategic focus points over time (see Figure 7.19).

Figure 7.19: Number of DBCs per focus point AMC (in Dutch) (\*)



(\*) Figure contains fictitious data

The figures shows per month (x-axis) the number of opened DBCs (y-axis), broken down by type of focus point (which include among other things: cardiovascular disease, immunology and infectious diseases, gynecological oncology, specialized care in early pregnancy, and pediatric oncology) and non-focus point (dark blue). It gives insight whether the intended strategic aims are realized.

The classifications of patient groups at the AMC were also used for the preparation of the administrative merger with VUmc (see Section 6.3.2). The DBC data of AMC and VUmc were clustered in the same way and presented to the chief physicians of both hospitals. In this way, insight was gained about which patient groups overlapped or which complemented each other's activities. The classification of AMC patient groups turned out to be very usable for the chief physicians of the VUmc and was only minimally adapted to identify specific patients of VUmc.

#### Valuation of patient groups

The chief physicians of the medical specialties valued their patient groups on the degree of relevance for the core tasks and distinctiveness on the health care market. These data were not available in the computer systems but were needed for the design of the CMI. With regard to the relevance for the core tasks, chief physicians indicated per patient group what percentage was relevant for the clinic, research, education, and training. Accordingly, *relevance scores* were calculated per patient group by adding up the scores of several questions. The scores on the questions with regard to education and training counted only for 50% because they had less priority in comparison with the core tasks of patient care and research (see Section 6.3.1). The relevance scores were used for the Portfolio Matrix (see Section 7.3.2). As concerned the *distinctiveness* of the health care market, chief physicians were asked to indicate per patient group, or diagnoses, the extent and reason of distinctiveness on the health care market (see Figure 7.20). This information could be used for internal discussions about case-mix decisions and negotiations with health insurers. The process of defining and valuing the patient groups itself was experienced as useful by the chief physicians since it stimulated them to think actively about their portfolio and discuss this with their staff members.

Figure 7.20: Example of the valuation of patient groups of the Department of Urology (in Dutch) (\*)

		specialty	specialty	specialty	
		patient group 1	patient group 2	patient group ...	
		# patients previous year	.....	.....	
		# patient current year	.....	.....	
1	Specify in terms of percentages how much of the patients' treatments per year were relevant for the clinic, research, training, and education	It is relevant for the clinic	...%	...%	...%
		It is relevant for research	...%	...%	...%
		It is relevant for training	...%	...%	...%
		It is relevant for education	...%	...%	...%
2	Would you like next year to increase, stabilize or decrease the number of patients of this population compared to the current year? Specify in terms of a percentage.	...%	...%	...%	
3a	When <b>increase</b> of patients is desired: are there factors that can hinder this? Several options are possible.	insufficient growth opportunities in the healthcare market (eg. by high competition)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		there is insufficient staff capacity / expertise available (physicians, nurses)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		there is insufficient physical space (outpatient clinic, clinic) available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		there is insufficient operating room	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		there is insufficient diagnostic capacity available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		there is insufficient money available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3b	When <b>decrease</b> of patients is desired: are there factors that can hinder this? Several options are possible.	Otherwise, namely:			
		patients have insufficient alternatives in the region	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		it concerns many chronic patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		it concerns many emergency patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		patients / referrers insist on treatment in the AMC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	How many patients should be minimally treated a year, for example to meet the requirements for training / education or to provide sufficient	it involves many internally referred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Otherwise, namely:			
5	Is the treatment of this patient population at the AMC demonstrably distinctive from other academic or general hospitals, if so where?	used technique	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		available expertise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		available infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		delivered quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		the population is distinctive compared to populations from other providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		otherwise, namely:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	How many other hospitals in the Amsterdam region treat this patient?	.... patients	.... patients	.... patients	

### 7.5.2 User training

Several types of user training sessions were organized, depending on the type of user (manager or business analyst) and skills and experience of the user, such as a Management Game, Computer Training sessions, and a Webinar. These products were needed to empower the (medical) managers and business analysts to use the CMI in an effective and responsible way

#### Management Game

A Management Game was designed for the medical managers to test their understanding of the case-mix information. The game was a response to their need for more education about the use of the CMI. Management Games are consistent with education theory that advocates 'learning by experience' (Cromwell et al, 1998). The Management Game was played at working conferences and management development programs.

The game typically has 12-15 participants and is played for half a day. During the game, the different phases of the strategic management cycle are simulated by means of a fictitious case. The game concerns a medical department of a university medical center, managed by a team with a chief physician, financial director, nursing manager, teacher in medicine, and researcher (see Figure 7.21). The medical department treats eight different patient groups. Each participant in the game fulfills a role and receive a card on which his or her interests are described and which (s)he has to defend.

Figure 7.21: Fictitious management team in the Management Game



The Management Game begins at the end of a financial year and consists of several rounds. In the first round, the management teams define their optimal portfolio strategy for the next year, given their interests. They are supported by different types of case-mix information per patient group (such as volumes, quality scores and opinions about relevance) with uncertainties and conflicts of interests, but without capacity issues and financial information. In this round the participants are asked not to take the available resources (capacity and money) into account, but focus on professional and social goals. In the second round, financial, capacity, and benchmark information per patient group are introduced and it appears that when realizing the desired portfolio of the first round, there will be insufficient capacity available in terms of nursing days and operating room-hours and a significant negative financial result will arise. The management team has to define measures by which the agreed portfolio can be realized within the available capacity. The solutions can relate to cost reductions by efficiency measures or increasing revenues. In the third round the management team has to decide which performance indicators and standards have to be used for their department.

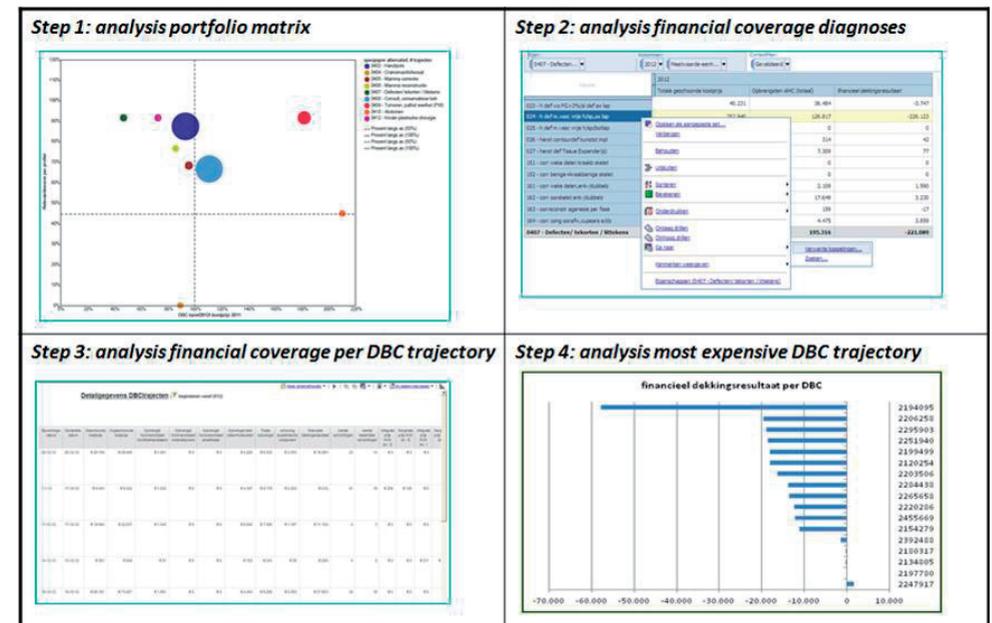
Although the case is fictitious, it is quite realistic because it simulates the real practice of the medical managers of the AMC as much as possible, for example, with respect to the type of decisions to be taken, involved actors and their interests and available case-mix information. Through this game, participants learn how case-mix information can assist in the different game rounds and how to interpret and use this type of information. They also learn to deal with different roles and interests, and shared decision-making. The Management Game was played at working conferences and management development programs and was well-received on each occasion.

#### Computer Training

Several Computer Training sessions were designed for the business analysts. In these training sessions, one learned to answer various types of information questions, based on the available information products. These questions were frequently asked by (medical) managers in practice. The emphasis was put on the right use of the information. In Figure 7.22, an example is given about how business analysts learned to analyze the financial coverage of the Plastic Surgery Department in steps.

In *step one*, the Portfolio Matrix of the department of Plastic Surgery showed that the patient group 'defects and scars' had negative financial coverage. In *step two*, the financial coverage was reproduced in the Cognos data cube care products and there was a drill down to the underlying diagnoses of this patient group. The main negative result appeared to be mainly caused by diagnosis 24. In *step three*, the data was drilled down to the details of its underlying DBC products and in *step four*, the financial results

Figure 7.22: Analyzing the financial coverage of the medical specialty Plastic Surgery (in Dutch) (\*)



(\*) Figure contains fictitious data

per DBC were put on a graph. In this example, it could be concluded that one DBC caused major negative financial coverage because of a long length of stay. The whole analysis process from aggregated to detailed information could take place within a few minutes. Afterward, all tasks and results were discussed in a plenary session. There were Computer Training sessions designed for beginners and advanced users.

#### Webinar

A Webinar<sup>29</sup> was recorded in which managers received explanations about external and internal developments and what type of case-mix information was available to them to fulfill their role as a manager. The Webinar was organized during a management development program for medical managers (workplace managers and head nurses). The advantage of this Webinar was that the presented knowledge could easily be shared.

<sup>29</sup> A Webinar is an online seminar or lecture, workshop, lecture or similar presentation or form of knowledge that takes place through the internet

### 7.5.3 Information Policy

During the project, various problems with regard to the use of data and management information in the AMC were identified, not only in the field of patient care, but also in finance, HR, and research, (see Section 6.3.2). The problems related both to the organization and to the quality of the data and management information. To solve these problems, an 'Information Policy' was defined. It contained topics such as principles for management information and the responsibilities of parties involved in the process of providing and using management information, a procedure for the design of new management information, and data governance. Examples of principles were that the F & C department was in control over the design and prioritization of management information, the central Standard Reports (such as A3, Standard Report Patient Care) were at the forefront for the quarterly meetings, and that these reports must be validated by the Internal Audit Services to ensure quality. Because of this, the Standard Report Patient Care was given a formal status in the organization and validation of the data became a prerequisite.

### 7.6 Technical infrastructure

This section presents, in global terms, how the information products were generated (technical infrastructure). A distinction was made between information products that were generated and updated weekly by the ICT department and information products that were generated irregularly by the F & C department.

#### *Generating information products by the ICT department*

The Standard Report Patient Care, Portfolio Matrix, and Data Cubes in Cognos were generated weekly (at the weekend) and these processes were highly automated. Figure 7.23 depicts the overall process to generate the information products.

**Figure 7.23: Process to publish the information products in Cognos**



In *step one*, all data were collected into a *Data Warehouse*. In the *Minimal Dataset* was defined what data were required for the CMI and how these data could be connected (see Section 5.3.1). The data consisted of system and non-system data and were recorded in different sources. The *system data* related for example to the medical data (DBC trajectories and care activities) and patient data (age, zip code) and were actualized weekly. In addition, a large number of reference tables were used, such as the DBC product structure and unit costs per medical procedure. The *non-system data* related for example to opinions of the chief physicians regarding the relevance and distinctiveness of patient groups. These data were recorded in Excel files.

In *step two*, several types of data processing took place by stored procedures, such as the categorizing of data (per year, patient group), the labeling of data (focal points, referral care), and the calculation of data (cost per DBC, forecasts). For this purpose, various business rules were used. The stored procedures were documented in SQL scripts. As a result, several large data tables were generated that formed the basis for the information products. The used data tables were stored on a central server and were also accessible to a select number of users for analysis directly on the database. In *step three*, the information products were generated automatically with the updated data.

At the start and end of this automated process, or when errors occurred, emails were sent to the ICT department to confirm that the processes had taken place. After the weekends, several additional checks were done by the staff of the ICT department (*step four*). The checks focused on the completeness of the data warehouse and the consistency of data between the different information products. After approval, the information products were published and the users informed (*step five*). From then on, the authorized users had access to the information products via the Intranet Page Management Information Patient Care, see Section 7.4.4.

#### *Tooling*

The AMC used Cognos as a management information system. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management. The software is designed to enable business users without technical knowledge to extract corporate data, analyze it and assemble reports. In 2008, the AMC bought the Cognos Business Intelligence 8 version. It was a web-based, integrated business intelligence suite. It provided a toolset for reporting, analysis, score carding, and monitoring of events and metrics. The software consisted of several components to meet the different information requirements in a company. Analysis Studio and Report Studio were used most. With Analysis Studio users could create analyses of large data sources and search for background information about an event or action. The Online Analytical Processing (OLAP) technique allows the data to be stored and accessed in

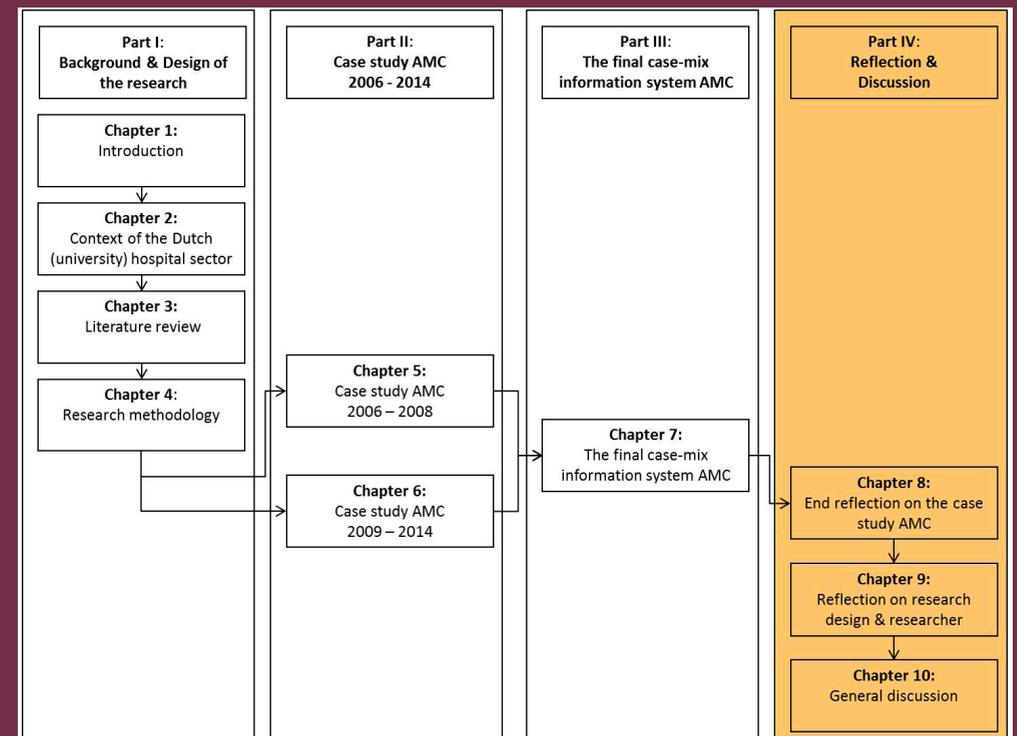
the most efficient manner—allowing end-users to traverse the edges of a hypothetical ‘Cube’ of many dimensions.

The cube’s dimensions are associated with facts (also called measures). Multidimensional analysis allows for identifying trends and understanding of anomalies or deviations that are not obvious in other types of reports. Drag-and-drop features, elements, and key performance indicators can be included in the analysis, rows and columns can be switched, drill-up and drill-down can be used to get a deeper understanding of the sources of the information used in the analysis. Report Studio is used to create management reports. It enables users to create any type of report, including charts, maps, lists, and repeat functions.

*Generating information products by the Finance & Control department*

The Interdependency Analysis, Benchmark Analysis Resource Use Profiles and Portfolio Checklist were generated by the F & C department. The Interdependency Analyses were generated by performing statistical analyses on DBC data using Access. As each patient was registered by diagnosis medical specialty, it was possible to calculate the correlations between diagnoses and medical specialties on the basis of DBC data over several years. For this purpose, several queries were designed. The outcomes per medical specialty were visualized in Excel sheets. The Interdependency Analyses were updated once every two or three years for all medical specialties. The Benchmark Analysis Resource Use Profiles was designed in cooperation with an external organization which maintained the DOT product structure (“DBC onderhoud”). All data of the Benchmark Analyses were stored in an Access database and were made available for users through download options on the Intranet Page Management Information Patient Care. The Portfolio Checklist was designed in Excel.

# PART IV: REFLECTION AND DISCUSSION



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# Chapter 8

End reflection on the case study AMC

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## Abstract

In April 2014, an end reflection on the CMI project took place by surveying 53 (medical) managers. The reflection related to the design and implementation variables, organizational and environmental variables and the outcomes of the CMI. Most of the respondents used the CMI mainly for getting insight into their case-mix, and to some extent for monitoring, internal legitimation, and decision support. The central managers particularly used the CMI for (annual) planning purposes, monitoring (A3 score card), process optimization (SLIM project), and the preparation of the administrative merger and for external legitimation (negotiations with health insurers. In accordance with the interim reflection, doubts over the quality of the CMI were the most frequently cited disadvantage. The CMI was eventually not used for budgeting and the allocation of capacity. As a result the CMI lost significance, as the idea of internal performance budgeting disappeared. In general, the respondents agreed with the statement that the CMI had an added value to the AMC and themselves. The CMI was especially found useful in the context of the present market and financial pressure. Frequently mentioned positive effects of using the CMI were an improved registration and cost savings. However, no substantial case-mix decisions immediately resulted from the functioning of a CMI. This was probably due to the several barriers which were experienced by the user apart from the (perceived) poor quality of the data, such as the lack of skills and knowledge, lack of decision power, the persistent complexity and volatility of the DBC system, existing organizational structure/ culture and legal barriers. Respondents also reported negative effects of the CMI, such as confusion and discussion about the data, information overload and selective and incorrect use. Overall, the CMI project was perceived as moderately successful for the users themselves, whereas the majority of the respondents perceived the CMI project as (very) successful for the organization. The chapter concludes with our final conclusions of the CMI project at the AMC. These conclusions are based on the results of both the interim reflections and the end reflection. A summarized overview of the factors that have promoted or obstructed successful outcomes of the CMI-project are also presented.

## 8.1 Introduction

This chapter describes the end reflection on the CMI project. This end reflection had taken place between April and June 2014. The results are presented in Section 8.2.

## 8.2 End reflection on the CMI project

### 8.2.1 Aims of the end reflection

The aim of the end reflection was to evaluate the CMI project extensively for the second and final time. This end reflection added knowledge in different ways to the interim reflection (Section 5.4). First, with this end reflection we got a final judgment by the users about the final CMI as implemented at the AMC, the perceived outcomes and the factors that promoted or obstructed its success. Compared to the interim reflection, the final CMI encompassed both existing products that were redesigned after the interim reflection (Standard Report Patient Care, Portfolio Matrix) and new products (Interdependency Analysis, Benchmark Analysis Resource Use Profiles, Portfolio Checklist, Data Cube Care Activities and Data Cube Market Shares. Second, where possible, we compared the outcomes of the final CMI and its associated success factors with the interim reflection to examine and explain possible changes herein.

### 8.2.2 Research methods

#### *Selecting participants*

To obtain the maximum number of participants and a good representation of the different clinical specialties and divisions of the AMC, all (sub) chief physicians, division managers and central managers, were asked to complete the questionnaire. In contrast to the interim reflection, the chief physicians of the sub-specialties of internal medicine and pediatrics were also invited, because they had become users of the CMI since 2012. A total of 53 of the 62 (85%) invited managers participated in this study. The sample consisted of 30 (sub) chief physicians, 17 division managers and six central managers, see Table 8.1. The chief physicians represented 29 medical specialties of eight different divisions.

#### *Questionnaires*

The reflection took place by means of a survey using a comprehensive questionnaire. Contrary to the interim reflection in 2008/2009, no follow-up interviews took place among the target groups because it was expected that this would not result in more information than was already collected in the numerous pilot groups and interviews held over the past years. Respondents, however, were given the opportunity to write

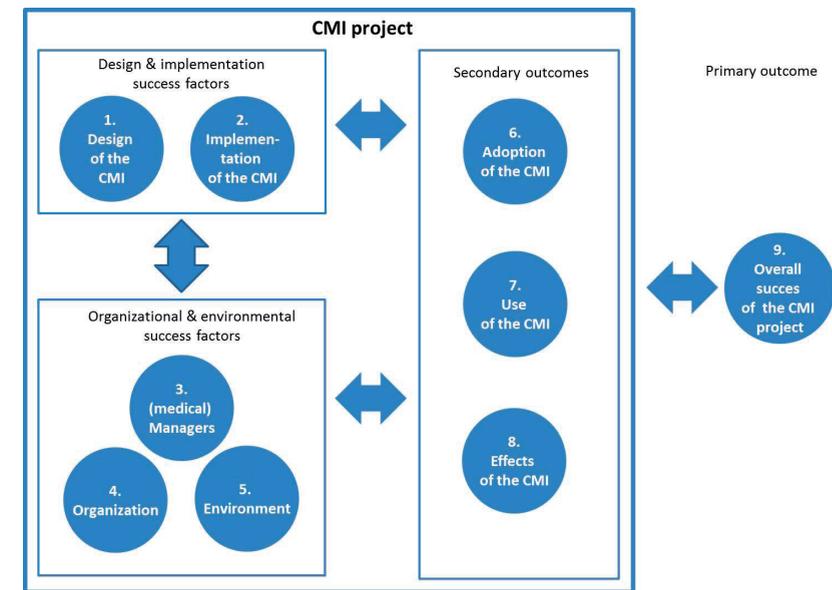
down explanatory notes on their answers. The questionnaires partly corresponded to the questionnaire from the interim reflection. The majority of the items were maintained to assess possible changes over time. Some items were omitted because it was expected that they wouldn't generate new information, and several new items were added, mainly with regard to the information products that were designed after the interim reflection. The questionnaire consisted of a mix of open and closed questions. Depending on the content of the closed question, participants were asked to fill in their answers using multiple choice categories, 7, 10 or 11-point Likert scales, or rank answer categories on their relevance. The questionnaires were sent electronically to the (medical) managers. Separately, a current Standard Report Patient Care (Section 7.3.1), Portfolio Matrix (Section 7.3.2) and an Interdependency Analysis (Section 7.3.3) for their entity (AMC, division or medical specialty) were sent to them. Like the interim reflection, the questionnaires for the chief physicians and for the division managers were the same; there were only some textual differences. Both questionnaires consisted of 63 items. On the questionnaire for the central managers, a number of questions were omitted; particularly the questions about the information products which were primarily designed for the division managers and chief physicians (such as the Portfolio Matrix and Interdependency Analysis) and the business analysts (Cognos Data Cubes). The reason for this was to reduce the completion time as much as possible for them and from the expectation that this subgroup did not work with these products. The questionnaire for the central managers consisted of 42 items. Participants had three weeks to respond. During and after that period, several emails were sent to the people to remind them about the deadline.

#### Research variables

In the end reflection, the same research variables were examined as in the interim reflection (see Figure 8.1).

The only difference was that in the end reflection, the primary outcome measure 'overall success of the CMI project' was distinguished between the success for the managers themselves and for the organization. The reason for this was that, between 2009 and 2014, the CMI was also used by other people than the respondents themselves, such as the business analysts, the SLIM team and the Sales department (see Section 6.3). These types of use of the CMI could also have impact on the success of the project.

Figure 8.1: Success factors and outcome measures examined in the end reflection



#### Data analysis

Success factors and outcomes were summarized using simple descriptive statistics. In view of the explorative nature of this end reflection we did not perform formal statistical testing on score differences. Neither did we consider our sample size sufficiently large (in relation to the number of independent variables studied) to assess the impact of success factors on outcomes using univariable and multivariable statistical techniques.

#### 8.2.3 Results: reflection on the design and implementation factors

The design and implementation success factors related to [1] the design and quality of the CMI and [2] the implementation strategy (see Figure 8.1).

##### 1. Design of the CMI

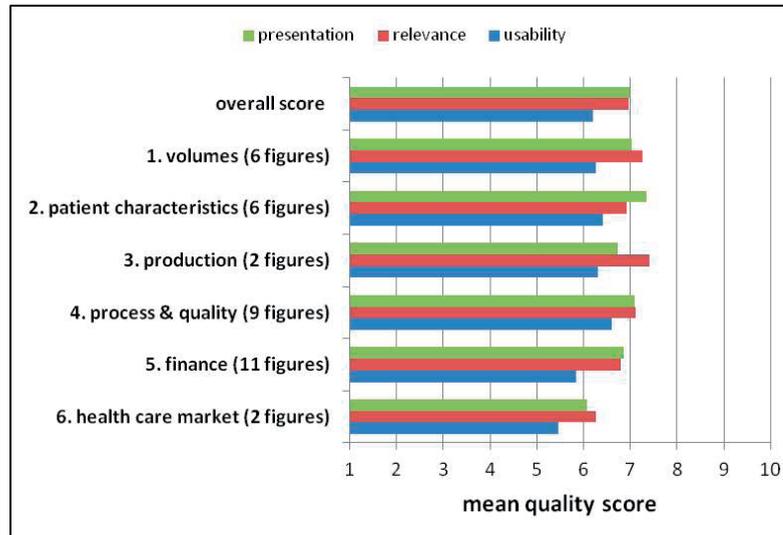
#### Quality of the case-mix information system

Participants assessed the quality of the following information products of the CMI: the Standard Report Patient Care, the Portfolio Matrix and the Interdependency Analysis.

#### Standard Report Patient Care

Figure 8.2 presents the average quality scores of the 39 figures in the Standard Report Patient Care per chapter in relation to the criteria: presentation, relevance, and usability.

Figure 8.2: Quality of the Standard Report Patient Care per chapter (N = 45\*)



(\*) N = 8 missing. Participants were asked to assess the quality of each figure of the Standard Report (in terms of relevance, presentation, and usability) on a 10-point scale, varying from 1 (very poor quality) to 10 (excellent quality). More detailed analysis of the data is available on request.

In general, the usefulness of the figures was assessed lower compared to relevance and presentation. This was probably due to the fact that several factors obstructed the usability of the CMI, such as the perceived unreliability of the data, existing barriers to actually managing on patients, and the fact that the internal budgets were still not based on the DBCs (see Section 6.4). The figures that specifically focused on the type of referrers, length of stay, and postponed surgical procedures were assessed as the best with average overall quality scores of 7.4, 7.2, and 7.2, respectively (data not presented, on request available).

The figures giving special attention to the costs of unbilled care products, financial coverage per declaration type, and distinctiveness on the hospital market, were assessed the worst with average overall quality scores of 5.8, 5.6 and 5.4, respectively (data not presented, on request available). These topics were included in the Standard Report to make the (medical) managers more aware of their role in the administrative process, to increase cost awareness for the full cycle of care, and to improve correct registrations (see Section 6.3.2). However, the information regarding the costs of unbilled care products was examined as less relevant by several managers because they saw it not as their responsibility and they felt no financial incentive for a better registration (their budgets

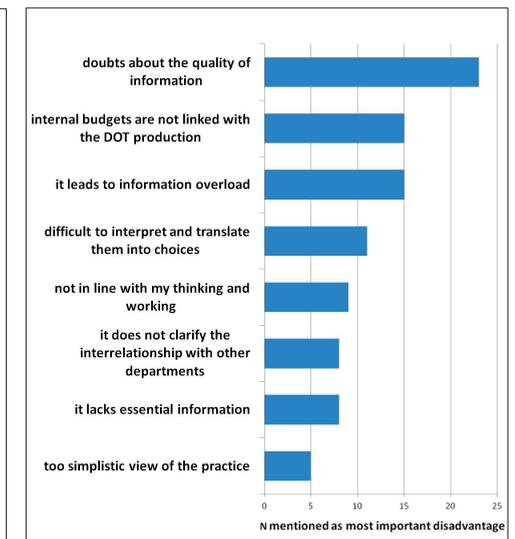
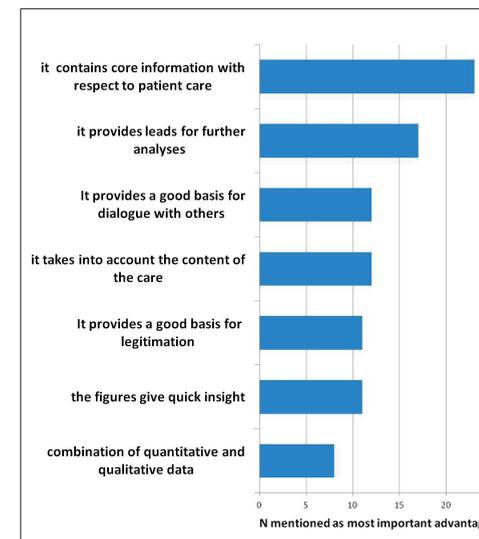
were not linked to DOT production). The information regarding finance (financial coverage, integral costs, and turnover) was examined as less relevant by the managers because this information encompassed integral costs (direct and indirect costs) and revenues and could only be partly influenced by them.

*Advantages and disadvantages of the Standard Report Patient Care*

Participants reported that the biggest advantages of the Standard Report Patient Care were that it contained the core information with respect to patient care and, although to a lesser extent, provided opportunities for further analyses (Figure 8.3a). In accordance with the interim reflection (see Figure 5.12b), doubts over the quality of the CMI were the most frequently cited disadvantage (see Figure 8.3b).

Figure 8.3a: Advantages of using the Standard Report (N = 39)

Figure 8.3b: Disadvantages of using the Standard Report (N = 39)

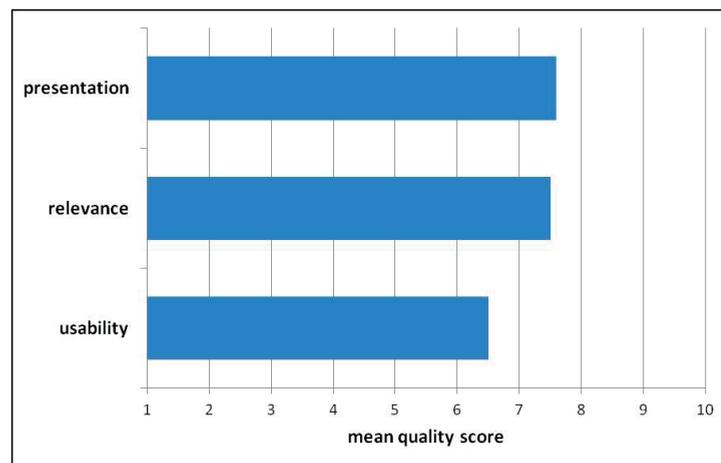


(\*) N = 14 missing. The high non-response was partly due to the fact that respondents found it difficult to determine a direct relationship between the use of the Standard Report and experienced (dis)advantages. Participants were asked to indicate for a number of predefined (dis)advantages of the CMI if they experience them and to hierarchically rank them: 1 = most important (dis)advantage, 2 = second most important (dis)advantage, etc.

### The Portfolio Matrix

In Figure 8.4, the average quality scores of the Portfolio Matrix are presented. On balance, the quality of the Portfolio Matrix was assessed well. The average scores of the Portfolio Matrix with regard to presentation and relevance were 7.6 (SD = 1.5, median = 8.0), and 7.5 (SD = 1.6, median = 8.0), respectively. The usability score, however, tended to be somewhat lower (mean = 6.5, SD = 1.7, median = 7.0). Several respondents gave an explanation of their scores and indicated that the current Portfolio Matrix had some disadvantages. Disadvantages mentioned by them were that the manageability of patients was often difficult, the determination of the medical relevance was considered as subjective and therefore prone to be manipulated, whereas the financial information was incorrect and outdated. Besides, the DOT-tariffs were beyond their influence and made decent management impossible. Finally, case-mix decisions were considered as a dynamic process with many influencing factors such as alliances, staffing, trends/innovations than perhaps reflected here. These findings corresponded largely with earlier evaluations of the Portfolio Matrix (see Section 6.3.1).

**Figure 8.4: Quality of the Portfolio Matrix (N = 32\*)**

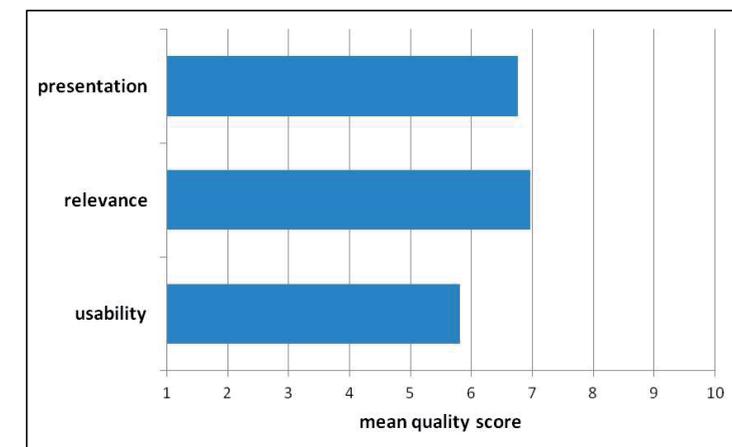


(\*) N = 21 missing. An explanation for the large number of missings was that for several medical specialties the Portfolio Matrix was incomplete, especially for the subspecialties of Internal Medicine and Pediatrics who became users at a later stage. Participants were asked to assess the Portfolio Matrix with regard to presentation, relevance, and usability on a 10-point scale, varying from 1 (very poor quality) to 10 (excellent quality).

### Interdependency Analysis

In Figure 8.5, the average quality scores of the Interdependency Analysis are presented. The average presentation and relevance scores of this product were 6.8 (SD = 1.8, median = 7.0) and 7.0 (SD = 2.2, median = 8.0), respectively. The usability of this CMI product was generally regarded as insufficient (mean = 5.8, SD = 2.5, median = 6.0). Some respondents gave an explanation of their scores and indicated that the current Interdependency Analysis had disadvantages; for example the medical supporting departments (laboratory and diagnostics facilities) were missing and the analyses only showed the interdependence between patient groups and medical specialties in volumes, but not in finance.

**Figure 8.5: Quality of the Interdependency Analysis (N = 34\*)**



(\*) N = 19 missing. An explanation for the large number of missing respondents was that not all (medical) managers had used this Interdependency Analysis; especially the sub-specialties of Internal Medicine and Pediatrics became users at a later stage. Participants were asked to assess the Interdependency Analysis with regard to presentation, relevance, and usability on a 10-point scale, varying from 1 (very poor quality) to 10 (excellent quality).

### Quality of other information products

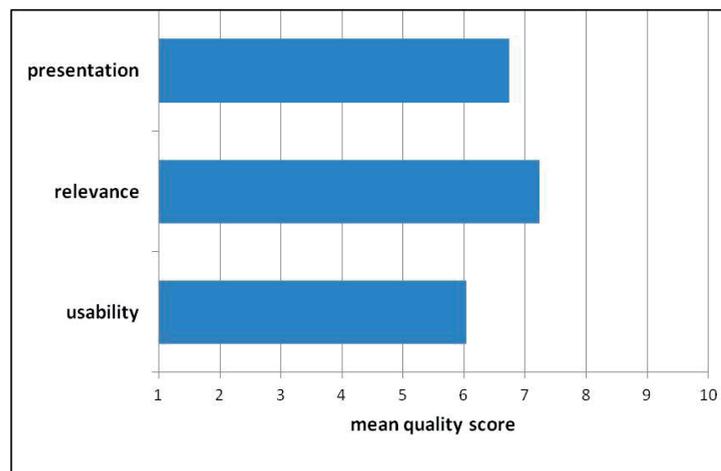
The participants were also asked to assess the quality of the information products of the CMI that were designed primarily for the (medical) managers although not yet implemented corporate-wide but in a limited number of medical specialties instead: the Benchmark Analysis Resource Use Profiles (Section 7.3.4) and the Portfolio Checklist (Section 7.3.5). These products were included in this end reflection to assess their potential success and to explore if it would be useful to implement them corporate-wide in the future. The number of responders was significantly lower than in the preceding information products.

An explanation for this was that several respondents had had no experience with these products and therefore were not able to express an opinion. The presented results should therefore only be interpreted as first indications of the quality of these products.

### Benchmark Analysis Resource Use Profiles

The Benchmark Analysis Resource Use Profile was designed for all medical specialties of the AMC and made available to the (medical) managers by publishing the analyses on Intranet Page Management Information Patient Care. However, as the benchmark analyses were only actively used in the context of the SLIM project (Section 6.3.2) most of the respondents had little or no experience with this product and were asked to assess its *potential* quality. In Figure 8.6, the quality scores of this product are presented. Overall the scores with regard to presentation (mean = 6.7, SD = 1.6, median = 7.0), (potential) relevance (mean = 7.2, SD = 1.5, median = 7.0), and (potential) usability (mean = 6.0, SD = 2.2, median = 7.0) were sufficient.

Figure 8.6: Quality of the Benchmark Analysis Resource Use Profiles (N=31\*)



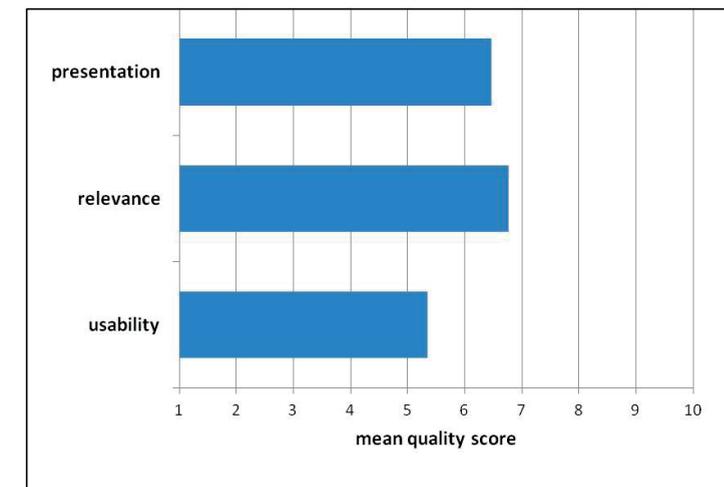
(\*) N = 22 missing. Participants were asked to assess the (potential) quality of the Benchmark Analysis Resource Use Profiles with regard to presentation, relevance, and usability on a 10-point scale, varying from 1 (very poor quality) to 10 (excellent quality).

Some respondents gave an explanation of their scores. The main drawbacks mentioned about this product were that they did not know the quality of the data in other hospitals and were in need for more regional benchmark information (rather than national) and better visualization of the data.

### Portfolio Checklist

In Figure 8.7, the average quality scores of the Portfolio Checklist are presented. The presentation (mean = 6.5, SD = 2.1, median = 7) and relevance (mean = 6.8, SD = 2.0, median = 7.0) of this information product were considered as sufficient. However, the usability scores (mean = 5.3, SD = 2.1, median = 6.0) turned out to be low.

Figure 8.7: Quality of the Portfolio Checklist (N=34)



(\*) N = 19 missing. Participants were asked to assess the (potential) quality of the Portfolio Checklist with regard to presentation, relevance, and usability on a 10-point scale, varying from 1 (very poor quality) to 10 (excellent quality).

Some (medical) managers gave an explanation of their scores. They argued that this product has potential for the future but for now suffered from several shortcomings. First, the checklist was not yet used AMC-wide, so for several managers it was considered as a theoretical tool. Second, some indicated that the predefined generic set of standards should be further developed and validated in consultation with the profession and the management.

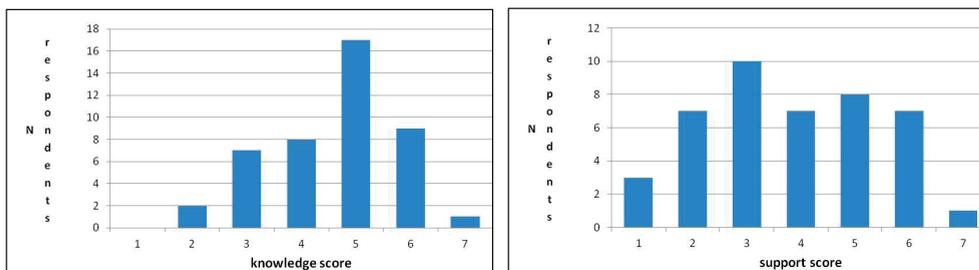
### 2. Implementation of the CMI

Participants were questioned on the quality of the project organization in terms of available knowledge and skills and on the strategy used in the design and implementation process.

### The project organization

Twenty-seven of the 44 respondents (61%) agreed to strongly agreed (scores  $\geq 5$ ) with the statement that the project organization had enough knowledge and skills to implement the CMI successfully (mean = 4.6, SD = 1.2, median = 5.0), see Figure 8.8a. This percentage was lower than the interim reflection (73%, See Figure 5.13). Eight of the 44 respondents (18%) had a more neutral opinion (score = 4). Only 16 of the 43 respondents (37%) agreed to strongly agreed with the statement that they had received sufficient support by them (mean = 3.8, SD = 1.6, median = 4.0) see Figure 8.8b. Seven of the 43 respondents (16%) had a neutral point of view. Possible explanations for this critical evaluation were that much personal support was needed to interpret and use the CMI after the introduction of the DOT product structure and the number of managers using the CMI had increased significantly since the interim analysis (see Section 6.3.2). Consequently, the project organization had insufficient capacity to realize this support.

Figure 8.8a: Knowledge of project organization (N = 44\*) Figure 8.8b: Support of project organization (N = 43\*)

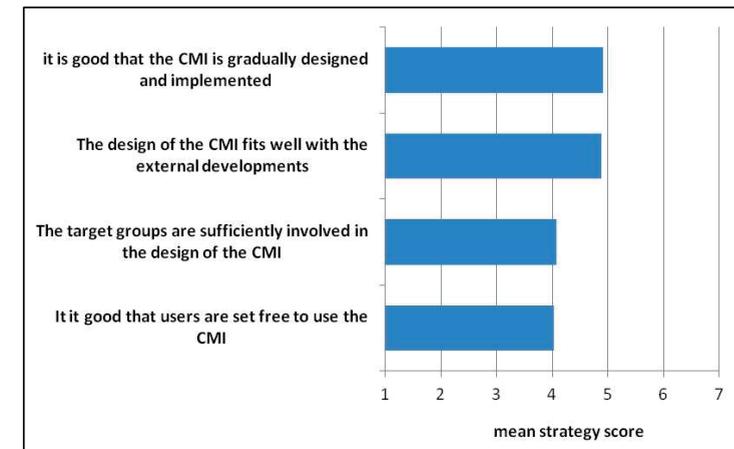


(\*) Participants were asked to indicate the extent to which they agree with the statement that the project organization has sufficient knowledge and skills to design and implement the CMI successfully (N = 9 missing) and if they receive sufficient support from them (N = 10 missing). Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

### Design and implementation strategy

In Figure 8.9, the respondents' assessments of the design and implementation strategy are presented. The results are largely in line with the results of the interim reflection (see Figure 5.14). On balance, the chosen strategy was assessed moderately positive (median of the average strategy scores = 4.5). The (medical) managers in particular agreed with the statements that that it was good that the information products were gradually designed and implemented (mean = 4.9, SD = 1.4, median = 5.0), and that the design fitted well with the external developments (mean = 4.9, SD = 1.2, median = 5.0).

Figure 8.9: Design and implementation strategy (N=44\*)



(\*) N = 9 missing. Participants were asked to indicate the extent to which they agree with four statements about the design and implementation strategy of the project organization. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree). More detailed analysis of the data is available on request.

### 8.2.4 Results: reflection on the organizational and environmental factors

The organizational and environmental success factors related to the characteristics of [3] the (medical) managers, [4] the organization, and [5] the environment (see Figure 8.1).

### 3. (Medical) manager

#### Socio-demographics

The respondents' socio-demographic characteristics are presented in Table 8.1. Thirty seven (70%) managers were male. Forty three managers (81%) were 50 years or older and this percentage had increased since the interim reflection (69%; Table 5.7). Most of the participants had a medical background and the chief physicians had the longest experience as managers.

**Table 8.1: Socio-demographics of the respondents (N = 53)**

Characteristic	Chief physicians (N = 30)	Division managers (N = 17)	Central managers (N = 6)	Total (N = 53)
<b>Sex</b>				
Male	24	10	3	37
Female	6	7	3	16
<b>Age</b>				
< 40 years	1	2	0	3
40 - 50 years	2	3	2	7
50 - 60 years	19	10	3	32
> 60 years	8	2	1	11
<b>Background</b>				
Medical background	30	12	3	45
Financial background	0	5	3	8
<b><math>\bar{x} \pm sd</math> Years of Experience</b>				
as (medical) manager	7.2 (5.2)	5.9 (5.6)	3.5 (2.1)	6.4 (5.1)

*Management knowledge and financial knowledge of the chief physicians*

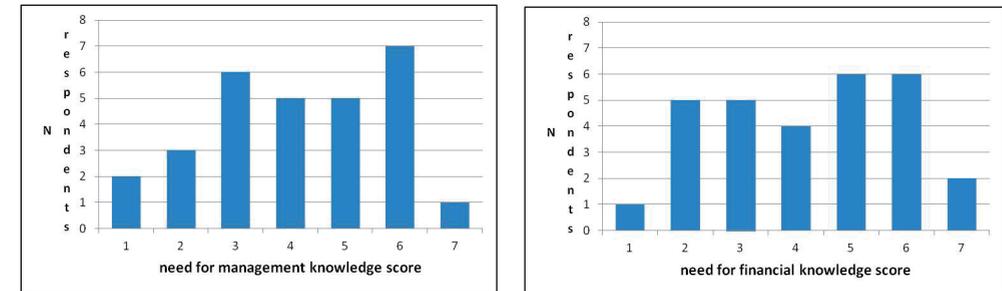
Thirteen of the 29 chief physicians (45%) agreed to strongly agreed (scores  $\geq 5$ ) with the statement that they needed more management knowledge (mean = 4.1, SD = 1.7, median = 4.0) (Figure 8.10a). This percentage was quite similar to the interim reflection (41%, Figure 5.15a). Five of the 29 respondents (17%) had a neutral opinion. Fourteen of the 29 chief physicians (48%) also strongly indicated that they needed more financial knowledge to fulfill their manager role (mean = 4.2, SD = 1.7, median = 4.0) (Figure 8.10b). This percentage was higher than in the interim reflection (36%, Figure 5.15b) and could probably be explained by the fact that since 2012 the sub-chief physicians for the sub specialties of internal Medicine and Pediatrics became new users of the CMI who had generally less financial responsibilities and therefore less financial knowledge than the chief physicians. Four of the 29 respondents (14%) had a neutral point of view.

*Relevant factors when making case-mix decisions*

In line with the interim reflection, many factors played a role when making case-mix decisions (median of the average impact scores = 5.1, Figure 8.11). An important finding was that since 2008 the ranking of impact factors hardly had changed (see also Figure 5.16). Scientific profiling, meeting last resort obligations, and available capacity and expertise were still considered as the three most important factors. Developments in other hospitals, finance (cost benefits), and meeting basic care obligations were considered as relatively least relevant, probably because the internal budget system had not changed in

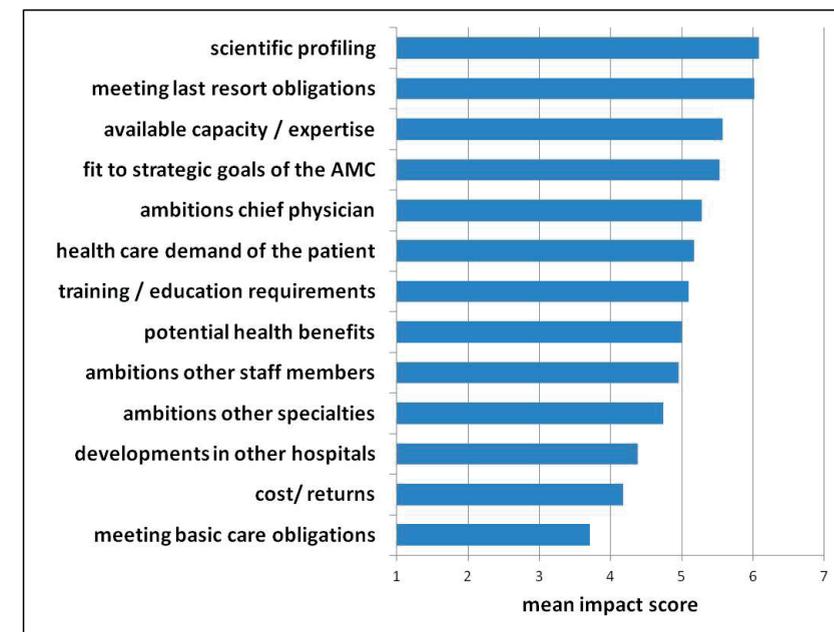
the period between 2009 and 2014.

**Figure 8.10a: Need for management knowledge (N= 29\*)**      **Figure 8.10b: Need for financial knowledge (N = 29\*)**



(\*) N = 1 missing. Chief physicians were asked to indicate the extent to which they agree with the statement that they need more management knowledge (Figure 8.10a) and financial knowledge (Figure 8.10b). Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

**Figure 8.11: Impact of factors on case-mix decisions (N = 51\*)**



(\*) N = 2 were missing. Participants were asked to indicate for a number of predefined factors the extent to which the factors have an impact on their case-mix decisions. Level of impact was scored on a 7-point scale, varying from 1 (no impact) to 7 (much impact). More detailed analysis of the data is available on request.

#### 4. Organization

##### *Support of Board of Directors*

Nine of the 39 (23%) chief physicians and division managers agreed to strongly agreed (scores  $\geq 5$ ) with the statement that the Board of Directors communicated well about the CMI (mean = 3.4, SD = 1.5, median = 3.0), see Figure 8.12a. This percentage was somewhat lower than in the interim reflection (30%, Figure 5.18a). Five of the 39 (13%) respondents gave a neutral score. Ten of the 38 (26%) respondents agreed to strongly agreed with the statement that the Board stimulated them enough to use the CMI (mean = 3.3, SD = 1.5, median = 3.0; Figure 8.12b). This percentage was in line with the interim reflection (29%, Figure 5.18b). Five of the 38 (13%) respondents had a neutral opinion on this topic. On balance, these support scores were still below average. Possible explanations for the relatively low support by the Board of Directors may be that their perception of the quality of the data had worsened due to the introduction of the DOT system, (see Section 6.3.2), change in composition of the Board, and that between 2009 and 2014 other, more urgent, topics emerged such as cost reductions, the proposed merger with the VU University Medical Centre and the introduction of an electronic patient system.

Figure 8.12a: Communication by Board of Directors (N = 39\*)

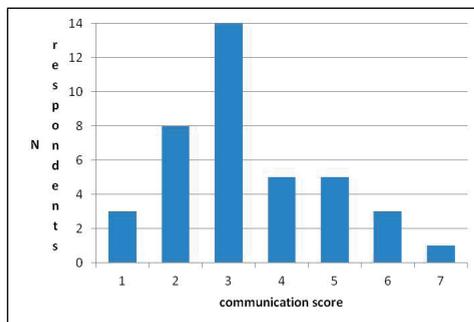
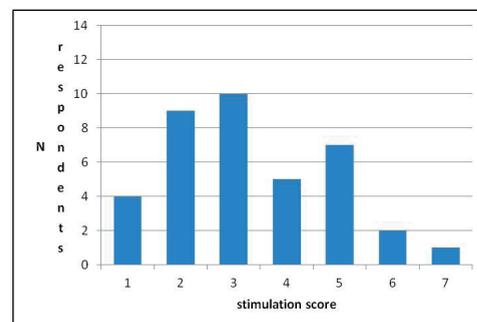


Figure 8.12b: Stimulation by Board of Directors (N = 38\*)



(\*) Chief physicians and division managers were asked to indicate the extent to which they agree with the statements that the Board of Directors communicates well about the CMI (N = 8 missing) and stimulates them enough to use the CMI (N = 9 missing). Level of agreement was measured on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

#### 5. Environment

##### *Financial and competition pressure*

There was a high perceived financial pressure (median = 6.0), see Figure 8.13a, and this pressure seemed to have increased since the interim reflection (median = 5.0, see Figure 5.19a). The increasing pressure was already predicted by the respondents in the interim reflection because of the growing production, increasing use and costs of expensive drugs, budget cuts, and the liberalization of healthcare. Furthermore, because the DBC system had many shortcomings, it was in the interim reflection already anticipated that certain academic care would not be funded enough in the future. At that time the managers also thought that due to adverse effects of market competition, the financial pressure would increase because general hospitals were shifting complex and expensive patients to the AMC earlier than before. Furthermore, because the DBC system had many shortcomings, it was in the interim reflection already hypothesized that certain academic care would not be funded enough in the future. Finally, at that time the managers expected that due to adverse effects of market mechanisms, the financial pressure would increase because general hospitals were shifting complex and expensive patients to the AMC earlier than before.

The competition pressure was perceived as moderate (mean = 4.4, SD = 1.6, median = 5.0), see Figure 8.13b, and was comparable with results of the interim reflection (mean = 4.6, SD = 1.9, median = 5.0, see Figure 5.19b). This was a rather surprising finding as in the period from 2009 to 2014, the liberalization of Dutch hospital care was continuously expanded and the percentage of B-list DBCs was substantially increased (see Section 6.2). Apparently these developments had not led to an increase of this type of pressure.

Figure 8.13a: Perceived financial pressure (N = 52\*)

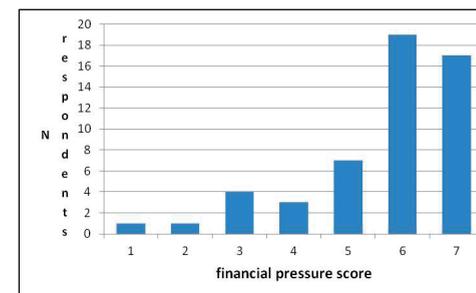
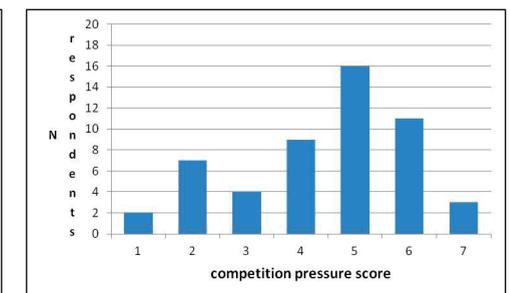


Figure 8.13b: Perceived competition pressure (N = 52\*)

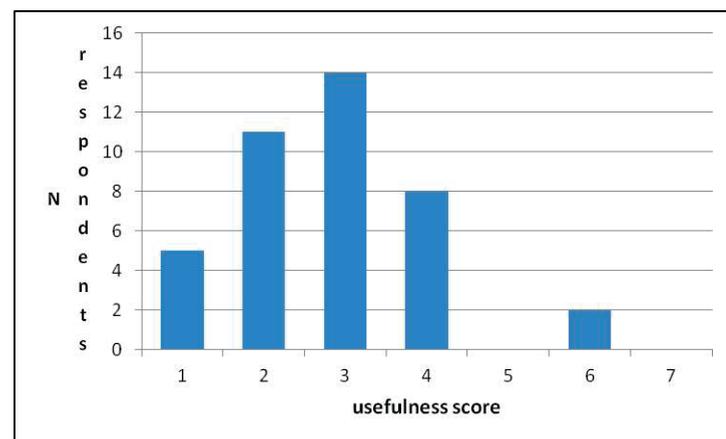


(\*) N = 1 missing. Participants were asked to indicate the extent to which they agree with the statements that they experience competition and financial pressure. Level of agreement was scored on a 7-point scale varying from 1 (strongly disagree) to 7 (strongly agree).

### Usefulness of the DOT product structure for the CMI

In contrast to the interim reflection, chief physicians and division managers were now asked to give an opinion on the DOT product structure. The reason for this was that in 2012 the CMI was technically fully redesigned because replacement of the DBC structure by the DOT structure and this could have impact on the success of the CMI project. Thirty of the 40 (75%) chief physicians and division managers indicated that the current DOT system was only to a limited extent useful (scores  $\leq 3$ ) for generating case-mix information, see Figure 8.14. Explanations for this were that the quality of the DOT data was experienced as poor by the managers because (a) DOT data were generated by complex computer algorithms and therefore insufficiently recognized and understood; and (b) the lack of actual data and the continuous changes in product structure made the data unpredictable (see Section 6.3.2). This was a remarkable finding as the CMI was to a large extent based on the DOT data.

Figure 8.14: Usefulness of the DOT product structure for the CMI (N = 40\*)



(\*) N = 7 missing. Chief physicians and division managers were asked to indicate the extent to which they agree with the statement that the national DOT product structure is useful to generate case-mix information. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

### 8.2.5 Results: reflection on the outcomes of the CMI

The outcomes of the CMI related to the [6] adoption, [7] use of the CMI, [8] effects of use, and [9] the overall success of the CMI project for the user and organization (see Figure 8.1).

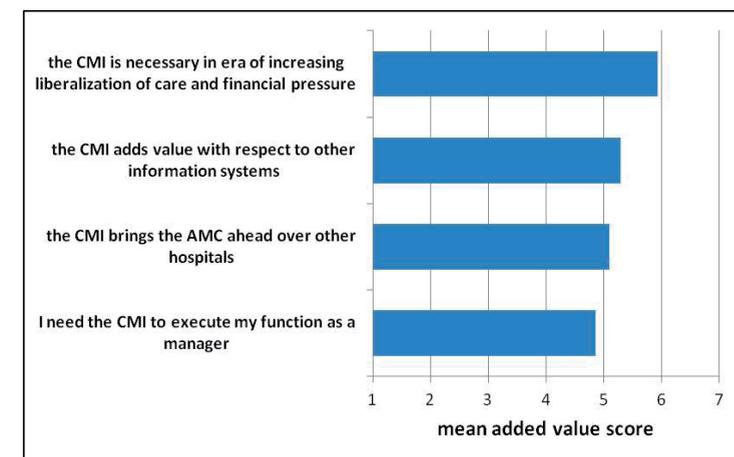
### 6. Adoption of the CMI

The items regarding adoption issues focused on the extent to which the respondents perceived an added value of the CMI.

#### Added value of the CMI

In general, the respondents agreed with the statement that the CMI had an added value to the AMC and themselves (median of the average value scores = 5.2; see Figure 8.15). The value scores were comparable with the scores of the interim reflection (see Figure 5.20). This was a promising finding: despite the disadvantages of the CMI, such as the perceived poor data quality of the data and the fact that the budgets were still not based on the DOT production (see Section 6.4), the managers still seemed to support the information system. The CMI was especially found useful in the context of the present market and financial pressure (mean = 5.9, SD = 0.9, median = 6.0).

Figure 8.15: Added value of the CMI (N = 44\*)



(\*) N = 9 missing. Participants were asked to indicate the extent to which they agree with four statements about the added value of the CMI. Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree). More detailed analysis of the data is available on request.

### 7. Use of the CMI

#### The Standard Report Patient Care

All participants were questioned on their use of the Standard Report Patient Care in the previous year. The chief physicians and division managers were additionally asked

for what purposes they had used it. Forty-five of the 50 respondents (90%) had used the Standard Report Patient Care (Figure 8.16a). Most of them had used it three to five times in the previous year. Almost all users wanted to receive this Standard Report on a regular basis, most of them per quarter or per month. The five non-users did not expect to use the Standard Report Patient Care in the future. The Standard Report was mainly used by the chief physicians and division managers for gaining insight into their case-mix, for monitoring reasons and internal legitimization, and to a lesser extent for decision-making (Figure 8.16b).

Figure 8.16a: Use of the Standard Report (N = 50\*)

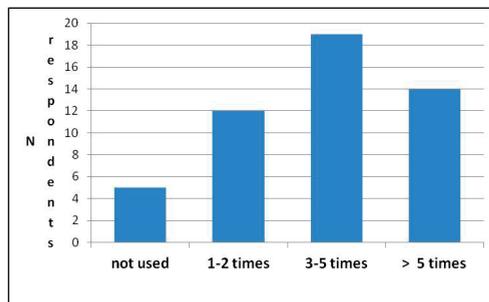
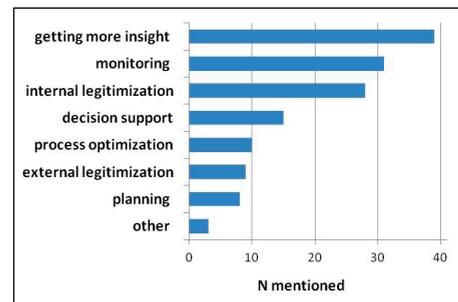


Figure 8.16b: Aims of the Standard Report (N = 41\*)



(\*) Participants were asked how often they had used the Standard Report Patient Care that were sent to them in the previous year (N = 3 missing). The chief physicians and division managers (N = 47, 6 missing) were additionally asked for which of the predefined aims they had used the Standard Report.

### The Portfolio Matrix

Chief physicians and division managers were also questioned on their use of the Portfolio Matrix. Of the 38 respondents, 30 (79%) had used the Portfolio Matrix in the previous year (Figure 8.17a). Most respondents had used the Portfolio Matrix once or twice, probably when drawing up the annual plans. Of the eight non-users, six expected to start using the Portfolio Matrix in the future. In line with the Standard Report, the most important reason for using the Portfolio Matrix was for getting more insight into their case-mix, see Figure 8.17b.

Figure 8.17a: Use of the Portfolio Matrix (N = 38\*)

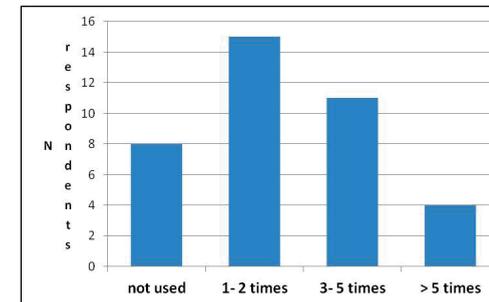
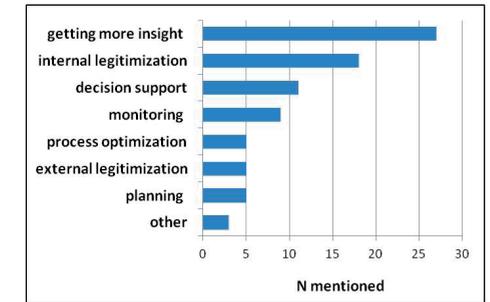


Figure 8.17b: Aims of the Portfolio Matrix (N = 38\*)



(\*) N = 9 missing. Chief physicians and division managers were asked how often they had used the Portfolio Matrix in the previous year and for which of the predefined aims they had used the Matrix.

### The Interdependency Analysis

Chief physicians and division managers were questioned about the Interdependency Analysis. As the Interdependency Analysis was updated corporate wide only once every two to three years, not all respondents had used this analysis, especially the sub-chief physicians of Internal Medicine and Pediatrics who became users of the CMI at a later stage (see Section 6.3.2). The chief physicians and division managers were therefore asked to indicate if they expect to use the analysis in the future and if so for what purpose. Of the 35 respondents, 21 (60%) expected to start using the analysis the following year, (see Figure 8.18a), especially for the purpose of gaining more insight into their case-mix (Figure 8.18b).

Figure 8.18a: Use of the Interdependency Analysis (N = 35\*)

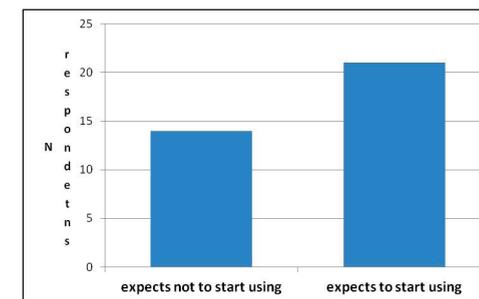
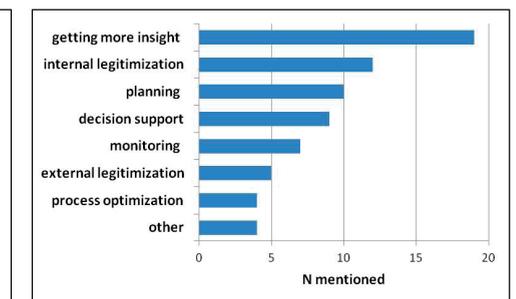


Figure 8.18b: Aims of the Interdependency Analysis (N = 35\*)



(\*) N = 12 missing. Chief physicians and division managers were asked if they expect to use the Interdependency Analysis the next year and for what aims.

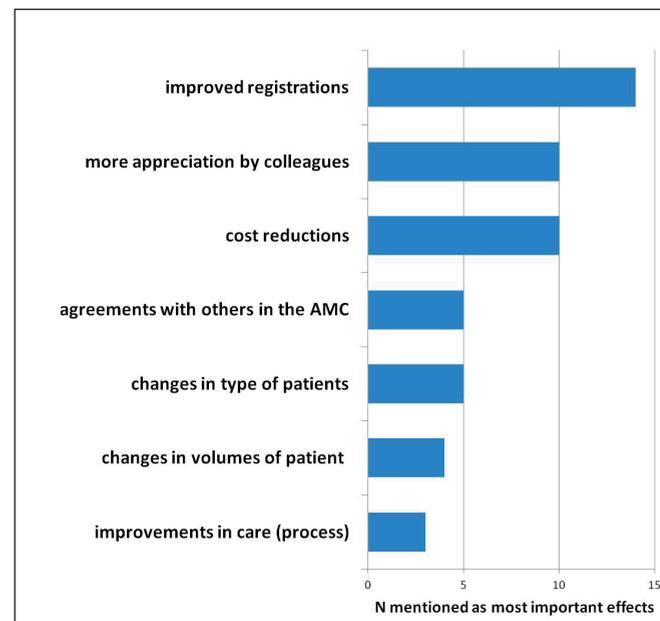
### The Benchmark Analysis Resource Use Profiles and Portfolio Checklist

The chief physicians and division managers were asked to indicate if they expected in the future to use the CMI's information products designed primarily for the (medical) managers but not yet implemented corporate wide: the Benchmark Analysis Resource Use Profiles (Section 7.3.4) and Portfolio Checklist (Section 7.3.5). Seventeen of the 27 chief physicians and division managers (63%, n = 20 missing) expected to start using the Benchmark Analysis Resource Use Profiles in the following year, whereas 17 of the 38 respondents (45%, n = 9 missing) expected to start using the Portfolio Checklist in the next year.

### 8. Effects of the CMI

Participants were questioned if they had experienced positive or negative effects of the CMI. The positive effects are summarized in Figure 8.19.

**Figure 8.19: Most important positive effects of using the CMI (N = 29\*)**



(\*) N = 24 missing. The high non-response was partly due to the fact that respondents found it difficult to determine direct relationships between the use of the CMI and positive effects. Participants were asked to indicate for a number of predefined positive effects if they experience them and if so to hierarchically rank these effects: 1 = most important effect, 2 = second most important effect, etc.

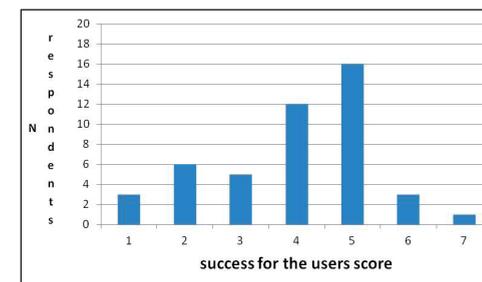
The advantage of an improved registration (of diagnoses and care activities) was mentioned most frequently by the respondents. A greater appreciation for their work

by their management and cost savings were also relatively frequently mentioned. The CMI did not seem to lead to a pronounced change in the case-mix. This was probably due to the several barriers which were experienced by the users, such as the lack of skills and knowledge, lack of decision power, the persistent complexity and volatility of the DBC system, the (perceived) poor quality of the data, existing organizational structure/culture and legal barriers (see also the interim conclusions in Sections 5.5 and 6.4). Concerning the negative effects, 19 of the 34 respondents (56%, n = 19 missing) also reported negative effects of the CMI, such as the complexity of financial data and DOT data, overlap and inconsistency with other types of information, information overload, mismatch with internal funding and selective and incorrect use of the information.

### 9. Perceived overall success of the CMI project

Overall success of the CMI project was selected as the primary outcome measure of the CMI project. In the questionnaire, participants were asked to indicate the extent to which they agree with the statement that the implementation of the CMI was successful so far, for them and for the organization, taking all aspects into account.

**Figure 8.20a: Success for the user (N = 46\*)**



**Figure 8.20b: Success for the organization (N = 45\*)**



(\*) Participants were asked to indicate the extent to which they agreed with the statement the CMI was successful for themselves (N = 7 missing) and for the organization (N = 8 missing). Level of agreement was scored on a 7-point scale, varying from 1 (strongly disagree) to 7 (strongly agree).

The CMI project was assessed as moderately successful for the users themselves. Of the 46 respondents, 20 (43%) perceived the CMI project as successful to very successful (scores  $\geq 5$ ) (mean = 4.0, SD = 1.4, median = 4.0), see Figure 8.20a. Twelve of the 46 respondents (26%) had a neutral opinion. The success scores were lower than at the interim reflection (See Figure 5.23, where 68% had perceived the project as (very) successful; mean=4.7, SD = 1.5, median = 5.0). Probably the most important explanation for the lower scores was the fact that in 2012 the DBC system was replaced by the DOT

system which had a negative effect on the quality, availability and understandability of the data. This drastic change in 2012 and the continuous changes in the years afterwards in product structure, rates, and calculation models made the data to some extent less predictable. One consequence of this was that the Board of Directors decided in 2012 to abandon the plans to link the internal budgets to the DOT production. Because of this, an important aim of the CMI could not be achieved. Although understandable from a management perspective, this was a major setback for the CMI project. Besides, in the management meetings, the focus shifted to other current and urgent issues, such as cost reductions, the proposed merger with the VUmc and the complex implementation of an electronic patient system, rather than the case-mix project. Consequently, this shifting focus impaired the motivation of division managers and chief physicians to use the CMI (Section 6.4). Possible explanations for the neutral score were that these respondents had experienced both advantages and disadvantages of the project or that they found it difficult to determine the actual project outcome.

The respondents with success scores  $\leq 3$  worked mainly in the departments of supporting specialties (rehabilitation, genetics) and subspecialties of Internal Medicine and Pediatrics. Possible explanations for low success rates on the supporting specialties were that parts of the case-mix information were not applicable for them or that they had fewer opportunities to manage their case-mix. Possible reasons for the low success rates on the sub-specialties were that they had become CMI users at a later stage (in 2012) and were directly confronted with the negative effects of the implementation of the DOT system and the fact that for several sub-specialties the case-mix information was incomplete. An encouraging result was that 26 of the 45 respondents (58%) perceived the CMI project as successful to very successful for the organization (mean = 4.3, SD = 1.5, median = 5.0), taking also into account the use of the CMI by others like the F & C department (negotiations with insurers, budgeting, legitimation in the annual accounts), clinical researchers (cost-effectiveness studies), and cooperation with other hospitals (see Figure 8.20b).

Reasons why the respondents perceived the CMI more successful for the organization than for themselves are probably related to the fact that they observed a corporate-wide system, used by various users and for different purposes, both within their own division and beyond. Moreover, there was the general belief that a CMI is necessary anyway in the context of the present competition and financial pressure (see also Figure 8.15).

Seven of the 45 respondents (16%) had a more neutral point of view of the outcome of the project.

### 8.3 Final conclusions

In this section, the final conclusions of the CMI project at the AMC are discussed. The conclusions are based on the results of the qualitative and quantitative results of the interim reflections and the just presented end reflection.

#### Outcomes of the CMI project

The outcome variables focused on the adoption, use and effects of the CMI, as well as the respondents' perceived overall success of the CMI project, both for the managers themselves and the organization.

##### *Adoption of the CMI*

In 2006, the CMI was adopted by the Board of Directors, because the top managers experienced increasing pressure on capacity, finance, competition, and external accountability. They felt the need for more detailed case-mix information (see Section 2.8). At the end of the project in 2014, most managers found that the CMI still had added value for themselves and the organization (see Figure 8.15). This was an encouraging finding: despite the disadvantages of the CMI, such as the perceived poor quality of the data and the fact that the budgets were still not based on the DOT production, the managers still seemed to support the CMI.

##### *Use of the CMI*

During the CMI project, the number of users increased significantly. In the course of time more medical specialties made use of the CMI and. Since 2012 the sub-chief physicians of the medical specialties of Internal Medicine and Pediatrics were additionally included as target groups. In addition to this, as off 2009 the business analysts joined the project (see Section 6.3.1). The business analysts of the divisions' business offices supported the chief physicians and division managers, for example by making in-depth analyses and by advising them on strategy and business operations. The business analysts of the F & C department supported the Board of Directors and concern controller by assessing the annual plans of the medical specialties and by making agreements with the funders. The CMI's underlying (big) database consisting of medical, patient, and financial data was also used by clinical researchers to conduct cost-effectiveness studies.

In 2014, most chief physicians and division managers had used the Standard Report Patient Care and Portfolio Matrix (see Figures 8.16a and 8.17a), which were the key information products of the CMI for them, and a number of them used these products regularly. The (medical) managers used both information products mainly for getting insight into their case-mix, and to some extent for monitoring, internal legitimation, and decision-making support (see Figures 8.16b and 8.17b). The central managers, in

particular, used the CMI for (annual) planning purposes, monitoring (A3 score card), process optimization (SLIM project), the preparation of the administrative merger and for external legitimation (negotiations with health insurers (see Section 6.3.2). The Standard Report Patient Care was also used by the Internal Review Committee to discuss with medical specialties about their policy with regard to patient care and to gain insight into the actual waiting times compared to the standards, to define what actions were needed, and how these would be monitored (see Section 5.3.2). The CMI database was used in various ways for external legitimation purposes, for example to define the percentage of top referral care in the annual account, to influence the tariffs of the A-list DBCs and for cost effectiveness studies. The CMI was eventually not used for the allocation of budgets. The continuous and dramatic changes in the product structure and associated selling prices generated too many uncertainties to implement output budgeting in a responsible way. The CMI was also used less for the planning of capacity. Reasons mentioned for this were that the production of the medical specialty was rather stable over the years and did not require an advanced planning tool and that some specialties used their own planning system and used their own data because the CMI data were not considered reliable enough to use.

#### *Effects of the CMI*

It is difficult to determine exactly what the contribution of the CMI has been to the AMC, because during the research period the CMI project was one of several measures that were taken to resist the increasing competition and financial pressure. Because of the CMI, the amount of available information was significantly increased and improved, which had led to several positive effects, both for the individual managers and the organization. These positive effects became evident from the various (interim) evaluations during the project (see Chapters 5, 6, and 8). Although the perceived effects of the CMI differed per manager, it can be concluded that the CMI contributed to the identification of possible case-mix changes and to provide the appropriate arguments, agreements were made about patient care, cost consciousness was increased, an improved registration of diagnoses and care activities, a greater appreciation for their work management, cost savings and the increase of some tariffs of A-list DBCs. The CMI, however, did not seem to lead to pronounced changes in the case-mix (see Figure 8.19). Some negative effects were also experienced. By far the most important one was the (perceived) poor quality of the information. Respondents also reported other negative effects of the CMI, such as information overload and selective and incorrect use of the CMI.

#### *Perceived overall success of the CMI project*

In the final reflection the (medical) managers assessed the CMI project as moderately successful (Figure 8.20a) for their own functioning. The perceived success seemed to

have decreased somewhat in the course of time, probably because of the introduction of the DOT system, the decreasing support of the Board of Directors and the abandonment of internal performance funding (Section 6.4). The interim reflection had already demonstrated that the expectations of the CMI were different per manager: some expected the CMI to be an answering machine, others a dialogue machine and others a budget generating machine (see Section 5.4.4). Despite this, at the end of the CMI project the majority of the managers still supported the CMI from an organizational perspective (Figure 8.15). The CMI was found especially useful in the context of the present competition and financial pressure. We conclude that the overall success of the CMI can be further increased when the technical capabilities of the CMI are fully used, for example, including by the aims of case-mix decision-making, budgeting, and sales strategy.

#### **Success factors**

The outcomes of the CMI project were determined by several elements: the design and implementation of the CMI, and factors related to the organization and environment.

#### *Design of the CMI*

Several characteristics of the CMI have promoted its success. This case study demonstrated that the CMI's surplus value was mainly determined by the fact that medical data, patient data, and financial data were collected at patient level and integrated into one system. This made it possible to establish relationships between these types of information and to aggregate information at each desired level and added value with respect to other (regular) information systems (see Section 5.4.2). The CMI was available from a large number of different dimensions. Because of this, the CMI had a broad scope of information and was quite flexible. The case study demonstrated how by the design of different information products a CMI can fulfill different functions for different stakeholders in the phases of the strategic management cycle (see Chapter 7). The strengths of the information products for the managers were that they were ready-made and easily accessible, that they provided standardized and highly aggregated information presented by powerful visualizations with clear explanations.

The patient groups, as defined by the chief physicians, appeared to be the best 'language' to be used in the CMI, because they were considered crucial for performance on all core tasks and on finance (See Figure 5.6). It also reflected the perceptions of the medical managers (see Section 7.5.1). Because of these patient groups, the contents of the care were automatically displayed. This made it possible to substantively connect and compare different types of information with each other, to reduce the management information to manageable units and to link the patient groups to the focus points as

defined in the strategic aims. The Standard Report Patient Care and Portfolio Matrix contributed to better insights and a better dialogue about care (see Figures 5.22, 8.16b and 8.17b). The Interdependency Analysis appeared to be useful since it was a visual representation of how the medical specialties were interrelated and where coordination of medical policy was needed (see Figure 8.18b). The Benchmark Analysis Resource Use Profiles showed that these analyses could seriously contribute to a dialogue about medical practice, efficiency gains, and cost reductions (see Section 6.3.2 and 7.3.4). The strengths were that the practice of the AMC was compared with the other UMCs only (rather than with general hospitals) and that the outcomes were presented at a detailed level. The Data Cubes in Cognos significantly increased the CMI's accessibility and analytical capabilities (see Section 7.4).

However, some of the CMI's characteristics obstructed the success of the project. The persistent perception of poor data quality was the most important obstructing factor. This was particularly true for DBC data (and from 2012, the DOT data) and cost data. One explanation for this was that these data were derived data; they were the result of complex processes consisting of a large number of steps, algorithms, and assumptions in which many managers were not personally involved. Another explanation was that costs per patient group were not registered in the financial systems but could only be estimated through unit costs and consequently over- or underestimated the actual costs as registered in the general ledger. This gave a distorted picture of the financial situation. Although this effect was inevitable, it was substantial and confusing for the users of the CMI. Also, in order to use the unit costs as a basis for negotiations with health insurers and to compare them with the selling prices, the unit costs had to be adjusted for several components that were covered by a separate (academic) budget, such as top referral care and training. The adjustments were made on the basis of agreements with other UMCs and the Dutch Health Authority (NZa). Because of this, the adjusted costs as presented by the CMI were no longer a representation of medical processes but the results of a political process. Both regarding the DBC and cost data, there was a high uncertainty between cause and effect. For these types of information, the CMI couldn't function as an answer machine or a dialogue machine, but more as a 'learning machine' or an 'idea-generating machine' (see Section 3.4.1). For many managers this was disappointing because they expected to get hard facts that would give them 'the right answers'. Finally, some types of information, such as relevance and quality of care were not registered in systems, could only be obtained by asking the medical specialties and were therefore by definition considered as subjective.

Yet this research shows that these learning and idea-generating functions could still be very useful. Although the CMI did not represent the 'truth', it gave relevant indications

about costs and financial coverage and this knowledge formed the basis for the dialogue on case-mix, thereby increasing cost-consciousness and improving registrations (See Figure 5.22 and 8.19). This also applied to the qualitative, non-system data that was by definition considered as soft and subjective. These data appeared to be useful, for example for the Portfolio Matrix, where non-system data (medical relevance) was combined with system data (financial relevance), see Section 5.3.1. Furthermore, a disadvantage of standardizing the case-mix information for all types of managers and medical specialties was that some parts of the case-mix information were not applicable for all users (such as the supporting medical specialties), and created a feeling of information overload (see Section 8.2.5). Finally, the BI tool Cognos appeared to be too complicated for the managers to work with (see Section 6.3.1).

#### *Implementation of the CMI*

The CMI project was managed by the F & C department. During the interim and end reflection, the majority of the managers (strongly) agreed with the statement that the project organization had enough knowledge and skills to implement the CMI successfully (see Figure 5.13 and 8.8a). The advantages of the project organization were that the needed competences were concentrated within one department and that the participants were approached in a uniform way. However, there was insufficient capacity at the project organization (see Section 6.3.2). In practice, the project organization consisted of only two permanent members (the project leader and an ICT consultant); the other members were temporary members and participated mainly in the pilot groups. This made the project very person dependent, and besides this, the project organization was not able to sufficiently support the managers to interpret and use the CMI in-depth. There was also competition from other projects that demanded capacity from the F & C and ICT departments, such as the implementation of the new electronic patient system and the A3 methodology.

Regarding the implementation strategy, several characteristics were assessed moderately positive by the respondents, such as the gradual design and implementation of the CMI, the active involvement of users by means of pilot groups and the fact that the design fitted well with the external developments (See Figures 5.14 and 8.9). However, several respondents expressed the opinion that the use of the case-mix information should not be voluntary, in order to reduce the risk that people would keep using their own information system and would use the system opportunistically.

From this research the advantages and disadvantages of the self-design of a CMI became visible. One advantage was that the designers knew the complex external and internal context of a UMC well and were familiar with the users and their management problems.

Second, the designers had the flexibility to set their own priorities in the design of products and to tailor information products to the users. So, it became possible to ensure that the information products complied with the users' requirements as much as possible. This, probably, could not be realized with an external, ready-made CMI where external (ICT) standards would have to be taken into account. Furthermore, this research showed that *the process of designing itself* was useful because it stimulated the users to think actively about their case-mix and decision-making criteria (see Section 6.3.1). Finally, the fact that the AMC decided to design the CMI directly after the introduction of the health care reforms made them a frontrunner in Dutch hospitals and this remained until the end of the project in 2014 (Groene Amsterdammer, 2014). The AMC was timely in its preparation for the era of full performance reimbursement. This also gave the AMC the opportunity to influence national developments, such as the improvement of the DBC tariffs (see Section 6.3.1).

However, there were also several disadvantages. First, it took a lot of (scarce) time, capacity, and energy to design the CMI from scratch. The more attention that was paid to this development phase, the less attention could be paid to the follow-up phases. Second, because of the iterative approach, the CMI was continuously under construction. As a result, the CMI was seen by the users as a test product with test data and it had to be repeatedly explained to them what could and could not be done with the CMI. It was a process of trial and error, with failures and successes. Examples of failures were that some products (such as the Standard Report Patient Care) were implemented too early because they contained insufficient or even incorrect data (see for example Section 5.3.2) These failures lingered long and it took quite some time to restore confidence among users. Third, some data were eventually insufficiently accepted by the health insurers and therefore after this project it was decided to outsource the Forecasting Model to a software supplier and to replace the Top Referral Care Model by a common model for all UMCs (see also Section 6.3.2).

#### *(Medical) manager*

The case study demonstrated that the decision to designate the chief physicians, division managers, and central managers as the primary target groups of the CMI was justified. They had substantial decision-making power, for example regarding the case-mix (see Figures 5.7 and 5.8) because of their hierarchical position and expertise. They thus had a lot of influence on the performance on core tasks and finance of the AMC. However, some chief physicians perceived little power to manage the case-mix. This was particularly true for medical specialties with a high percentage of emergency patients or chronic patients and internal referrers (see Section 5.4.1). Several managers also stressed that the space for case-mix decisions is relatively limited, because the case-mix is a result

of accumulated expertise and infrastructure where often multi-year research programs are associated with patient groups and that does not change overnight. The (medical) managers had relatively less influence on the budget and on the total cost of the DBC.

The majority of them felt the need for case-mix information to make case-mix decisions in a more rational and explicit way to realize their core areas in times of increasing competitive pressures and financial pressures (see Section 5.4.1). They therefore supported the CMI and were prepared to participate in its design. Some (medical) managers did not feel the need to change their way of decision making, for example, because it gave them freedom.

The need for types of case-mix information varied by manager, but it revealed that there was quite a consensus between the managers about what topics should be minimally covered in the CMI: volumes, patient characteristics, medical production, process, quality, finance, and the health care market (see Section 5.3.1). However, within these topics, the information needs differed considerably by type of manager and type of medical specialty in terms of level of detail and content of the information. The difference between the needs of the managers could be explained by differences in personality traits, the presence of supporting personnel, and the availability of alternative information. Some managers wanted to receive a wide range of case-mix information in order to be as informed as possible; others wanted to receive only a (filtered) summary to prevent information overload.

The managers were particularly interested in information on topics that they could influence themselves and/or were made formally responsible for, such as the type of patients, length of stay, waiting times, top referral care, and the use of expensive materials and diagnostics (see Section 8.2.3). Other topics were considered much less relevant, for example the registration, health care market, and invoicing. One obstructing factor with regard to finance was that the target groups experienced barriers to actually managing their case-mixes, costs, or returns. With regard to the case-mix it appeared that the possibilities of managing were related to the type of medical specialty (see Section 5.4.1). If a specialty treated relatively many patients with either acute or chronic diseases, managers saw few opportunities to manage. Furthermore, no drastic case-mix decisions could be expected because the case-mix was a result of accumulated expertise and infrastructure that did not change overnight. With regard to costs and returns, the target groups lacked some decision-making power. They were not allowed to appoint staff (at the nursing department or polyclinic), to order expensive materials, and to make investments. They also had no direct influence on the budget, since the budget was still determined by historically defined parameters, and not on the DBC revenues.

Finally, there were no clear job descriptions with committed tasks and responsibilities. Another obstructing factor was that several medical managers lacked the knowledge and skills to use the CMI in a responsible way (see Section 5.5 and 6.4). One explanation for this could be that the majority of them were relatively old, which meant that these managers were mainly used to fixed budgets and not to a free health care market. Finally, several managers with a medical background found it difficult to combine the different logics of medicine and management.

#### *Organization*

On the basis of this research it can be concluded that some characteristics of the organization have promoted, but also obstructed its success. First, the AMC is a university hospital. This creates a positive culture to design and test evidence-based innovations where people are willing to participate in studies. Furthermore, similar to other UMCs, the AMC is a large organization with excellent ICT facilities. Second, the AMC has three core tasks (care, research, and education) which are inextricably interwoven. The (medical) managers have overall responsibility for all these core activities. This research revealed that the case-mix has a major impact on all the core tasks (see Figure 5.6). This makes the decision-making process complicated. Moreover, it proved difficult to support several decision-making criteria with system data, because in practice activities for the core tasks, such as patient care and research, are registered and financed separately. Also, in some cases, artificial adjustments had to be made to the cost data to make them comparable to general hospitals. Third, the AMC supplies largely tertiary and top-specialized care to complex patients. Academic care requires costly infrastructure, personnel with (small) sub-specialties and a multidisciplinary approach. The interdependence of various medical disciplines is much greater than in non-academic hospitals. Multi-disciplinary work requires continuous coordination between medical specialties. This implies that the responsibility for case-mix decisions cannot be assigned to a single medical specialty. Fourth, the case-mix of a UMC is often a result of longitudinal accumulated expertise and infrastructure, where often multi-year research programs are associated with patient groups. Therefore, chief physicians do not feel the urge and the possibility to change the mix regularly. Fifth, because of their large size, in most UMCs vertically-oriented organizational structures are used where responsibilities are primarily allocated to divisions and subsequently medical departments. This means that the internal control and information systems are also vertically oriented. In our case study the implementation of the DBC-based and process-oriented CMI was difficult because the divisional structure remained unchanged. Therefore there was a missing link between the process information of the DBC and the vertically allocated responsibilities and regular management information. For example, a DBC contains all of the direct and indirect activities and associated costs that can be attributed to the DBC (so including

the medical and non-medical supporting departments), whereas the (medical) managers are only responsible for the activities and costs within their own specialty or division. Finally, in the Dutch UMCs all (medical) managers are employed, so they have no personal economic interest in the financial effects of the case-mix of their division or medical specialty. In the case study of the AMC, the financial consequences were considered to be least relevant when making case-mix decisions (see Figures 5.16 and 8.11) Because of this, the interest for case-mix information is probably lower in UMCs than in general hospitals where a number of medical specialists are self-employed.

Furthermore, several examples showed that the principles of the CMI did not match with the prevailing organizational culture. Some aims and principles of the CMI were supported by the managers more in theory than in practice. For example, the aim of the CMI was to better rationalize and objectify decision-making processes. But several attempts to rationalize in practice failed. The implementation of the Portfolio Checklist (see Section 7.3.5) with objective and measurable standards to assess the portfolio in a uniform way ultimately didn't work because the chief physicians were afraid to lose autonomy (see Section 6.3.1). Also the attempt to objectify the relevance scores of the Portfolio Matrix by quantitative data failed, with the argument that this had to remain an opinion, not a fact (see Section 6.3.1). Attempts to link case-mix decisions directly to surgery budgets failed because one was afraid that it would lead to discussions between divisions (see Section 6.3.1). The principle that the case-mix had to be put centrally in management talks and management information, was supported by almost all participants, but was not realized in practice. Management meetings were dominated by other current and urgent issues, such as cost reductions, the appointments of professors, and new priorities such as the proposed administrative merger with the VUmc.

Although the Board of Directors underlined the importance of the CMI at the outset of the project, the actual support given was perceived as too weak to be effective. Also, the Board of Directors did not actively encourage a dialogue about using the CMI (see Figure 5.18 and 8.12). The principle of 'professional in the lead' was still applied (see Section 2.8), which gave chief physicians and divisional managers considerable freedom as to whether they used the CMI or not. The CMI was offered only as a learning tool, not to control or curtail their behavior. One advantage of this approach was that the freedom of choice and flexibility of adoption seem to have softened potential conflicts and settled disputes. Thereby it enhanced the flexibility in adoption. However, the downside of this approach was that several managers lacked the incentive to use the CMI. The risk remained that people would keep using their own information system, would use the CMI opportunistically, or would ignore the CMI because of a lack of interest or priority. This had a negative impact on the outcome of the CMI project. The

implementation of performance-based budgeting was an important goal of the CMI, but ultimately was not realized and historical budgets were retained. This meant that the medical managers lacked the financial incentives and opportunities to further improve their case-mix which reduced their need for case-mix information. In summary, the organizational culture and budget system remained unchanged, which was an obstacle for the success of the CMI.

#### *Environment*

With regard to the environment, it can be concluded that the introduction of market mechanisms and increasing financial and legitimization pressure had increased the need of the AMC to redefine their strategy, to start developing performance-based budgeting and to adopt a CMI (see Section 5.2 and 6.2). However, the effects of the market mechanisms took place much slower and in a more limited way than expected and eventually decreased the need for a CMI over the years, see Section 6.4. The effects were limited because the national performance-based reimbursement system was implemented much later than announced (in 2012 rather than 2008), measures were taken at different levels to mitigate the effects of the reforms (through a Gentleman's Agreement and safety nets) and negotiations with the health insurers continued to be focused primarily on budgets per hospital, rather than on the price and quality per care product. Also, the share of freely negotiable care in 2014 was still limited to 50%, because most complex care was still regulated (A-list DBCs) and the academic budget remained. As a result, the revenues of the UMCs were still rather guaranteed. Competition increased but mainly in basic care, which was considered by the UMCs as more of an opportunity to reduce their waiting lists than as a threat. Also the fact that the hospitals were covered by the Competition Act reduced their opportunities to make agreements with other hospitals about their case-mix and reduced their need for the CMI (see Section 6.3.1).

The national DBC system (and since 2012 the DOT system) provided good opportunities for the design of the CMI, because new types of data were registered in a uniform manner and it became possible to connect the medical, patient, and financial data (see Section 5.5 and 6.4). Through this, it became possible to identify and quantify the patient groups and to connect the strategy with medical, logistical and financial policies. The different 'worlds' between medical and financial professionals which were previously widely separated, could then be integrated. However, the DBC system also had several drawbacks. The DBC-data were considered as an artificial and financial administrative language and therefore insufficiently recognized by the (medical) managers. Furthermore, it did not sufficiently represent the academic care, and did not match with the allocated responsibilities in the UMCs. Also, until 2011, the tariffs or the A-list DBCs were only virtual and did not represent the actual returns (see Section

2.5). Furthermore, the DBC system was too detailed and too volatile to be used for free negotiations between the AMC and health insurers. Every year it took between nine to eleven months to make agreements with insurers regarding volumes and prices per care product and this hardly improved in the course of time (see Figure 2.4). As a result, there were no actual prices available during that time and users had no idea of the financial coverage of their patient groups. This hampered the managers tremendously in using the CMI for decision-making and budgeting.

The replacement of the DBC structure by the DOT structure was more complex and extensive than expected and had a huge impact on the CMI. The existing information products had to be technically redesigned because the DOT data were generated in a different way and based on different sources than the DBC. It took about nine months before the first DOT production data became available. The negative effects of this incomplete dataset were that there were risks of using this information and disclaimers had to be added to the information products. For example, a warning not to make case-mix decisions on the basis of the CMI. The DOT product structure also implied a substantive change: the contents and terminology of care products were different from the DBC, which meant that users of the CMI had to be trained to understand the DOT system and to interpret the related case-mix information. Managers considered the DOT system as a deterioration of the DBC system and the majority of them found that that the current DOT system was only to a limited extent useful in generating case-mix information. This was a striking finding, as the CMI was to a large extent based on the DOT data as this was the only way of integrating medical, patient, and financial data.

Table 8.2 gives a summarized overview of the identified factors that have promoted or obstructed successful outcomes of the CMI project in the AMC.

Table 8.2: Summarized overview of factors promoting or obstructing the successful outcomes of the CMI-project

Design and implementation factors

Factor	Topic	Factors promoting successful outcomes	Factors obstructing successful outcomes
Design of the CMI	Inte-grated character	<ul style="list-style-type: none"> <li>The integration and correlation of medical data, patient data and financial data in one system</li> </ul>	
	Function	<ul style="list-style-type: none"> <li>Fulfills particularly function as learning, dialogue, idea-generating machine</li> <li>Fulfills different functions for different stakeholders in the phases of the strategic management cycle</li> </ul>	<ul style="list-style-type: none"> <li>Fulfills limited function as answer machine because of high uncertainty between cause and effect. It doesn't provide hard facts that would give 'the right answers'.</li> </ul>
	Language of patient groups	<ul style="list-style-type: none"> <li>Provides a common language to substantively discuss medical policies</li> <li>Reflects the perception of the medical manager</li> <li>Reduces the management information to manageable units.</li> <li>Makes it possible to connect and compare different types of information with each other</li> <li>Defining and valuing patient groups compels to think about portfolio</li> </ul>	<ul style="list-style-type: none"> <li>Personnel dependent, labor intensive</li> <li>There is overlap of patient groups between medical specialties</li> </ul>
	Contents	<ul style="list-style-type: none"> <li>Contains the key topics in patient care in the strategic management cycle</li> <li>Data are collected at patient level and can be aggregated at each desired level</li> <li>The CMI is available from a large number of different dimensions and is therefore quite flexible.</li> <li>The CMI's underlying (big) database can also be used by clinical researchers</li> </ul>	<ul style="list-style-type: none"> <li>Some data were not (easily) available in systems, such as relevance and quality of care, but can only be obtained by asking the medical specialties and were therefore by definition considered as subjective.</li> <li>Some data are not connected with each other, for example patient care and research data</li> <li>Too broad information set, risk of information overload</li> </ul>
	Presenta-tion	<ul style="list-style-type: none"> <li>Ready-made and easily accessible (automatic mailing)</li> <li>Standardized and highly aggregated information</li> <li>Presented by powerful visualizations with clear explanations.</li> <li>The combination of qualitative, non-system data with system data (Portfolio Matrix)</li> </ul>	<ul style="list-style-type: none"> <li>Some parts of the case-mix information are not applicable for all users</li> </ul>
Quality of the data	<ul style="list-style-type: none"> <li>The CMI triggers to improve the quality of the data (registrations, cost calculations)</li> </ul>	<ul style="list-style-type: none"> <li>(Perceived) poor quality of the data, because of:                             <ul style="list-style-type: none"> <li>poor registrations, failing computer systems</li> <li>data are the result of (complex) methods, definitions, assumptions, and systems</li> <li>subjectivity of the non-system data</li> <li>volatility of the DBC and financial data,</li> <li>lack of data/ outdated data (sales prices)</li> </ul> </li> </ul>	

Table 8.2: Summarized overview of factors promoting or obstructing the successful outcomes of the CMI-project

Design and implementation factors

Implementa-tion of the CMI	Project organi-za-tion	<ul style="list-style-type: none"> <li>Concentration of skills / knowledge in project organization,</li> <li>uniform approach of (medical) managers</li> </ul>	<ul style="list-style-type: none"> <li>Person dependent</li> <li>Lack of priority and resources, competition from other projects</li> </ul>
	Strategy	<ul style="list-style-type: none"> <li>Iterative design and implementation</li> <li>Active involvement of the users (pilot groups)</li> <li>Design fits well with external developments</li> <li>The freedom of choice to use the CMI softens potential conflicts and settled disputes.</li> </ul>	<ul style="list-style-type: none"> <li>The freedom of choice to use the CMI has the risk that people would keep using their own information system, would use the CMI opportunistically, or would ignore the CMI because of a lack of interest or priority.</li> </ul>
	Self design	<ul style="list-style-type: none"> <li>Designers know the context of a UMC and are familiar with the users of the CMI.</li> <li>Flexibility to set own priorities, customization of products,</li> <li>Positive effects gained during the design</li> <li>Being a frontrunner enables to influence national developments at an early stage</li> </ul>	<ul style="list-style-type: none"> <li>It takes a lot of (scarce) time, capacity, and energy to design the CMI from scratch.</li> <li>Continuously seen as a test product with test results, the CMI is never in a final state</li> <li>Process of trial and error. Failures can linger long and it takes time to restore confidence among users.</li> <li>Some data are insufficiently accepted by external stakeholders, such as health insurers and other UMCs</li> </ul>

Organizational factors

Factor	Topic	Factors promoting successful outcomes	Factors obstructing successful outcomes
(Medical) manager	Decision power	<ul style="list-style-type: none"> <li>Chief physicians, division managers, and central managers are designated as the primary target group of the CMI, because they have the power to make key decisions</li> </ul>	<ul style="list-style-type: none"> <li>Some medical specialties (perceive) insufficient decision-making power with regard to the case-mix (specialties with a high percentage of emergency patients, chronic patients or internal referrers)</li> <li>No drastic case-mix decisions can be expected from the CMI because the case-mix is a result of accumulated expertise and infrastructure where often multi-year research programs are associated with patient groups that do not change overnight.</li> <li>Several (medical) managers lack some decision power regarding their costs and returns</li> </ul>
	Need for CMI	<ul style="list-style-type: none"> <li>(Medical) managers feel the need for a CMI to make their (case-mix) decisions more rational, and explicit and to realize their core areas in times of increasing competitive pressures and financial pressures</li> <li>There is quite a consensus between the (medical) managers about what topics should be minimally covered in the CMI</li> </ul>	<ul style="list-style-type: none"> <li>Complex and irrational nature of decision-making</li> <li>Some (medical) managers fear losing decision autonomy because of the CMI</li> <li>Within the key topics of the CMI, the information needs differ considerably by manager and medical specialty in terms of level of detail and content of the information</li> </ul>
	Know-ledge/ skills		<ul style="list-style-type: none"> <li>Several (medical) managers lack the knowledge and skills to use the CMI</li> </ul>

Table 8.2: Summarized overview of factors promoting or obstructing the successful outcomes of the CMI-project

(continued)

**Organizational factors**

Factor	Topic	Factors promoting successful outcomes	Factors obstructing successful outcomes
Organiza- tion	Charac- teristic of a UMC		<ul style="list-style-type: none"> <li>The different core tasks and medical specialties of an UMC are inextricably interwoven which complicates the (case-mix) decision-making process and the use of the CMI</li> <li>Artificial adjustments have to be made to the cost data to make them comparable to general hospitals</li> <li>All (medical) managers are employed, so they have no personal economic interest in the financial effects of their case-mix</li> </ul>
	Organi- zation culture	<ul style="list-style-type: none"> <li>Positive culture to design and test evidence-based (information) innovations where people are willing to participate in studies</li> </ul>	<ul style="list-style-type: none"> <li>(Unchanged) culture: decision are made by 'wheeling and dealing' between people</li> </ul>
	Organi- zation structure		<ul style="list-style-type: none"> <li>There is a missing link between the process information of the DBC and the vertically allocated responsibilities and regular management information.</li> </ul>
	ICT facilities	<ul style="list-style-type: none"> <li>Good ICT facilities (data warehouse, BI tools)</li> <li>Data Cubes in Cognos significantly increased the CMI's accessibility and analytical capabilities</li> <li>Options to drill down in the data to patient level and</li> </ul>	<ul style="list-style-type: none"> <li>Cognos is too complicated for the managers to work with</li> <li>Competing ICT projects (EPIC)</li> </ul>
	Plan- ning & control	<ul style="list-style-type: none"> <li>Announcement of performance-based budgeting</li> </ul>	<ul style="list-style-type: none"> <li>Retention of historical (fixed) budgets, the abandonment of plans to base the internal budgets on the DOT production</li> </ul>
	Board of Direc- tors	<ul style="list-style-type: none"> <li>The CMI is offered by the Board as a learning tool, not to control or curtail their behavior.</li> </ul>	<ul style="list-style-type: none"> <li>(Perceived) insufficient stimulation by the Board to use the CMI</li> <li>CMI is little discussed in management meetings/ competition with other, more urgent, issues (merger, EPIC, cost reductions)</li> <li>Change of members of the Board of Directors (including the initiator of the CMI project.</li> </ul>

Table 8.2: Summarized overview of factors promoting or obstructing the successful outcomes of the CMI-project

(continued)

**Environmental factors**

Factor	Topic	Factors promoting successful outcomes	Factors obstructing successful outcomes
Environ- ment	Introduc- tion of market mecha- nism	<ul style="list-style-type: none"> <li>The increasing competition and financial pressure increases the need for UMCs to redefine their strategy, to start developing performance-based budgeting and to adopt a CMI</li> </ul>	<ul style="list-style-type: none"> <li>Relatively limited freely negotiable care, still substantial income with lump-sum character</li> <li>(Severely) delayed agreements with insurers on DBC/ DOT volumes/ prices, focus still on budgets</li> <li>Limited competition in high complex care</li> <li>(Perceived) fewer legal opportunities to manage the case-mix in consultation with other hospitals in the region because of the Competition Act</li> <li>(Budget) measures to mitigate the effects of the reforms (safety nets, contracting sums)</li> </ul>
	DBC / DOT product structure	<ul style="list-style-type: none"> <li>Leads to several types of new information, for example about the content and complexity of care, the full cycle of care, the financial coverage of patients and the relationship between types of data.</li> <li>It enables to connect the medical, patient, and financial data.</li> <li>It becomes possible to identify and quantify the patient groups and to connect the strategy with medical, logistical and financial policies. Thereby, the different 'worlds' between medical and financial professionals can be integrated.</li> </ul>	<ul style="list-style-type: none"> <li>Complexity and volatility of DBC / DOT product structure</li> <li>Mismatch between reimbursement and funding system of the regulated segment (2006 - 2011)</li> <li>Insufficient representation of academic care</li> <li>DBC-data are considered as an artificial and financial administrative language and therefore insufficiently recognized by the (medical) managers</li> <li>Too detailed and too volatile to be used for negotiations with health insurers</li> <li>Mismatch between product structure and organization structure / allocated responsibilities</li> </ul>

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# Chapter 9

Reflection on research design and researcher

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## Abstract

This chapter reflects on the objectives of the research project, the research methodology, the role of the researcher, and the applicability of the research findings to other hospital organizations. We concluded that the aims of the CMI project have been partly achieved. The CMI was especially used by the (medical) managers for gaining insight, monitoring, process optimization, and stimulating the dialogue about the case-mix, and decision support. However, no substantial and actual case-mix decisions by the managers immediately resulted from the functioning of a CMI. Besides, although the CMI was also technically capable of being used for the allocation of budgets and external legitimation, this happened only to a limited extent. Explanations for this were that output budgeting was ultimately not implemented and agreements with insurers still focused on global budgets rather than specific DBC products. The research period had a major impact on the results. The case study took place just after the implementation of health care reforms. This was a chaotic period. Several organizational and environmental variables were very unstable and unpredictable in the course of time. This complicated not only the design and implementation of the CMI, but also the exploration of the relationships between success factors and outcomes of the CMI. With regard to the methodological implications, the conclusion is that design-oriented research may be of high value in the accounting discipline, particularly but not exclusively in the domain of health care, because it can contribute to the production of relevant knowledge. The design-oriented research methodology can be further improved by adding extensive reflections to the regulative cycle to gain contemplative knowledge. The multiple roles of the researcher (project leader and senior advisor to the Board of Directors) had advantages because in this way he had a thorough understanding of the external and internal context of the UMCs, its management structure and the organization-related problems. However, there were also potential disadvantages of combining work and research in the same field in terms of risk of bias and preconceptions of the results. The design-oriented knowledge about the Portfolio Matrix, which was a key product of the CMI, turned out to be applicable to two other UMCs: the UMCG and VUmc. However, in the design and implementation of the Portfolio Matrices, different choices had to be made.

## 9.1 Introduction

Sections 9.2 and 9.3 reflect on the objectives of the research project and the research methodology. Section 9.4 describes the advantages and disadvantages of the fact that the researcher also worked as project leader and as senior advisor to the Board of Directors. In Section 9.5, we explore the applicability of our research findings to other hospital organizations.

## 9.2 Reflection on the research objectives

The research objectives were: 1) to design and implement a CMI for the top medical and non-medical management in the AMC and 2) to gain in-depth design-oriented knowledge about a CMI (see Section 1.4). Below will be evaluated to what extent these objectives have been achieved

### *1. To design and implement a CMI for the top medical and non-medical management in the AMC*

The first objective was to design and implement a CMI for the top medical and non-medical management of the AMC. This objective has been largely achieved. During the case study, an advanced CMI has been designed, with different aims, information products, and applications (see Chapter 7) that were accessible to all top managers. However, the intention was to make the different information products available through the same prevailing business intelligence tool (Cognos), but this failed. Several (medical) managers found Cognos too complex to work with, even after they had received training (see Section 6.3.1). As a result, we decided to design separate information products for the (medical) managers, which were ready made and contained information at a highly aggregated level, and to design advanced and detailed information products in Cognos for the business analysts to support the managers.

The research was primarily targeted at the management level of chief physicians, division managers, and central managers because they were considered to be the key decision-makers of the CMI and therefore its most important target group of the CMI. However, during research project it became clear that the CMI, and its underlying (big) database, was also relevant for other target groups, such as managers at lower levels (head of sales department, chiefs of the (poli)clinics, head nurses), staff members (physicians), business office employees, DBC consultants, and clinical researchers. Although we provided some examples of their use of the CMI, we decided not to include them as target groups in order to keep the scope limited. Furthermore, to obtain a good representation of the different types of medical specialties and top managers, the CMI was designed for and implemented at all clinical medical specialties and divisions (contemplative, surgical

and supporting specialties). All top managers of these entities were invited to participate in the interim (Section 5.4) and end reflection (Section 8.2). In both reflections, the response was very high, 97% and 85%, respectively, and therefore the responders formed a good representation of the top management of different types of medical (sub) specialties. However, a limitation was that only the clinical specialties that registered Diagnosis Treatment Combinations (DBC's) were included, and not the supporting medical departments such as laboratory, diagnostics, operating rooms, and intensive care. Therefore these departments felt less involved in the project, whereas the CMI could also provide good opportunities for them, for example, with planning.

The CMI was designed to support the (medical) managers in all phases of the strategic management cycle (see Section 7.2). In retrospect, it can be concluded that the CMI was especially used by the managers for gaining insight, monitoring, stimulating the dialogue about the case-mix (internal legitimation), and decision support; see Figures 8.16b - 8.17b. However, no substantial and actual case-mix decisions by the managers immediately resulted from the functioning of a CMI (Figure 8.19). Factors that hindered real case-mix decisions were perceived poor quality of the data, the complexity of case-mix processes, less urgent needs and possibilities for changing the case-mix and that in practice, many decisions were still made on the basis of "wheeling and dealing" between. Besides, several types of necessary information could not be supported by a CMI because the data were not available in the systems, such as qualitative data. The CMI was to some extent also used for planning purposes, but only by central managers (the concern controller) and at a highly aggregated level. Although the CMI was technically capable of being used for detailed planning, for example, for the preparation of financial and capacity budgets, this happened only exceptionally. Explanations for this were that output budgeting was ultimately not implemented and the historically based budgeting did not require an advanced planning tool. Furthermore, the CMI data were not considered reliable enough to be used for planning purposes. The CMI was also used by central managers for negotiations with insurers, but mainly at a highly aggregated level because the agreements still focused on global budgets rather than specific DBC products.

The moment in time was a relevant contextual factor for the research project because it had a major impact on the results. The research took place just after the implementation of the health care reforms, which included the introduction of a new reimbursement system, the product structure, and the liberalization of care. There was a mixture of a complex internal environment and a chaotic outside world. Several organizational and environmental variables were very unstable and unpredictable in the course of time. For example, during the research period, the plans for hospital reforms and the DBC

product structure changed continuously, the negotiations with health care insurers were finalized at a very late date, the plan for internal performance-based budgeting was abandoned, the composition of Board of Directors changed, and (medical) managers had to get used to the new era of the liberalization of care. Eventually, the free market of hospital care did not really come through. As a result, the aims of the CMI changed during the research project, as did the basic material to design it, such as the DBC data, data sources, and definitions. These factors complicated the design of the CMI and implied that eventually some goals of the CMI such as making case-mix decisions and budgeting could not fully be achieved (see Section 6.4) and examined. Although this is unfortunate, unpredictable time-related events are inherent to longitudinal design-oriented research. On the other hand, there were some positive, unexpected developments, which provided new opportunities, such as the use of the CMI for the preparation of the administrative merger with the VUmc, determining national rates, and cost-effectiveness studies.

Finally, it is difficult to determine and quantify exactly what the impact of the CMI has been on the user and the organization. The design and implementation of the CMI project was one out of a set of measures taken by the Board of Directors as a response to the increasing competition and financial pressure and we cannot provide hard evidence on which measure independently contributed to what outcome. However, based on the extensive interim and end reflections we can conclude that the CMI has increased and improved the available information regarding patient groups enormously, and that this information has contributed to a more systematic thinking about the case-mix, better insights, better registrations, more and better external legitimation, increasing cost consciousness, increasing transparency, cost reductions and better rates (A-list DBC's), see Section 8.3. However, to obtain more robust (statistical) evidence of the positive effects of CMIs, additional research in other (academic) hospitals is necessary.

## *2. To gain in-depth design-oriented knowledge about a CMI*

This research contributed in several ways to the knowledge about CMIs, both for the management accounting discipline and practice. First, this is the first scientific research project on CMIs conducted in the context of Dutch university medical centers (UMCs). This context was unique with regard to the type of environment (Dutch hospital sector), the reimbursement system (DBC system), the type of organization (UMCs), and in terms of momentum (just after the introduction of health care reforms). Through this research we gained knowledge of the possible applications, outcomes, and success-determining factors of the CMI in this specific context and could relate this knowledge to the conclusions of similar studies in other countries (see Section 10.2).

Second, this research related to both the design and the implementation of a CMI,

whereas prior accounting research mostly focused on the implementation of an already designed CMI. In addition, this research related to an information system where medical information, patient information and financial information was integrated, whereas many other studies concerned information systems focusing on specific topics such as patient or cost (accounting). This resulted in new design knowledge of CMIs. Through continuous iterations in the reflective cycle, we gained knowledge about what types and combinations of information were useful to whom and about how the information system could be implemented in a responsible way. The study demonstrated that a CMI can fulfil multiple functions for multiple stakeholders at the same time. Through the research the advantages and disadvantages of self-design of a CMI by a UMC became apparent (see Section 8.3).

Third, the outcomes and the success factors of a CMI were examined in-depth, with both qualitative and quantitative methods. As a result, detailed insights were gained about the factors that hindered or facilitated the success of the CMI, and about the ways these obstructions could be reduced. We extensively examined the process of case-mix decision-making, and discovered why dramatic changes in the case-mix cannot be expected of the implementation of a CMI in UMCs. The conclusions on this topic were complementary to the ones in previously mentioned studies on CMIs in other than UMCs contexts (Chapter 3). The study also explained why a CMI performs particularly as a dialogue and learning machine and not as an answering machine. Finally, this research clarified that a CMI can have a direct impact on the organization and its practitioners, both in positive and negative ways, and it demonstrated that the design and implementation of a CMI should be evidence-based.

### 9.3 Reflection on the research methodology

Until now, design-oriented research was scarcely focused on (case-mix) accounting systems in the health care sector (see Section 4.2). Reflecting on the design-oriented research methodology the following issues arise.

#### 1. *Design-oriented research contributes to new and relevant knowledge in the field of management accounting*

Design-oriented research is widely used in technical sciences, mathematics, and clinical medicine, but scarcely in management accounting research (Kasanen et al, 1993; Vosselman, 1996). On the basis of this study it can be concluded that design-oriented research can also be of high value in the accounting discipline, particularly but not exclusively in the domain of health care. Design-oriented research distinguishes itself from positive accounting research because it is inherently a goal-directed problem-solving activity and because of its normative or prescriptive nature (Kasanen et al,

1993). It always entails an attempt to explicitly demonstrate the practical usability of the constructed solution. In this research project, the problem-solving process took place in practice through the design and implementation of a CMI in close operation with the target groups of top medical and non-medical managers. This resulted in a usefully operating CMI that produced solutions to explicit problems for many managers, i.e. a lack of case-mix information in the multiple phases in the strategic management cycle. Furthermore, with continuous iterations of the reflective cycle we gained new and more in-depth knowledge about the outcomes of the CMI and the factors explaining its success in this specific context (See Chapters 5, 6, and 8). Another advantage was that the effects of certain variables could be observed rapidly and interventions could be used for further improvement. Furthermore, the active involvement of the users in the design, implementation, and evaluation phases, and the use of qualitative research methods (interviews, and ‘being around’) ensured that a lot of focus could be on human and social aspects. Topics such as behavior, opinions, power struggles, and resistance could be addressed (Briers and Chua, 2001). Finally, the gained knowledge could be translated well into guidelines for practitioners in the focal field (see further Section 10.3). As a result, this study met both the criteria of scholarly quality and managerial relevance (Van Aken, 2005).

From this research it can be concluded that the design-oriented research methodology may be further improved by adding extensive reflections to the regulative cycle (see Section 4.4) as described in the mainstream literature on design-oriented research (Heusinkveld & Reijers 2009; Vosselman, 1996). The aim of these improvements is to reflect extensively over a longer period of time and to gain contemplative knowledge about several topics. The opinions of the project are requested from all the people in the target group of the (information) innovation, and not only from the people in the pilots, thus creating a more representative picture. This is of particular relevance if a design project lasts several years.

#### 2. *Design-oriented research is both qualitative and quantitative*

We believe that adding quantitative methods will increase the legitimation of design-oriented research, which is still not very strong (Heusinkveld & Reijers, 2009). To support the results of the qualitative methods, we performed two comprehensive surveys using self-report questionnaires that consisted of a mix of open and closed questions. The questionnaires during the interim reflections were specially used as preparation for the semi-structured interviews so that the participants could be focused on specific topics. The quantitative data of the interim and end reflections were only analyzed using simple descriptive statistics. Due to the relative small sample size and the large number of (sometime unplanned) comparisons no formal statistical testing on score differences was

performed. Neither were we able to analyse the (independent) impact of success factors on the outcomes of the CMI using univariable and multivariable statistical techniques. In future design-oriented research, both an appropriate sample size calculation and a thoughtful statistical analysis plan are needed as basis and guide for a more advanced statistical approach to validate the results of the qualitative part of the study.

### 3. *Design-oriented research requires a rather stable context*

Design-oriented research is essentially a process of gaining knowledge (theories) on the basis of reflection on the functioning of the regulative cycle (Vosselman, 1996). Advantages of this methodology include that it is a structured organizational problem-solving process that continues until a satisfactory solution crystallizes that works well for the specified class of problems (Heusinkveld & Reijers; 2009). This methodology requires a rather stable environment. However, in the CMI-project study several organizational and environmental variables were very unstable and unpredictable, see Section 2.4. For example, in the course of time the national plans for hospital reforms and the DBC product structure changed continuously and dramatically, resulting in much-delayed agreements with insurers on DBC prices and volumes and in the abandonment of internal DBC-based budgeting. So, according to the definition by Snowden & Boone (2007) the context of our research project was rather chaotic. In a chaotic context, searching for the right answers becomes pointless: the relationships between cause and effect are impossible to determine because they shift constantly and no manageable patterns exist—only turbulence. This complicated not only the design and implementation of the CMI, but also the exploration of the relationships between success factors and outcomes of the CMI. The research variables were constantly moving targets. Although we realize that in each empirical research the context will be dynamic, we conclude that for design-oriented research a certain degree of stability in an organization and environment is required. Beyond those limits, different research strategies may be needed. It would be interesting for future research to examine the conditions under which design-oriented research can be conducted in the management accounting discipline.

### 9.4 Reflection on the role of the researcher

The researcher also worked as project leader and as senior advisor to the Board of Directors. These multiple roles had several advantages. First, the researcher had a thorough understanding of the external and internal context of an UMC, its management structure and the organization-related problems. Second, the prolonged personal contact between the researcher and the (medical) managers contributed to trust in relationships and to a thorough understanding of the managers' problems, needs, behavior, skills,

and opinions. Furthermore, because of his position, the researcher was in continuous contact with the research environment. He observed events and processes that might be relevant to his research; he had easy access to people, systems, and information, and could easily confirm his research findings in practice. However, there were also disadvantages of combining work and research in the same field.

First, in the case of research, there were risks of bias and preconceptions of the results because in his role as project leader the researcher might be too strongly involved in the project to be objective; and related to his role as senior advisor, he might be not independent enough. Moreover, the managers involved in the study were also clients of the senior advisor. So the risk existed that they would give strategically or politically correct answers. Several measures were taken to reduce these risks of biases as much as possible. Triangulation of research methods was used by collecting data from multiple sources, like questionnaires, interviews, and by 'being around' (see Section 4.4). Furthermore, all participants were guaranteed anonymity to ensure that they could honestly say what they thought and did not have to be afraid that the results would be used against them. Finally, the conclusions of this research were presented to several experts of the AMC to test the reliability, completeness, and relevance. Second, the combination of work and research made it difficult to share the priorities and available time on these activities. In general, daily work received the highest priority, as it often concerned urgent problems that called for immediate action. Research was focused on the long term and, in this case, had no hard deadline. Therefore, at certain moments, research activities had to be postponed or abandoned because there was no time available.

### 9.5 The applicability of the case study results to other university medical centers

This research at the AMC showed that the outcomes of the CMI were partly influenced by a number of organization related factors, such as, the existing organization culture, organization structure, ICT facilities, Planning & control process, and Board of Directors (see Section 8.3). Since these factors may differ per UMC, the results of our case study are not automatically generalizable to other UMCs. On the other hand, there are several important similarities between the AMC and the other Dutch UMCs: all perform the same core tasks, all are large organizations, all staff is employed and all were and are confronted with the same hospital care reforms. From this perspective, it could be expected that the knowledge gained at the AMC was applicable for the other UMCs, at least to a certain extent. To test the external validity of the results, a secondary case study was conducted at the University Medical Centre in Groningen (UMCG) in 2010 and 2011. During the study, the AMC's Portfolio Matrix was redesigned and

implemented. In 2014, the design knowledge with regard to the Portfolio Matrix was also shared with the Free University Medical Centre (VUmc) in the context of the intended administrative merger. On the basis of the findings from these UMCs, several interesting insights were gained, which are described below.

### 9.5.1 The University Medical Center of Groningen (UMCG)

In 2010, the UMCG (located in the north of the Netherlands; 9003 FTE per 2013) was asked to participate in a design-oriented research project. The UMCG was selected because AMC and UMCG were not direct competitors in the field of patient care and were therefore legally allowed to share knowledge about strategic tools such as a CMI system. The Board of Directors of the UMCG decided to adopt the AMC's Portfolio Matrix (see Section 7.3.2) because they assumed the matrix could contribute to the dialogue about case-mix decisions. From the perspective of the AMC researcher, the Portfolio Matrix was considered an excellent product for testing its applicability in another setting because it represented the key elements of the AMC's CMI: it was based on DBCs, it contained both quantitative (financial) and qualitative (relevance) information, the information was presented per patient group, and it was a new way of visualizing information.

#### *The case study UMCG*

During the study, the AMC's Portfolio Matrix was redesigned (tailored to the UMCG organization) and implemented at a selected number of medical specialties by passing through the regulative cycle. It was expected that by going through the same process for this, selected information products would create insight into the extent to which the success factors and outcomes matched or differed from the AMC and where revision or addition to the gained design knowledge was desirable. Similar to the AMC, the reflection took place by means of a survey using self-report questionnaires, followed by semi-structured interviews. In total, 14 (medical) managers participated: seven chief physicians, seven division managers and two central managers. The medical specialties varied with regard to size.

#### *The regulative cycle UMCG 2010 - 2011*

In 2010 the Portfolio Matrix of the AMC was evaluated by a project group<sup>30</sup>. The conclusion was that some adjustments were necessary. First, the way in which the relevance scores per patient group were determined in the AMC was considered as too personal and subjective and had to be more objectified by quantitative data. There was also a strong need to measure and assess the medical specialties in a uniform manner. For the determination of the relevance of the patient groups, data were collected, such as percentages of top referral, top clinical and basic care, publications in top journals, principal investigators and research funding of the last three years. The chief physicians were still responsible for the determination of the final relevance scores per core task, but if these scores differed significantly from the quantitative data they had to motivate it. Second, the axis of the Portfolio Matrix of the AMC were converted to make it their 'own' product and the size of the bulbs represented the turnover per patient group, rather than the number of patients as used in the AMC. Like the AMC, the Portfolio Matrix was (re)designed and tested first by a pilot group consisting of nine medical specialties<sup>31</sup>, a mix of contemplative, surgical and supporting medical specialties.

The Portfolio Matrix was designed for the pilot specialties and evaluated by the pilot group. The pilot specialties considered the Portfolio Matrix as useful and necessary (UMCG, 2010). It gave new insights and facilitated the discussion about the strategic focus. A large part of the project group indicated that the use of Portfolio Matrix should be mandatory for all medical specialties. Based on this evaluation, the Board of Directors decided to roll out the Portfolio Matrix corporate wide. In 2011, the process for generating the portfolio matrices was further automated. The definition of patient groups on the basis of DBC production could be done by the chief physicians themselves in Cognos<sup>32</sup> by using criteria as type of diagnosis, method of treatment and age. Furthermore, detailed data were made available at the patient level in Cognos, such as the care products and underlying care activities. In 2011 the Portfolio Matrix were designed and implemented for all major medical specialties. The matrices were available for the chief physicians of the medical specialties, the division (or sector) managers, the Board of Directors and the Finance & Control department. These matrices were discussed between the medical specialties and Board of Directors during the budgeting process

<sup>30</sup>The project group consisted of the director of Finance & Control, a sector manager, staff members of Finance & Control and the researcher of this thesis.

<sup>31</sup>Cardiology, Otolaryngology, Obstetrics and Gynaecology. Radiotherapy, Cardiothoracic Surgery, Gastroenterology, Urology

<sup>32</sup>The UMCG used Cognos as management information system, like the AMC. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management.

*Interim reflection*

In the second half of 2011, a limited interim reflection on the project had taken place by the researcher. In total, twelve (medical) managers participated, consisting of seven chief physicians, seven division (or cluster) managers and two central managers. The medical specialties<sup>33</sup> varied with regard to size, and extent of free market. Similar to the AMC, the reflection took place by means of *questionnaires*, followed by semi-structured *interviews*.

With regard to the *design* of the Portfolio Matrix, respondents were positive about the way in which the relevance scores were determined. There was much support for the supplementary data as selected by the staff convent and the allocation of these data to patient groups was fairly simple. Chief departments were pleased that they could give the final scores. However, there were serious concerns about the quality of the financial data used for the Portfolio Matrix, especially the cost data. Few specialties had been involved in the calculations so far. An important difference with the AMC was that one was largely positive about the quality of the DBC data. This was explained by the fact that the UMCG had come significantly into financial difficulties in the past due to poor registrations. Since then there had been great emphasis on proper registration. Furthermore, it was indicated by the respondents that they had insufficient access to the underlying data.

Regarding the *design and implementation strategy*, it became clear the UMCG had substantially benefited from the AMC; this was already a product that had proven itself in practice. If medical specialties had criticism about the Portfolio Matrix this could be countered with: “it worked in the AMC too, so why not here”. Furthermore, it was appreciated that the staff convent was actively involved in the design and implementation process. Finally, as in the AMC the ownership of the design and implementation process was transferred to just a few people so knowledge was very concentrated. That made the process vulnerable.

Concerning the (*medical*) *managers*, many factors played a role when making case-mix decisions and had a more or less equivalent impact. On balance, case-mix decisions were mainly based on available expertise and (academic) medical content (tertiary care, scientific profiling). Developments in other hospitals and meeting basis care obligations were considered as relatively least relevant. These findings were rather in line with the AMC. One important difference was that finance (cost/returns) had relatively more impact on the decision than in the AMC. With regard to the decision-making power

<sup>33</sup> Paediatrics, Internal Medicine, Surgery, Obstetrics & Gynaecology, Neurology, Ophthalmology, Radiotherapy, Neurosurgery

there was a relevant difference between the UMCG and AMC. In the UMC, the staff convent (the representation of the medical staff) had relatively a lot of power. They had an important advisory role towards the Board of Directors, but also votes in their decisions, so also about the adoption of the Portfolio Matrix. On balance, the chief physicians and divisions managers indicated that the Board of directors supported the project rather well. They appreciated the several meetings which were organized to inform them and discuss the Portfolio Matrix.

With regard to *competition pressure* the overall conclusion was that there was moderate perceived competition pressure, less than the AMC. However, there were some interesting differences with the AMC. The UMCG was located in a different region (the north of the Netherlands) with just a few care suppliers in the health care market. There was only one other hospital within 30 kilometers, while the AMC had twelve other hospitals within this range. As a result, the UMCG experienced little competitive pressure. The UMCG fulfilled an important regional function and therefore the less complex patients were also referred to them because there was no alternative. This reduced their opportunities to manage the case-mix. *Financial pressure* was experienced more at the current time than competition pressure and it was expected that this would increase.

The majority of the respondents used the CMI once or twice, probably when drawing up the annual plans. Like the AMC, the Portfolio Matrix was mainly used by the chief physicians and division managers for getting more insight and internal legitimation and to a lesser extent for decision support. The main advantages of the Portfolio Matrix were that it was a good tool to conduct dialogue (mentioned six times) on medical policy, and to legitimize themselves on their activities (mentioned five times mentioned). It had mainly increased insights in the financial aspects of the case-mix. Like the AMC, the medical specialties also experienced several disadvantages from the Portfolio Matrix. Doubts on the quality of the data, a mismatch with other information reports and insufficient understanding of the interrelationship with other specialties were the most mentioned disadvantages (four, three, and three mentioned respectively). Another barrier was that they could hardly influence the cost of the support units, while they had a significant impact on the total cost of the patient groups. Furthermore, they had hardly any influence on the negotiations with health insurers and therefore on the financial coverage for their specialty. The Portfolio Matrix was only used shortly and therefore it was difficult to indicate the effects of it. Some effects mentioned were that it had led to increased budget (mentioned two times), change in type of mentioned once) and change in volume of patients (mentioned once). Furthermore, the Portfolio Matrix had sometimes confirmed case-mix decisions which were taken earlier. The overall perceptions of the success of the Portfolio Matrix differed per respondent. Some

respondents found it already successful because they had experienced the positive effects of it. Others found it too premature to draw conclusions. In general, the Portfolio Matrix was seen as a useful tool for the future, especially if the reliability of the data improved, more detailed information was generated and real consequences were attached to it by the Board of Directors.

#### *The regulative cycle UMCG 2012 - 2014*

During 2012 and 2014 only minor adjustments were made. The process to generate the portfolio matrices was a completely automated system as a result of these matrices being able to be generated directly by the medical specialty. Furthermore, new reports were designed in Cognos which enabled a drill down to the underlying data per patient group, including the data as used for the determination of the relevance scores. The matrices and underlying data were updated once a year. Like the AMC, it was the intention to introduce full internal output budgeting by coupling the internal budgets to the external revenues of the DOT production, but this failed too. The problem was that because of the continuous and dramatic changes in the DBC product structures and associated selling prices in the previous years, there were too few (comparable) data and too many uncertainties to implement output budgeting in a responsible way. This reduced the usefulness of the Portfolio Matrix. Despite this, in 2014 the Portfolio Matrices were still used for the budget meetings between the Board of Directors and the medical specialties. Furthermore, the language of the patient groups was also used for other purposes such as sales budgets and negotiations with health insurers. Finally, a UMCG-wide steering committee was introduced (chaired by the president of the staff convent) to advise the Board of Directors on case-mix decisions and sales contracts for the following years. The rationale behind this was that these decisions can be better taken at the corporate level than at the specialty level, because each chief physician will try to obtain the maximum result for their specialty, but this might be suboptimal at corporate level.

#### *Conclusions*

Based on this case study, it was concluded that the design-oriented knowledge about the CMI, as gained at the AMC, was rather applicable at the UMCG. As a result, the adapted Portfolio Matrix could be implemented fairly quickly. In line with the AMC, the Portfolio Matrix was seen as a powerful tool because it contributed to more awareness, more insight in the case-mix and registrations, and better dialogues about patient care. Furthermore, as at the AMC, the UMCG's (medical) managers experienced several barriers when using the Portfolio Matrix. The quality of the data was generally perceived as poor (mainly the cost information and as a result they also decided not to use this product for allocating budgets to the medical specialties. However, the case

study also gave some indications that significant differences existed between the AMC and UMCG, which had an impact on the outcomes of the CMI. For example, the factors that were taken into account when making case-mix decisions seemed to differ between the medical centers and led to different needs for case-mix information. For the managers at the UMCG, information about the health care market was considered to be less relevant than at the AMC, because there is much less competition in the rural region of Groningen than in the urban region of Amsterdam. On the other hand, UMCG managers attached more value to financial information than the AMC managers. Furthermore, some differences were observed with regard to the level of support from the Board of Directors, the (perceived) quality of the DBC data, and the organization's culture. For example, at the UMCG, more importance was attached to the objectivity of the data and obligatory use of the CMI. These differences in organization and culture between both organizations showed that the results of our case study at the AMC are not per definition generalizable to other UMC settings.

Table 9.1 presents the similarities and differences between the AMC and UMCG in relation to the success factors of a CMI system as observed by the researcher during the two case-studies.

Table 9.1: Similarities and differences between the AMC and UMCG in relation to success factors of a CMI

Success factor	Research variable	AMC	UMCG
Design & implementation factors	Aims of Portfolio Matrix	Dialogue, support for case-mix decisions, legitimization	Guidance for case-mix decisions, assessment of medical specialties
	Portfolio Matrix	Qualitative data with regard to relevance of care, number of patients as indicator for size	Qualitative and quantitative data with regard to relevance of care, turnover as indicator for size.
	Quality of the DBC data	Quality perceived as very poor	Quality perceived as moderate to good
	Quality of cost data	Quality perceived as moderate to poor	Quality perceived as very poor
	Design strategy	Iterative design in cooperation with users	Redesign of Portfolio Matrix of the AMC in cooperation with the staff representatives
	Design and implementation process	Long process of trial and error	Fast implementation, fast success
	Implementation strategy	Voluntary use of the CMI	Mandatory use of the CMI in the budget meetings
	Competition pressure	Many competitors in the region	Few competitors in the region
	Financial pressure	Fairly strongly present	Strongly present
	Board of Directors	Little centralized management	Much centralized management
Organizational and environmental factors	Culture	Informal	Formal
	Budgeting	Historic budgets	Cost budgets

### 9.5.2 Free University Medical Center (VUmc)

In 2014, in the context of the preparation of the administrative merger between AMC and VUmc, the classification of patient groups at the AMC (see Section 7.5.1) was used to cluster the DBC data of both AMC and VUmc in the same way and presented to the joint chief physicians of the medical specialties by 'plots' (see Section 6.3.2). Because of this, insight was gained about which patient groups overlapped or which complemented each other's activities. The classification of AMC patient groups turned out to be very usable for the chief physicians of the VUmc and was only minimally adapted to identify specific patients at the VUmc.

Furthermore, in 2015 the VUmc adopted the Portfolio Matrix for the same reasons as the AMC and UMCG. The increasing pressure on resources and competition encouraged them to make clear case-mix decisions and they lacked the right tools to support these. There were some tools available, but these were mainly qualitative in nature and were only related to the (research) focus points, and not to all (basic care) activities. Like the AMC and UMCG, the Portfolio Matrix was mainly adopted to facilitate the dialogue about the case-mix, especially between the Board of Directors and the chief physicians of the medical specialties. The (re)design and implementation of the Portfolio Matrix took place through the Strategy and Innovation Department of the VUmc. They adjusted the AMC's Portfolio Matrix in several ways. In line with the UMCG, the Board of Directors of the VUmc attached more value to quantitative system data to be used in the Portfolio Matrix than the qualitative non-system data at the AMC. After comparing several options, the VUmc decided to design two alternative portfolio matrices with alternative axes. One matrix consisted of the axes: '% top referral care' and '% financial coverage.' The percentage of top referral care was based on a methodology as agreed between the UMCs and the Ministry of Health (the so-called Robijn labels). The percentage of financial coverage was chosen as the criterion to increase cost awareness and to improve registrations. The other matrix consisted of the axes: '% top referral care' and '% market share.' The axes were selected because they were objective and rather stable in the course of time. Another argument was that the percentage of top referral care was accepted by the environment and was considered to be the prevailing measure. In both matrices, the patient groups were based on the formal ICD-10 classification rather than on the classifications by the chief physicians. Based on the results of the Portfolio Matrices, the Board of Directors prioritized seven medical specialties to discuss the case-mix with. In addition to the design of the portfolio matrices, the VUmc took various measures to enable changes in the case-mix, such as making long-term agreements with health care insurers and other health care suppliers in the care chain, such as general hospitals and general practitioners. Like the AMC and the UMCG, the VUmc concluded that the Portfolio Matrix provided new insights and contributed to better dialogues about the case-mix.

### 9.5.3 Conclusions

The comparisons between the three UMCs showed some similarities and differences. The similarities were that the Portfolio Matrix was considered a powerful tool because it presented their case-mix in a simple way and contributed to the dialogue about case-mix decisions. Therefore we conclude that the Portfolio Matrix can be implemented at a wide range of academic health care settings. However, in the design and implementation of the portfolio matrices, different choices were made. The differences were determined by different factors such as differences in the characteristics of the Board of Directors and in organization culture. The VUmc chose a top-down strategy with little participation from the medical specialties in the design process and used only (objective) quantitative data. The AMC went for a bottom-up strategy with much participation from the medical specialties and used both quantitative data and also qualitative, subjective, data. Each design and implementation strategy, and alternative of the AMC Portfolio Matrix will have advantages and disadvantages. In the future, it would be interesting to study the strengths and weaknesses of the different design and implementation strategies to determine to what extent these approaches can be standardized or should be tailored to a specific UMC organization.

#### *Applicability of the case study results to Dutch general hospitals*

This research only took place at academic hospitals. It can be expected that the outcomes of this case study are to a large extent also applicable to general hospitals. Similar to UMCs, general hospitals were and are confronted with hospital care reforms, have joined the DBC system, and face increasing competition and financial pressure that will undoubtedly increase their need for more, and better, case-mix information. However, there are some major differences between UMCs and general hospitals. First, the differences in core tasks between UMCs and general hospitals may have an impact on the design of the CMI. In UMCs, patient care, research, and education are much more integrated than in general hospitals. This means that other factors have to be taken into account when making case-mix decisions, which need to be incorporated into the CMI. Second, there are differences in type of employment of (medical) managers: in UMCs, all managers are in paid employment, including the (chief) physicians, whereas in many general hospitals, the (chief) physicians are self-employed and linked with hospitals through contracts. This means that physicians in UMCs have fixed salaries, whereas the salaries of physicians in contractual partnerships are directly linked to the DOT production. That implies that physicians in general hospitals receive other financial incentives than physicians in UMCs do and this may have an impact on their information needs.

Because of the differences in type of organization and employment, it can also be expected that there are differences between chief physicians in UMCs and general hospitals with regard to attitudes, entrepreneurship, management style, and skills, which may also affect the content, adoption and use of the CMI. Third, the differences in types of patients between UMCs and general hospitals may also have a profound impact on the CMI. UMCs treat more highly complex patients (with rare diseases) and treatment options are more interwoven with other specialties than in general hospitals. These differences affect the extent to which the case-mix can be managed, the medical and financial responsibilities can be assigned to medical specialties, and case-mix information can be standardized.

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# Chapter 10

General discussion

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## Abstract

In this chapter, the implications of the research project as regards to the management accounting discipline are presented. The main design-oriented knowledge claims from the case study are described, and we explore whether the knowledge gained was in line with the literature and research findings of other research groups. To further expand the knowledge of CMIs in health care settings, several suggestions and directions for future research are given. Finally, the design-oriented knowledge gained was translated into practical guidelines (or recommendations) for a successful implementation of a CMI in Dutch university hospitals (UMCs). The guidelines are meant for practitioners who can directly or indirectly influence the success of CMIs in UMCs, such as hospital managers (Board of Directors, division managers, chief physicians, project managers, IT managers) and regulators, (Ministry of Health and health authorities such as the NZa and ACM).

## 10.1 Introduction

During the case study period, a CMI was iteratively designed and implemented in the AMC (*Research objective one*). The regulative cycle was passed through several times and the CMI project was extensively reflected on facilitating and obstructing success factors and a range of primary and secondary outcomes. As a result, we gained in-depth design-oriented knowledge about a CMI (*Research objective two*).

Section 10.2 summarizes the implications of the research project with regard to the management accounting discipline. It describes the main design-oriented knowledge claims that can be derived from this case study; it assesses whether the knowledge matches with or differs from the existing body of knowledge about CMIs in the management accounting discipline, and how this knowledge is complementary. Furthermore, our analyses in this study were not complete and left several questions unanswered. Therefore, suggestions for future research are given to expand the design-oriented knowledge of accounting in health care. Finally, in Section 10.3 the gained knowledge is translated into practical guidelines for a successful implementation of a CMI in Dutch university medical centers (UMCs).

## 10.2 Implications for the management accounting discipline

This study contributes in several ways to the management accounting discipline and has several practical implications (see Table 10.1). First, through this research we gained in-depth knowledge of the possible benefits of a CMI in the context of Dutch UMCs (**Implication 1**). It demonstrated that the (DBC-based) market mechanisms can be a driving force for UMCs to change their organization, but there are also characteristics of market mechanisms that can reduce or even obstruct the process of management accounting change and the success of a CMI (**Implication 2**). Second, this research related to both the design and the implementation of a CMI, whereas prior accounting research mostly focused on the implementation of an already designed CMI. This resulted in new design knowledge of CMIs. Through continuous iterations in the reflective cycle, we gained in-depth knowledge about what types and combinations of information are useful to whom and about how the information system could be implemented in a responsible way. The study demonstrates that a CMI can fulfill multiple functions for multiple stakeholders at the same time (**Implication 3**). Through the research the advantages and disadvantages of self-design of a CMI by a UMC became apparent. Third, the outcomes and the success factors of a CMI were examined in-depth, with both qualitative and quantitative methods. As a result, detailed insights were gained about the factors that hindered or facilitated the success of a CMI, and about the ways through which obstructions can be reduced (**Implications 4 - 9**). Finally, we conclude that the design and implementation of a CMI should be approached in a scientific way

**(Implication 10).** To achieve this, the gained design-oriented knowledge was translated into practical guidelines for a successful implementation of a CMI in Dutch (university) hospitals (see Section 10.3). The guidelines are meant for hospital managers (Board of Directors, medical managers, chief physicians, project managers, IT managers) as well as regulators (Ministry of Health, Ministry of Education and other health authorities such as the NZa and ACM), who can directly or indirectly influence the success of CMIs in hospitals.

Table 10.1 summarizes the general implications of this research. It provides the main design-oriented knowledge claims that can be derived from the case study.

**Table 10.1: General implications**

1	With a CMI, significant benefits can be achieved for Dutch university medical centers
2	Market mechanisms can promote but also reduce and obstruct the success of a CMI
3	A CMI can serve multiple stakeholders in multiple phases of the strategic management cycle
4	The decision-support function of a CMI varies between types of information
5	No substantial case-mix changes can be expected in UMCs because of a CMI
6	Cultural, structural, and practical barriers can obstruct the functioning of a CMI
7	Negative effects of a CMI are inevitable but can be reduced
8	Using a CMI requires the logic of management and this can be problematic for medical managers
9	Managers are mainly interested in case-mix information on topics they can control and are responsible for
10	The design and implementation of a CMI should be approached in a scientific way

### 1. With a CMI, significant benefits can be achieved for Dutch university medical centers

This research demonstrated that in the context of the Dutch UMCs, a CMI can be successfully implemented and can have significant benefits. Several benefits were similar to those found in earlier studies in other countries regarding CMIs (Abernethy et al, 2007; Lehtonen, 2007; Lowe, 2000<sup>1</sup>; Lowe & Doolin, 1999; Reid, 2013; Scarparo, 2006; Sumner & Moreland, 1995) or to similar (cost) accounting systems in hospitals (Abernethy and Vagnoni, 2004; Coombs, 1987; Hill, 2000; Kurunmäki, 2003; Lapsley & Wright, 2004; Nyland & Pettersen, 2004; Pettersen & Solstad, 2014). The benefits included better insights about the case-mix, improved dialogues about care, process optimization, more cost awareness, efficiency gains, and better external legitimization. In addition to prior studies, some other benefits were detected. The mere process of

designing a CMI can have positive effects, regardless of the outcomes of this process. The definition of patient groups and the minimal dataset used by chief physicians appeared to contribute to more awareness about the relevance and distinctiveness of their case-mix. Also the opinions of chief physicians were made explicit. Furthermore, the CMI triggered users to improve their registrations and cost calculations. Also, new types of insights were gained, such as the interdependency between medical specialties and deviations from other UMCs in the care provided. These insights were useful for planning purposes. An important side-effect of the study was that the underlying (big) database of the CMI consisting of medical, patient, and financial data provided new opportunities to conduct cost-effectiveness studies in the context of health care efficiency research.

The case study also showed that the speed and extent to which the maximum achievable benefits of a CMI will actually be realized will differ per UMC, per manager and per medical specialty. This depends on a number of success factors related to design, implementation, organization and environment. The success factors studied were selected by combining the strengths of earlier models of the implementation of cost-management systems (Shields, 1995), accounting information systems (Gordon & Miller, 1976) and clinical guidelines (Grol, 1997, 2001). Extant scientific research regarding clinical guidelines appeared to be very useful for research on CMIs because guideline research is about implementing innovations for doctors (or medical managers) with the aim of changing their behavior. The technical capabilities of a CMI can be optimized when market mechanisms actually gets going, when the DBC system becomes more stable, and when the quality of the data improves, so that a CMI can actually be used for case-mix decision-making, budgeting, and sales strategy. It would be interesting in the future to research the use and effects of the CMI again when this situation realized. New electronic patient systems (like EPIC) will also create new opportunities for the design of CMIs in the future because new types of data, such as patient health outcomes, can be documented. The next step could be to add these registered health outcomes to a CMI, and to analyze the processes and structures behind each activity to help optimize the outcomes of your outcome measures. By learning from data it will be possible to identify and disseminate best practices in healthcare.

We are convinced that many more benefits can be achieved from a CMI than presented in this study and probably the best is yet to come! Some information products, for example the Benchmark Analysis Resource Use profiles and Portfolio Checklist were designed for the (medical) managers but not yet implemented hospital-wide because of a lack of time, capacity, or reliable data. However, on the basis of the assessments by the (medical) managers, we conclude that these products have the potential to become successful. Our

belief in the potential of the CMI was confirmed by the fact that, in 2014, the CMI project was nominated for the European Porter Prize and was described as ‘a wonderful example of how healthcare in the Netherlands could be more sustainable.’ We hope this case study will motivate other researchers to further (re)design and examine these products. Further, in EPIC, the data were better structured and integrated than in the research period. Now, it became possible to link patient data with scientific research projects. By this, for example, the impact of case-mix decisions on research activities can be made visible. It might be interesting to research what the electronic patient record system can contribute to the success of the CMI. Moreover, it is important to further investigate the benefits of CMIs for target groups other than the top management level, for example, chiefs of the (poli)clinics, staff members (physicians), head nurses, clinical researchers, business office employees, DBC consultants, and head of sale departments. It would also be relevant for future management accounting researchers to further explore the benefits of CMIs, both in academic and general hospitals. It might for example be useful to compare the design, use, and effects of CMIs between UMCs and general hospitals and to determine the impact of the type of hospital, employment structure, and type of managers on the success of a CMI.

## **2. Market mechanisms can promote but also reduce and obstruct the success of a CMI**

Literature concerning *new public management* shows that in other countries the introduction of (DRG-based) market mechanisms in the hospital sector was for many hospitals an incentive to make their organization more business-like and to adopt new accounting technologies (Abernethy et al 2007; Doolin, 2001; Kurunmäki, 2004; Pettersen & Solstad, 2014; Robbins, 2007; Samuel et al, 2005). In this study we have gained a detailed understanding of the impact of the different characteristics of Dutch market mechanisms on UMCs. The results of the research confirmed earlier findings (Lapsley & Wright, 2004) that adoption of accounting innovations by public sector organizations is largely affected by government influence, and that this influence can be both positive and negative. In the Netherlands, the (DBC-based) market mechanisms were a driving force for UMCs to change their organization. All three participating UMCs (AMC, UMCG and VUmc) redefined their strategy, started with performance-based budgeting, and adopted (parts of a) CMI to better support management. This matched with earlier research showing that six of the eight Dutch UMCs changed their internal budgeting system after the introduction of the DBC system (Balogh & Van Veen-Dirks, 2010). However, on the basis of this study it can be concluded that there are also characteristics of market mechanisms that can reduce or even obstruct the process of management accounting change and the success of a CMI.

The success of market mechanisms will be limited when the effects are mitigated, for example, by regulators or health insurers. In this case study, conditions favorable to competition were mainly absent and the participants experienced only moderate competition pressure because the market mechanisms related mainly to basic care, whereas the hospital market for complex care was still heavily regulated. This hardly changed during the research period, despite the fact that the liberalization of Dutch hospital care was continuously expanded and the percentage of B-list DBCs was substantially increased. Financial risks stemming from market pressure were experienced less severely than expected, because several measures were taken at different levels to mitigate the effects of the market pressure. Negotiations with insurers continued to focus primarily on the total contracting sum, with historic budgets as the starting point. As a result, the revenues of the UMCs were and are still more or less guaranteed. The agreed DBC prices only had a mathematical function and did not represent the true market value or costs. Apparently these developments had not led to an increase of this type of pressure. These findings were quite similar to an earlier study in Finland where market forces were introduced into the hospital sector. Despite the significant changes in the rules of the game, the business appeared to continue as usual with only slight modifications in its nature (Kurunmäki, 1999). At the end of the case study, ten years after the hospital care reforms, market mechanisms had barely taken off for the UMCs and were still ‘stuck in the middle’ between a free and regulated market. As a result, the effects of market mechanisms and derived incentives (motivators) to adopt a CMI by hospital managers were experienced as less severely than expected. The reason why hospital top management felt the need to adopt CMIs was mainly the increasing financial pressure from insurers, rather than the market mechanisms. This confirmed earlier studies (Lehtonen, 2007; Hill, 2000) that revealed that revenue constraints played the dominant role in adopting (case-mix) accounting systems to provide better data for cost control.

In addition to earlier studies, our research showed that some aspects of market mechanisms can also obstruct the success of a CMI. The longitudinal mismatch between the reimbursement and funding of A-list DBCs (see Section 2.5) reduced the added value of the CMI substantially because the presented DBC revenues were only virtual numbers. This mismatch was considered to be so complex that it was almost impossible to quantify the real financial effects of case-mix decisions. Furthermore, although the DBC system provided good opportunities for the design of the CMI, it had serious shortcomings. The DBC system was not properly tested before it was implemented nationwide, and therefore the system and associated DBC rates were continuously adjusted over the years. This undermined the confidence in and understanding of the system by hospital managers and made the CMI data unpredictable. The DBCs were also

considered to be an artificial and financial administrative language. For some medical specialties the DBC product structure did not represent the complexity of academic care enough. As a result, the DBC data were insufficiently recognized and accepted by the managers. A DBC contains integral costs and passes through (administrative) calendar years, which is quite different from how responsibilities are generally allocated in UMCs. Due to the complex and detailed nature of the DBC system it took much effort and time to make yearly agreements between hospitals and insurers regarding volumes and prices per DBC. Also, the fact that the strongly interwoven activities of UMCs are funded through various funds led to much discussion with funders about what cost should be covered by what fund. Due to delayed agreements, during most months of the year hospital managers had no insight in the actual financial coverage of their patient groups and production budgets. This hindered them in making case-mix decisions, because they didn't know the financial consequences of these decisions, and eventually reduced the added value of the CMI for them.

The quality of the data even deteriorated when the DBC system was replaced by the DOT system. As a result, there were no production data available for almost a year and it was, in many respects, no longer possible to compare data from previous years, so a lot of data on trends were lost. For this reason the Board of Directors of the AMC decided, eventually, to abandon the plans to introduce DBC-based performance budgeting and to maintain historical budgeting. The Board did not want to burden their organization with the chaos of the outside world. From a management perspective, this is understandable because 'loose coupling' creates persistence and serves as a buffer towards turbulence in the political environment (Nyland & Pettersen, 2004). However, as a consequence the budgets were hardly linked with the clinical activity and the DBC products, and the CMI lost much of its significance. For these reasons, the DBC system was considered as the *'Achilles heel'* of the CMI and led to strong resistance. This resonates with earlier research into the DBC system in Dutch mental care (Tummers & Van de Walle, 2008) that revealed that health professionals were quite resistant towards the DBC system because they believed that the DBCs neither contributed to care quality nor helped to control costs. Also, because the UMCs are covered by the Competition Act, they have fewer legal opportunities to make agreements with other hospitals about exchanging their case-mixes. Thus, it was impossible to make agreements that enabled the UMC to concentrate on highly complex care and to leave simple care to other health care suppliers. As a result, several managers abandoned their initiatives for cooperation with other health care suppliers because they were afraid to risk a fine. Consequently, this reduced their need for a CMI.

These delaying and obstructing effects of introducing the ideology of market mechanisms in the health sector may be given more attention in the management accounting literature. From a public policy perspective, more research on the Dutch hospital care reforms and the manner in which they are implemented could guide policy makers in other countries in reaching their objectives for efficient care giving at affordable prices that are accessible to all citizens.

### 3. A CMI can serve multiple stakeholders in multiple phases of the strategic management cycle

Prior literature has stipulated that a CMI as an integrated system can serve different aims for various stakeholders (Abernethy & Vagnoni, 2004). In line with this, the AMC case study showed that a CMI can be useful in each phase of the strategic management cycle, which consists of gaining insight, monitoring, process optimization, stimulating the dialogue about the case-mix, and decision support (see also: Naranjo-Gil & Hartmann, 2007<sup>1</sup>). Our research project revealed that the added value of the CMI was mainly determined by the fact that medical, patient, and financial data are collected at patient level and integrated into one system. This makes it possible to establish meaningful relationships between these types of information, to aggregate information at each desired level, and to provide a broad spectrum of information to managers in the context of learning. This matches with the uncertain decision-making contexts of UMCs that require an information set that is much broader than the narrow financially-oriented data provided by traditional management accounting systems (Chong, 1996; Kurunmäki, 1999).

The various stakeholders of a CMI have to be approached and trained differently. Managers may not to be distinguished from business analysts, and within the manager group chief physicians may need to be distinguished from division managers and central managers. Each subgroup fulfils different roles at different stages of the strategic management cycle and has different needs and skills with regard to a CMI (Grol & Wensing, 2001). At the same time, in a similar way to other studies (Briers & Chua, 2001), the case study exemplifies that a CMI is also able to mediate between different target groups by using a common clinical language in terms of patient groups. Although primarily focusing on the use of the CMI by top managers in the strategic management cycle, this study provides illustrations of how a CMI can serve other stakeholders as well, especially business analysts, but also medical managers at operational levels, clinical researchers, and sales people. It would be interesting for further research to examine which other opportunities of a CMI can be provided to whom and with what types of information products.

#### 4. The decision-support function of a CMI varies between types of information

The framework of Thompson & Tuden (Abernethy et al, 2007) demonstrated that the support function of a (case-mix) accounting system in the decision-making process varies with respect to two key conditions: 1) uncertainty of cause and effect relationships, and 2) ambiguity of objectives. In addition to this, we conclude that the uncertainty in cause and effect relationships depends on the type of case-mix information. With regard to medical production and patient data, a CMI functions as an answering machine because the cause and effect relationships are fairly straightforward. However, with regard to the DBC and cost data, a CMI functions mainly as a learning machine and an idea-generating machine because there is a high uncertainty between cause and effect. Explanations for this are that these data are the result of (complex) methods, definitions, assumptions, and systems, and therefore contain various uncertainties. With regard to the cost data, during our project we identified the substantial effects of *calculation fiction*, which occurs when the costs per patient are not registered in the general ledger but have to be approximated by unit cost data. This made us aware that cost data are by definition arbitrary and do not provide unequivocal answers.

However, although the CMI did not represent *the truth*, it served as a tool that could be interrogated and used to facilitate debate. And although it gave no accurate answers, it gave useful indications about the cost and financial coverage, thus invoking and facilitating dialogue. This matched with earlier literature by Merchant and Shields (1993) that stated that some purposes of accounting systems are not necessarily best served by accurate cost data. This also applied to the qualitative non-system data that by definition is considered as soft, subjective, and inaccurate. Yet, these data appeared to be useful, particularly in combination with system data. For example, in the Portfolio Matrix, medical relevance per patient group was plotted against financial relevance. Hereby, the Portfolio Matrix was used not to give answers but to invoke and facilitate the dialogue about care. This dialogue function should not be underestimated. We conclude, in line with Abernethy et al (2007), that in light of the many environmental and organizational uncertainties, medical managers in UMCs should move away from the answering machine role for CMIs, towards a dialogue machine role. This would encourage learning. In management accounting literature, more attention should be paid to the different functions of CMIs. Future research may want to address the strengths and limitations of system and non-system case-mix data.

#### 5. No substantial case-mix changes can be expected in UMCs because of a CMI

Several earlier studies (Covaleski et al, 1993; Lowe & Doolin, 1999; Jones & Dewing, 1997; Preston, 1992; Pettersen and Solstad, 2014) have pointed to the ineffectiveness of CMIs; for example, they hardly influenced the internal processes within an organization.

This case study also demonstrates that, in general, the CMI did not seem to lead to pronounced changes in the case-mix. The study offers a number of explanations for the absence of major changes in case mix.

First, UMCs have three core tasks (care, research, and education) that are inextricably interwoven. The managers have overall responsibility for all these core activities. The case-mix has a major impact on all the core tasks and this must be taken into account when making case-mix decisions. This interwovenness makes the decision-making on the case-mix complicated. Particularly in UMCs, the case-mix is a result of longitudinal accumulated expertise and infrastructure, where, often, multi-year research programs are associated with patient groups. The medical specialties are thus not like *sailing boats* that can react quickly to developments, but more like *tankers*. Space for choice is relatively limited. Therefore, chief physicians do not feel the urge and the possibility to change the mix regularly. Besides, at UMCs, all (medical) managers are employees, and that means that they have no personal interest in the financial effects of the case-mix of their division or medical specialty. Because of this, the interest for case-mix information is probably lower than in general hospitals where medical specialists are generally self-employed and linked with hospitals through contracts. Moreover, because UMCs fulfill a last-resort function, academic specialists have fewer opportunities to shift their patients to other hospitals.

Second, UMCs supply largely tertiary and specialized care. This highly complex care requires costly infrastructure, personnel from (small) subspecialties, and a multidisciplinary approach. The interdependence of various medical disciplines is much greater than in 'non-academic hospitals, which implies that the responsibility for case-mix decisions can often not be assigned to a single specialty. Another limiting factor is that, besides a CMI, a broad range of external factors (alliances, staffing, innovations, etc) can have a major impact on the decision-making process. Nevertheless, the case-mix decision-making processes in UMCs can be improved further by making them more systematic, transparent, and evidence-based. For example, the developed Portfolio Checklist (see Section 7.3.5), served well as a structured priority-setting tool for managers to assess whether their case-mix and underlying care processes need adjustments. This tool is complementary to other priority-setting frameworks that have been developed previously (Gibson et al, 2004; Mitton et al, 2003, Mitton & Donaldson 2002, 2004; Mitton & Patten, 2004). Given the political and historical influence in the current process of priority setting and resource allocation in UMCs, future research should focus on how case-mix decisions can be made in a more evidence-based way.

## 6. Cultural, structural, and practical barriers can obstruct the functioning of a CMI

In literature, it is claimed that CMIs in health care are adopted largely because they affirm conformance to supposedly orderly, objective, and rational organizational processes (Abernethy et al 2007; Lowe & Doolin, 1999). In the AMC the CMI was also adopted to better rationalize and objectify processes. The processes were particularly embedded in the strategic management cycle and concerned (case-mix) decision-making and legitimizing. However, our case study showed that organizational culture, structure, and practical barriers can be obstacles in making the CMI work in daily practice. For example, attempts at rationalizing case-mix decisions by developing a Portfolio Checklist led to resistance because chief physicians saw these attempts as an undermining of their autonomy and they feared that decision-making was dominated by financial criteria and that clinical issues would be ignored. This observation matches with study findings of other research groups (Lowe and Doolin, 1999; Doolin, 2004). They also observed reluctance on the part of clinicians to have their practices scrutinized and their medical privilege and clinical autonomy potentially infringed upon. Attempts to rationalize the allocations of budgets of the medical specialties on the basis of DBC data failed, not only because of the perceived poor quality of the data, but also because of political and historical influences in the budgeting process. The Board of Directors was afraid that budget changes would lead to discussions between divisions. The plans for performance-based budgeting were important incentives to the design of the CMI. Unfortunately, however, in the end the deep-seated organizational culture of 'wheeling and dealing' and the budget system of the AMC remained rather unchanged, which was an obstacle to the success of the CMI. These examples of an obstructing organizational culture support the vision of Robbins (2007) who stated that an obstacle to successful implementation of accounting change in the hospital is the danger of getting caught in the constraints of tradition, such as a very restricted view of budgeting and there being no link between resources consumed and the services delivered. Linkage to competitive strategy, performance evaluation, and compensation are important for motivating and rewarding employees into focusing appropriately and using (case-mix) information to improve their firm's competitive position and profits (Shields, 1995).

The study also demonstrated that the need to rationalize case-mix decisions and allocations of resources may vary per UMC and is influenced by the management style of the Board of Directors. For example, one UMC attached more importance to objective CMI data and the obligatory use of it than the others and was more ready to attach consequences to it (see Section 9.5). This is in line with earlier research by Abernethy et al (2010) that leadership characteristics of top management influence the design and use of information systems. Furthermore, a DBC-based CMI does not necessarily

correspond to the internal organizational structure and control of UMCs. Because of the large size, in most UMCs vertically-oriented organizational structures are used where responsibilities are primarily allocated to divisions and, subsequently, medical specialties. This means that their internal control and information systems are also vertically oriented. However, the DBC system is process oriented, has an integral character (all direct and indirect activities and costs), often covers several calendar years (instead of one calendar year) and therefore crosses numerous administrative boundaries (Nyland & Pettersen, 2004). This makes it difficult for the (medical) managers to recognize the information and confirms earlier research that vertically-oriented structures may be 'a threat' to process orientation (Kastberg & Siverbo, 2013). In literature on process orientation, information system design and use have generally been given a secondary role. A disadvantage of the vertically-oriented organizational structures and associated systems is that they can create borders, make cooperation harder, produce dysfunctional incentives, do not stimulate change orientation and flexibility, and lead to short-term focus instead of continuous improvement (Kastberg & Siverbo, 2013). To tackle this, a Swedish hospital experimented with the introduction of a matrix organization where the traditional functional division was kept intact but complemented by a process owner, a chief process director, who was responsible for non-financial targets such as waiting times, guidelines, and standard care plans. In further research, it would be important to investigate how the benefits of the process-oriented structure and the vertically-oriented structure of the Dutch UMCs can be better integrated.

Finally, there are practical barriers; for example, the principle that the case-mix had to be put centrally in management talks and management information was supported by almost all managers but did not become operational in practice. Rather than on case-mixes, management talks were still dominated by other current and (more) urgent issues, such as cost reductions, the new electronic patient system and new priorities such as the proposed administrative merger with the VUmc. Also, the Board of Directors did not actively stimulate dialogue about the use of the CMI in order to make it more broadly implemented. This had a negative impact on the success of the CMI because not all managers were intrinsically motivated to use it. The inhibitory effect of the Board is in accordance with other studies that demonstrated that top management support is crucial because they can focus resources, goals, strategies on initiatives they deem worthwhile, and can provide the political help needed to motivate or push aside individuals and coalitions that resist the innovation (Shields, 1995; Naranjo-Gil & Hartmann, 2007<sup>1</sup>).

### 7. Negative effects of a CMI are inevitable but can be reduced

In earlier studies, several negative effects of CMIs in hospitals have been reported (Abernethy et al, 2007; Chong, 1996; Coombs, 1987; Doolin, 2004; Pizzini, 2006; Lowe & Doolin, 1999). In the AMC case study, negative effects were also experienced. By far the most important one was the confusion and irritation about the (perceived) poor quality of the information. This matches with the conclusion by Lowe and Doolin (1999) that the validity of a CMI is often seen as problematic and the data that the system provided might be interpreted in different ways. An in-depth analysis of the causes of the (perceived) quality of the data revealed that a distinction should be made between the actual quality of the information (in terms of completeness, timeliness, reliability) and perceived quality (in terms of recognition and comprehensiveness), since there might be a gap between these. The actual poor quality of data was mainly caused by the lack of (financial) incentives for proper registration, lack of proper system controls, and by missing and outdated data. The perception of the data's poor quality was sometimes worse than the actual quality. The perception of low quality was particularly true for DBC data and cost data. As mentioned earlier, these data were derived from complex (accounting) algorithms, assumptions, models, and political interventions. As a result, the data were not recognized and understood by the (medical) managers and therefore easily interpreted as unreliable. To some extent the (perception of) poor quality of the data is probably inevitable, but can be improved by taking targeted measures, such as linking the budgets to CMI data, and organizing user training to improve the understandability and interpretation of data. However, there will always be managers who will use the poor quality of a CMI as an excuse to ignore or disapprove its results.

Finally, in several studies, it is stated that a CMI contributes to resistance and tensions between clinicians and technocrats if it shifts power relations within the organization (Abernethy et al 2007; Pizzini, 2006; Markus & Pfeffer, 1983). However, in this study conflicts hardly occurred because the CMI did not lead to a redistribution of power within the organization. Major explanations for this were that the managers actively participated in the design of the CMI and that the use of the CMI was not prescribed to them. The CMI was offered as a learning tool, not to control or curtail their behavior as found in other studies (Abernethy & Vagnoni, 2004; Jones & Dewing, 1997). It was not surveillance as a part of management control (Doolin, 2004). It was also not considered as a process leading to managerial colonization of clinicians' domains and therefore it was no potential threat to the autonomy of the chief physicians and division managers. Furthermore, the CMI was not used to redistribute power among the various organizational actors, for example, by delegating budgets through the system. So, in the absence of power shifts there were no power struggles. This is consistent with the literature (Lehtonen, 2007; Kasurinen, 2002; Scarparo, 2006) saying that the freedom

of choice and flexibility in the use of (case-mix) information systems alleviate conflicts and settle disputes. The CMI project did not lead to conflicts between the hospital board and the managers. Non-medical managers gained more insight into the medical world and they were given new opportunities to understand the medical specialists. Medical managers gained more insights into the financial aspects of their case-mix and were given the opportunity to confront non-medical management with new 'facts' in order to get support for their decisions. The study confirms prior research by Lowe and Doolin (1999) that demonstrated that information systems are best thought of as enabling systems that make a new discursive space possible within which all organizational participants can act.

### 8. Using a CMI requires the logic of management and this can be problematic for medical managers

Using case-mix information requires specific knowledge about topics such as finance, the DBC system, and administration. Furthermore, it encompasses abstract and derived information containing several kinds of subjectivities, uncertainties, and contradictions. Using this information requires the logic of management and, as this is contrary to the logic of medicine, it can be particularly problematic for managers with a medical background (Witman, 2008). This is consistent with the idea that the scientific and positivistic training of doctors makes it difficult for them to adapt to the more open-ended approaches utilized by managers in making decisions on less than perfect information (Doolin, 2004). Also in this case study, several medical managers found it difficult to combine the different logics of medicine and management. They lacked the skills and knowledge to interpret the case-mix information, translate it into action, and to deal with uncertainties and conflicts of interests. This is a relevant finding because the vast majority of the hospital managers have a medical background. These managers are made responsible for both the clinical and the financial part; they become *hybrid professionals* (Llewellyn, 2001; Witman, 2008). The question, however, is to what extent can the medical and management roles be combined in one person. In our research project, the medical managers interviewed were willing to acquire the necessary managerial skills and combine these with their existing clinical knowledge basis, but within limits. It would be interesting to further investigate what the limits are of hybridization and what the boundaries should be between medical and accounting expertise.

Several studies have shown that the background of the user has an impact not only on managerial behavior and strategic choices, but also on the use of information systems (Naranjo-Gil & Hartmann, 2007<sup>1</sup>). Managers with a predominantly clinical background appeared to focus more on non-financial (or clinical) information for decision-making and preferred an interactive style when using a CMI. On the other hand, managers

with a predominantly administrative background seemed more effective in establishing cost-reduction strategies because of their focus on financial information in combination with a diagnostic use of a CMI. One explanation for this is that decisions by managers are determined and biased by patterns of knowledge formed by previous experience and training. Another explanation is that clinical training and practice over many years has imbued a deep-seated ethos based on patient care, almost regardless of costs (Jones & Dewing, 1997). Since medical managers are key decision-makers in UMCs and therefore have much influence on performance, they must have the right skills and knowledge to use a CMI in a responsible way. That also means that their perception of management needs to be adjusted: they need to recognize that management is not just common sense or easily learned (Doolin, 2001). Doctors and managers have much to learn from each other but each group has a unique contribution that needs to be respected and valued (Edwards et al, 2003). It is, therefore, important to investigate in future research how medical managers can be better trained in using the logic of management and how non-medical managers, in turn, can be better trained in understanding the complex process of medical decision-making. The Management Game, as designed by the AMC, seems to be a good training method for this, since it was well-received on each occasion.

### **9. Managers are mainly interested in case-mix information on topics they can control and are responsible for**

In our study, the strategy was used to provide the (medical) managers with extensive information set on various topics regarding the case-mix. Earlier studies (Abernethy et al, 2007; Chong, 1996) had shown that when task difficulty and variability of the user of the (case-mix) accounting system are high, broad-scope information is continuously required to help the manager understand difficult tasks more clearly. This rich information set could be used in the context of learning. In the case study AMC, some types of information were included by the project organization to give the managers insight into some aspects of the case-mix to the entire organization rather than the individual medical specialty or division. One advantage of the strategy to provide broad-scope information was that it could serve different functions for different types of users at the same time. However, a disadvantage was that several managers experienced information overload.

Our study demonstrated that the need for types of case-mix information varies per (medical) manager, but in general managers are particularly interested in information on topics that they can control themselves and on topics they are formally responsible for. Several medical managers indicated that their ability to actually manage some topics, such as their case-mix (type and volume of patients), finances and health care market, were limited and made the CMI for these parts less relevant to them. Regarding the

case-mix, there are indications that medical specialties with relatively much urgent care or many internally referred patients perceive the CMI less often as successful, because they had fewer opportunities to actually manage their case-mix. Regarding to finance the CMI was examined as less relevant because the presented (DBC) information contained (integral) cost and revenues and they could only influence a part of it. They had no direct influence on the fixed cost and cost beyond their entities. They had no influence on the budget, since the budget was not linked to on the DBC revenues and rather fixed. There was no direct link established between strategy, performance evaluation, and compensation. So, important motivating factors to use the CMI (Shields, 1995) were absent. This is in line with prior studies that demonstrate that when controllability does not exist, managers cannot be held responsible for departmental or directorate performance and accounting information is not considered important in decision-making at the operational level (Pettersen & Solstad, 2014). We also conclude that the perception of controllability and also responsibility can greatly vary between managers. For example, when the job responsibilities of the managers are not clearly described or when the principle of shared responsibilities is used, each manager will interpret his/her responsibilities in his/her own way.

These findings have several implications for the management accounting discipline. First, more research is needed about the factors (such as the type of organizational structure, job responsibilities, personal characteristics and medical specialty) that influence the controllability of managers in UMCs, and derived from that the success of a CMI. This knowledge may be useful for assessing the potential benefits of the CMI for the individual manager and organization and for prioritizing when designing and implementing the CMI. Second, our findings pose the question whether it is sensible to provide (case-mix) information which is beyond the controllability and responsibility of the users. Who will be involved in defining the available management information, with what role and with what priorities? To what extent will a particular point of view be prescribed because it is thought to be in the interest of the organization? Is it sensible to provide (top down) information to managers in order to increase (cost) awareness of the integral process if managers are not integrally responsible? Is it wise to expand the responsibilities of the manager? Future research may want to address these questions.

### **10. The design and implementation of a CMI should be approached in a scientific way**

The process of design, implementation and outcome evaluation of the CMI project at the AMC was approached in a scientific way, because we were uncertain about the effects of it on the behavior of people and the organization. In retrospect we conclude that this was a sensible approach. As concluded earlier, with a CMI, significant benefits

can be achieved for Dutch university medical centers (see Implication 1). However, also the risk of negative effects exists, such as power conflicts, discussions about the data or incorrect use of the CMI. Because of our scientific approach, there was an extensive examination about what case-mix information had to be designed, for whom and how it could be interpreted and used in a responsible way. In this context, there were many experiments with different types of information products and user training. With continuous iterations of the reflective cycle and extensive literature research we gained new and more in-depth knowledge about the outcomes of the CMI and the factors explaining its success in this specific context. This knowledge will be partly applicable, but not per definition be generalizable to other UMC settings. Each specific context will require local research into the factors which may determine the success of the CMI, such as the design, implementation, organizational and environmental factors. A scientific approach of the design and implementation of a CMI requires specific professional knowledge and skills from the designers. It would be useful for future research to examine by whom a CMI should be ideally designed and implemented: by the hospital, by an ICT consultancy firm, or a combination?

### 10.3 Practical guidelines for successful implementation of a CMI in university hospitals

The intention of this research was to contribute to practice in the following ways. First, following this research, a full CMI was designed and implemented at the AMC. Based on this, it could be determined whether a CMI could indeed influence and affect the way the AMC operated, both in beneficial and in harmful ways, and to what extent. This research has demonstrated that a CMI can really contribute to this and the presented outcomes can be seen as indicators of the potential benefits from the implementation of a CMI in other (Dutch) (academic) hospitals for regulators and hospitals. We expect that our findings will have a more general validity and will yield insights that go beyond the research setting of UMCs, in, for example, general hospitals. The results could be seen as an indicator for the potential benefits gained from the implementation of CMIs. We have a common social interest that the patient be treated in the right place with the right treatment at the right cost. Furthermore, knowledge from this research design can be derived for professionals who are involved in implementing CMIs or similar information innovations in a similar context, such as (health) regulators, and hospital managers. This research within the Dutch system could also help other countries that are considering the introduction of market competition into the hospital sector achieve their goals in the right way. Finally, by linking this practice-oriented research to science, hopefully the gap can be bridged between the validity of the management accounting research and its practical relevance.

In Table 10.2 the gained design-oriented knowledge is translated into practical guidelines (or recommendations) for a successful implementation of a CMI in Dutch university hospitals. The guidelines are meant for hospital managers (Board of Directors, medical managers, chief physicians project managers, IT managers) as well as (international) regulators (Ministry of Health, Ministry of Education and other health authorities such as the NZa and ACM), that can directly or indirectly influence the success of CMIs in hospitals. It must be emphasized that we are attempting to provide *general guidelines* rather than to prescribe a unique CMI, as we believe that a one size fits all system will never be effective in all circumstances.

Table 10.2: Practical guidelines for a successful implementation of a CMI in university medical centers (UMCs)

No	Implication	Guidelines for hospital managers	Guidelines for regulators
1	With a CMI, significant benefits can be achieved for Dutch university medical centers	<ul style="list-style-type: none"> <li>Before hospital managers decide to adopt a CMI, there has to be an examination of what information problems exist, to whom, and how often they occur. The potential positive and negative effects have to be weighed up. Based on the findings, it can be concluded that a CMI is a valuable option for solving these problems. The results can be used to define the scope of the project, the potential users, the aims of a CMI, subjects, principles, end products, etc.</li> <li>It takes a lot of time, capacity, energy and money to design and implement a CMI. It will particularly become profitable if it is used for multiple purposes and multiple users.</li> <li>With the adoption of a CMI, not only a new information system is introduced, but also a new philosophy, namely 1) the recognition that the composition of the case-mix is critical to the performance in all core tasks and finance of a hospital and therefore has to be put centrally in the management cycle, and 2) the belief that a CMI can contribute to this by rationalizing and objectifying the different phases in the management cycle. Hospital managers should endorse this philosophy.</li> </ul>	<ul style="list-style-type: none"> <li>Given the potential benefits of CMIs, regulators should promote, or if necessary, prescribe, that all (academic) hospitals and stakeholders in the hospital sector start working with a CMI, preferably a similar one, so that everyone speaks the same language and uses the same sources and definitions.</li> <li>Regulators should bundle the knowledge of CMIs and case-mix data, such as benchmark data, in a national health care (information) organization. The knowledge and (benchmark) data should be made available to the different stakeholders in the hospital sector with the right support.</li> <li>The current DOT system has to be improved. The system must be more consistent with the language and experience of the medical professional and more aggregated to be used for the internal dialogue and negotiations with insurers. This can be achieved by using the <i>patient groups</i>, such as defined by the AMC, as product structure rather than the care products.</li> <li>Changes in the (DOT) product structure have to be properly tested before it is implemented nationally. Afterwards, the product structure should remain as stable as possible in the course of time.</li> </ul>
2	Market mechanisms can promote but also reduce and obstruct the success of a CMI	<ul style="list-style-type: none"> <li>The benefits of a CMI will increase when hospital managers delegate the incentives of market mechanisms to the medical specialties, for example by (partly) linking the internal budgets to the external revenues as agreed with health insurers.</li> <li>As the divestment or investment in personnel, infrastructure, and communication for realizing a case-mix is a multi-year process, medical specialties should not be faced with the delusions of the market and too volatile annual revenues. Hospital managers can contribute to this by making long-term arrangements with insurers and by making the internal budgets not fully dependent on the outside world.</li> </ul>	<ul style="list-style-type: none"> <li>If regulators want to increase the rationality of decisions in hospitals and, related to this, the adoption of CMIs, the hospital market has to be really liberalized rather than (semi) regulated. (Budget) measures that mitigate the effects of market mechanism should be minimized. However, it should be evaluated whether the market mechanisms are effectively applicable to UMCs, given their specific and public functions.</li> <li>Since particularly the financial pressure motivates the UMCs into adopting CMIs, regulators might better suffice with more simple cost control measures, for example, by concluding gentlemen's agreements about health care expenses.</li> <li>If regulators want UMCs to take money into account when making CMI-based case-mix decisions, they must facilitate for UMCs that they have timely insight into their DBC revenues for the longer term. To achieve this, regulators should prepare or enforce long-term agreements, for example for two or three years, between UMCs and health insurers. If this proves inadequate, it is probably better to fix the rates nationwide rather than negotiate them freely.</li> <li>If regulators want UMCs to specialize in highly complex care and to leave low complexity care to other health care suppliers, they must facilitate joint agreements between UMCs and general hospitals.</li> </ul>

Table 10.2: Practical guidelines for a successful implementation of a CMI in university medical centers (UMCs) (continued)

No	Implication	Guidelines for hospital managers	Guidelines for regulators
3	A CMI can serve multiple stakeholders in multiple phases of the strategic management cycle	<ul style="list-style-type: none"> <li>Before the design and implementation of a CMI, a comprehensive diagnostic analysis of the target group in its setting has to be conducted: who needs what type of information, when and why? Different functions and different sub-target groups for the CMI who may be approached differently regarding information products and user training should be identified.</li> <li>Information products for management need to be ready-made and easily accessible, and must generate highly aggregated information. Information should be presented by powerful visualizations with clear explanations. Business analysis need tools that enable them to support their managers by analyzing the case-mix information at a more detailed and technical level.</li> </ul>	
4	The decision-support function of a CMI varies between types of information	<ul style="list-style-type: none"> <li>Do not wait to implement a CMI until the quality of the data is perfect because that will never happen. The presentation of incorrect data may trigger an improvement in the quality.</li> <li>Hospital managers should realize that a CMI rarely acts as a machine to provide <i>truth and the right answers</i>, but mainly invokes and facilitates dialogue about care, and encourages learning.</li> <li>Users of a CMI should be trained on the strengths and weakness of each type of information and for what purposes the information can and cannot be used.</li> <li>Non-system data, such as opinions about relevance and distinctiveness of patient groups can be very useful, but measures have to be taken so that they are used in a responsible way.</li> </ul>	
5	No substantial case-mix changes can be expected in UMCs because of a CMI	<ul style="list-style-type: none"> <li>It is top management's responsibility to (try to) facilitate economically justified and medically effective case-mix decisions and set the right priorities. Providing a CMI to the key decision-makers, such as chief physicians, division managers, and the board of directors can contribute to this.</li> <li>In addition, hospital managers can facilitate the CMI-based case-mix decision processes by providing the relevant conditions for optimizing this, such as defining the (joint) responsibilities of the different stakeholders in the priority-setting process, defining priority areas and priority-setting criteria, and organizing strategic meetings. In addition, the priority-setting process should be supported by leadership development and change management strategies.</li> </ul>	<ul style="list-style-type: none"> <li>If regulators want UMCs to take quality of care into account when making CMI-based case-mix decisions, then uniform and clear national quality standards must be available. The current national quality standards have to be improved: they must also relate to complex care, must become patient-outcome oriented, and easy to operationalize. Furthermore, each health insurer uses its own quality criteria. Quality information is necessary for a competitive health care market to work properly. Therefore outcome and quality measures must be available to all decision-makers.</li> <li>The core tasks of UMC (care, research, and education) are inextricably interwoven. Regulators can facilitate CMI-based making case-mix decisions in UMCs by also integrating the funding of the different care tasks.</li> </ul>

Table 10.2: Practical guidelines for a successful implementation of a CMI in university medical centers (UMCs) (continued)

No	Implication	Guidelines for hospital managers	Guidelines for regulators
6	Cultural, structural, and practical barriers can obstruct putting the philosophy of the CMI into practice	<ul style="list-style-type: none"> <li>The introduction of a CMI can be a means to start managing the organization in a different manner. Managers should identify to what extent the philosophy of the CMI is consistent with the organizational culture, structure, and practice of the UMC and whether they are sufficiently prepared to make these changes.</li> <li>Top managers should not only promote the aims of the CMI but also act on behalf of it. They should use it themselves and discuss it in the management meetings. They have to actively stimulate the dialogue amongst clinicians and administrators and make the CMI broadly owned.</li> <li>The CMI must be integrated into the Planning &amp; Control cycle and discussed in management meetings.</li> </ul>	
7	Negative effects of a CMI are inevitable but can be reduced	<ul style="list-style-type: none"> <li>Several measures have to be taken to obtain good quality CMI data. To achieve this, medical specialties should have a (financial) interest in and responsibility for the quality of the data.</li> <li>Costs and sales data must be stabilized as much as possible by minimizing the changes in the cost calculation model, using normative unit costs, and by minimizing the changes in the selling prices by taking more aspects than unit costs into account, such as the selling prices of the previous year, and strategic considerations.</li> <li>Users need to have a basic knowledge of how CMI data are generated and by whom, so they know with whom they can discuss the implications.</li> <li>Users must have easy access to the information products, with minimal effort.</li> <li>Power conflicts can be prevented when the CMI is offered as a learning tool and not as a way to control or curtail the behavior of people.</li> <li>It is wise, both from a substantive and financial perspective, to standardize case-mix information as much as possible for the different medical specialties and divisions. However, to prevent information overload, users must have the opportunity to indicate which standard figures and tables are relevant to them and which additional details they need.</li> </ul>	

Table 10.2: Practical guidelines for a successful implementation of a CMI in university medical centers (UMCs) (continued)

No	Implication	Guidelines for hospital managers	Guidelines for regulators
8	Using a CMI requires the logic of management and this can be problematic for medical managers	<ul style="list-style-type: none"> <li>Top managers must ensure that the medical managers have the right skills and knowledge to use a CMI in a responsible way. Using a CMI requires that managers are able to handle abstract data and uncertainties, connect data, and translate it into action and conflicts of interest. Before medical managers get access to the CMI there has to be an assessment of their abilities to combine the different logics of management and medicine.</li> <li>The medical managers also have to be trained in the management of their case-mix portfolio and underlying processes, both practically and legally. For this purpose, the Portfolio Checklist of the AMC can be useful. Finally, the (medical) manager must have some basic knowledge of finance in order to use the CMI in a responsible way. They should at least understand how the external and internal funding works, how costs and revenues are determined, and how they can influence them as managers.</li> </ul>	<ul style="list-style-type: none"> <li>In current medical studies in the Netherlands there is not much room for management and financial knowledge. This is remarkable, since there will be a large number of doctors who are assigned management functions in their careers, and they will need that type of knowledge and skills. Regulators can do more to better prepare doctors for working as hospital managers and increase the management skills of (chief) physicians.</li> <li>The improvement of management skills can be promoted by offering (optional) management courses to doctors and nurses. These courses should include training in control techniques and processes but also in conflict resolution and conflict management. The Management Game developed by the AMC might be useful for this purpose.</li> </ul>
9	Managers are mainly interested in case-mix information on topics they can control and are responsible for	<ul style="list-style-type: none"> <li>Hospital managers must ensure that top (medical) managers have the appropriate formal rights and power to influence key topics such as the case-mix, costs and revenues.</li> <li>There must be clear job descriptions with committed tasks and responsibilities. Regarding their responsibilities, there needs to be clear definitions of what the managers are responsible for: which (core) tasks, which elements (content and/or business/finance), and which entities (medical specialty, medical departments). It should be clearly stated how these responsibilities relate to those of other managers and how the responsibilities are divided when more medical specialties and medical departments are involved in the treatment of patient groups.</li> </ul>	
10	The design and implementation of a CMI should be approached in a scientific way	<ul style="list-style-type: none"> <li>Case-mix information should be considered a strategic asset for organizations. It is recommended that the knowledge and skills about a CMI are concentrated in one (management) information department. It may be wise to make a Chief Information Officer (CIO) responsible for the design and implementation of the CMI.</li> <li>The design and implementation of a CMI must be considered as a science that should be left to professionals. Hospital managers should examine whether this can be done by the hospital's own people or better outsourced. In this context, the advantages and disadvantages of the self-design of the CMI have to be weighed up.</li> </ul>	

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## **Summary/Samenvatting**

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## Summary

### Part I: Background and design of the research

The Dutch health care sector is under great financial pressure. As a result, since 2005, several major reforms have been introduced, including significant legislative changes. In the hospital sector, the liberalization of care was gradually expanded. Also, a new performance-based pricing system, called the Diagnosis Treatment Combinations (DBCs), was introduced and replaced the budget system. The increasing competition and financial pressure required adjustments to the way hospitals were generally managed. Case-mix information became increasingly important in order to make the right decisions regarding the type and volumes of patients (case-mix), planning, monitoring, process optimizing, and legitimizing. For several hospitals, the DBC system was an incentive to start introducing case-mix information systems. In a case-mix information system (CMI), financial, patient, and medical data are collected at patient level. This data can be integrated, correlated, and aggregated at different levels.

In the Dutch (academic) hospitals, there was actually no knowledge available about what type of CMI could be designed and how it could be implemented successfully. Up until then, no studies had been done in this context. In the literature, there were stories of failure and success of CMIs in other countries. Some implementations were successful and led to positive outcomes, such as better informed choices, increasing cost consciousness, rationalizing of operating processes, and cost reductions. But several implementations failed and led to negative effects, such as power conflicts and disputes about the data. In general, too little research has been done on the effects of CMIs in different contexts. Because of this, many important research topics had been left unexplored. To solve this, a design-oriented research project was executed as an in-depth longitudinal case study from 2006 to 2014 at the Academic Medical Center (AMC) in Amsterdam. The objectives of this research were:

1. To design and implement a CMI for the top medical and non-medical management, namely the chief physicians, division managers, and central managers;
2. To gain in-depth design-oriented knowledge about a CMI.

The methodology of *design-oriented research* was applied, which is essentially a process of gaining knowledge on the basis of reflection on the regulative cycle and involves a structured organizational problem-solving process within an organization. In the case study, the regulative cycles consisted of following phases: process design, object design, implementation, and evaluation, and was passed through several times. In addition to the regular evaluations, two extensive reflections took place about the outcomes and potential success factors of the CMI project. The evaluations and reflections were based

on qualitative and quantitative research methods, using pilot groups, (semi-structured) interviews, and questionnaires. This research context was unique as regards to the reimbursement system (the Diagnosis Treatment Combinations [DBC] system), type of organization (university medical center [UMC]), and the momentum (just after the health care reforms).

## Part II: Case study AMC 2006 - 2014

During the case study and while passing through the phases of the regulative cycle, the CMI was iteratively designed and implemented by pilot groups. In the first phase of the case study – the period between 2006 and 2008 – the *Standard Report Patient Care* and the *Portfolio Matrix* were designed by a pilot group. In the design of these information products, the patient groups of the medical specialties were put centrally, based on the assumption that the type and volumes of patients (case-mix) had a large impact on the performance in all core tasks and funding of the AMC. For this purpose, each medical specialty classified their patients into manageable groups that matched with their experience and language. There was quite a consensus between the managers about what types of information should be minimally covered (minimal data set) in the CMI and consisted of system data (such as patient characteristics, capacity, health care market and finance) and non-system data (such as relevance of care). In the Standard Report Patient Care, these types of information per patient group were presented side by side to allow comparison with each other and to evaluate strategic alternatives. The Portfolio Matrix was designed to provide quick insight into the medical and financial relevance per patient group. For each quadrant of the Portfolio Matrix, actions could be defined to optimize the portfolio. At the end of 2006, the pilot was positively evaluated and a decision was made to roll out the Standard Report and Portfolio Matrix to all medical specialties in order to support them when defining their annual plans. Between 2006 and 2008, the Standard Report Patient Care and Portfolio Matrix were updated three times and sent to the managers. In 2008, 26 medical specialties participated and a total of 350 patient groups were defined. Training sessions were organized to demonstrate to the managers what types of case-mix information were available and how these could be used for their practice. At the end of 2008 the CMI was also made available through Cognos, the prevailing Business Intelligence tool, to increase the accessibility of the information for users.

At the end of 2008, an interim reflection on the project took place by surveying and interviewing 35 top managers (chief physicians, division managers and central managers). It showed that the Standard Report Patient Care and Portfolio Matrix were actually used by almost all managers of the target groups. The CMI was mostly used for getting more insight, decision support and, although to a lesser extent legitimization. However,

doubts about the quality of the data, particularly the DBC and cost data, appeared to be a major obstacle to the acceptance and use of the information. The poor quality was also due to errors in the computer systems, such as failing algorithms, incorrect linkages between care activities and DBCs and the leakage of data. It also took a long time to reach agreement with health insurers about volumes and prices (B-list DBCs) of the care products and as a result the prices only became available in the CMI late in the current year. Also, until then, the tariffs of the A-list DBCs were only used for administrative purposes, and did not determine the actual returns because these returns were still based on the budget system. This reduced the usefulness of the CMI considerably, since it was not possible to determine the financial coverage per care product or patient group. Also several managers indicated that they had insufficient knowledge and skills about how the CMI could be used for decision making. Moreover, they found it difficult to really implement choices into practice. About two-thirds of the respondents had perceived the CMI project as (very) successful for themselves, but it was also concluded that several necessary measures for improvement had to be taken to further increase the success of the CMI. The interim reflection also demonstrated that the expectations of the CMI were different per manager: some expected it to be an ‘answering machine’, others a ‘dialogue machine’, and others a ‘budget generating machine’.

In the second phase of the case study – the period between 2009 and 2004 – the Standard Report Patient Care and the Portfolio Matrix were redesigned and improved. With regards to the Standard Report, new types of information were added (such as the type of referrer, waiting times, market shares, revenue forecasts, and percentages of top referral care) and several standards were added (for example, budgets and waiting times). Since data with regard to revenue forecasts and top referral care were not registered in the computer systems, calculation models were developed on extensive statistical analyses, such as a *Forecasting Model* and a *Top Referral Care Model*. Next, the Standard Report was not only made available per medical specialty, but also per division and at the corporate level. The Standard Reports could also be downloaded by the users at any time and at any organizational level (AMC, division or medical specialty). This increased the timeliness and accessibility of the Standard Report significantly.

In addition, new information products were designed, such as the *Interdependency Analysis*, the *Benchmark Analysis Resource Use Profiles* and the *Portfolio Checklist*. The Interdependency Analysis was developed for the managers in order to provide insight on what the clinical interdependency was between patient groups and could be used by the managers to determine where coordination of medical policy between specialties was necessary when making case-mix decisions. The Benchmark Analysis Resource Use Profiles was designed to optimize the care processes and to reduce costs by comparing

costs and activities per care product from the AMC with other University Medical Centers (UMCs). The constructed Portfolio Checklist was a tool to assess the performance of the current case-mix in a systematic way by means of the CMI and to translate their outcomes to policy decisions in order to optimize the case-mix or underlying care processes. During this period the CMI was more and more embedded in the strategic management cycle and was used for gaining insight, conducting a dialogue on portfolio choices, external legitimization, process optimization, cost reduction, and also cost-effectiveness studies.

In 2012, all existing information products had to be redesigned because of the replacement of the DBC system by the DOT (DBCs On their way to Transparency) system. This had a major negative impact on the CMI project. It meant not only a major technical change of the CMI, but also a substantive change as users had to understand this new system and related case-mix information. Although the DOT system certainly had advantages, the data were still perceived as unreliable, even more so than the DBC data. Furthermore, it still took much time to negotiate about volumes and prices with the health insurers and this meant that during the year essential data were missing. This reduced the number of possible applications and the use of the CMI in several ways. The continuous and dramatic changes in the DOT product structure and associated selling prices generated too many uncertainties to implement output budgeting in a responsible way. As a result, in 2012 the Board of Directors decided to abandon the plans to link the internal budgets to the DOT production. Because of this, an important aim of the CMI project, namely to use the CMI for planning purposes, could not be achieved and the need to use it was reduced. Further, the negative effects of the incomplete dataset were that there were risks of using this information and disclaimers had to be added to the information products. For example, a warning not to make case-mix decisions on basis of the CMI. Other obstructing factors were that managers still experienced several legal and practical barriers in managing the case-mix and that new priorities arose at the AMC such as the implementation of the electronic patient system and the proposed administrative merger with VUmc. The CMI was also used less for planning capacity. Reasons mentioned for this were that the production of the medical specialty was rather stable over the years and did not require an advanced planning tool and that some specialties used their own planning system and used their own data because the CMI data were not considered reliable enough to use.

Between 2009 and 2014, information products were designed for the *business analysts* to be able to support their top managers in their use of the CMI. The *Intranet Page*

*Management Information* and several *Data Cubes in Cognos*<sup>34</sup> were designed for them. The Data Cubes contained the detailed data of the Standard Report Patient Care and had options for drilling down into the data to patient level and for correlating medical data, patient data, and financial data. In 2014 about 40 business analysts used these products regularly.

In 2014, the CMI was technically completed and it was concluded that the highest possible aims had been achieved and the project could end. At that time, 49 medical (sub)specialties, belonging to 10 divisions, were participating in the CMI project. Afterward, several actions were taken to secure the CMI for the future, such as the designation of those responsible for the CMI in the organization and to ensure that the case-mix information would be kept available in 2015 when the new electronic patient system (EPIC) was planned to be implemented.

### **Part III: The final case-mix information system of the AMC**

The final CMI of the AMC consisted of a set of information products regarding patient care. The CMI served multiple functions for multiple users at the same time. A distinction was made between products primarily designed for the top managers and those for the business analysts. The products for the top managers were designed to support them in the different stages of the strategic management cycle. For chief physicians and division managers, the CMI mainly served the *decision-facilitating function*, which meant that it would give insight into the case-mix and underlying care processes and these insights would support management in making (policy) decisions with regard to the case-mix and process optimization. For central management, the CMI mainly served a *decision-control function*, which meant that it could be used for planning (capacity, money) and monitoring of the policy plans. It was also helpful for external legitimization purposes (negotiating with the health insurance companies). To fulfill these functions, several information products were designed that were ready-made and contained information at a highly aggregated level. The Standard Report Patient Care and Portfolio Matrix were the key products of the CMI for the managers and were sent to them on a monthly basis. The Interdependency Analysis was generated for all medical specialties and updated every two or three years. The Benchmark Analysis Resource Profiles and Portfolio Checklist were implemented for a selected number of medical specialties. The products for the business analysts were designed to support the managers in their use of the CMI by giving background information and making in-depth analyses. All information products were part of the CMI and what they had

<sup>34</sup> The AMC used Cognos as their management information system. Cognos is a brand name used by IBM for activities in the field of business intelligence and business performance management. The software is designed to enable business users without technical knowledge to extract corporate data, analyse it, and assemble reports.

in common was that the information was always based on the same resources and definitions; the information was expressed in the same clinical language, namely the patient group. This made it possible to connect and compare information with each other. With the total set of products, a substantial amount of information with regard to patient care was available from a variety of perspectives: from strategic to operational, from historical to prospective, from standard to ad hoc, and from one's own hospital's information to information from other hospitals.

#### **Part IV: Reflection and discussion**

In April 2014, an end reflection on the CMI project took place by surveying 53 (medical) managers (chief physicians, division managers and central managers). The reflection related to the design and implementation variables, organizational and environmental variables and the outcomes of the CMI. Most of the respondents used the CMI mainly for gaining insight into their case-mix, and to some extent for monitoring, internal legitimation, and decision support. The central managers, in particular, used the CMI for (annual) planning purposes, monitoring (A3 score card), process optimization (SLIM project), the preparation of the administrative merger (with VUmc), internal legitimation (Internal Review Committee) and for external legitimation (negotiations with health insurers). In accordance with the interim reflection, doubts over the quality of the CMI were the most frequently cited disadvantage. The CMI database was used in various ways for external legitimation purposes, for example to define the percentage of top referral care in the annual account and to influence the rate of the A-list DBCs. The CMI also supported cost effectiveness studies. The CMI was eventually not used for budgeting and the allocation of capacity. As a result the CMI lost significance, as the idea of internal performance budgeting disappeared. In general, the respondents agreed with the statement that the CMI had added value to the AMC and to themselves. The CMI was found especially useful in the context of the present market and financial pressure.

It is difficult to determine exactly what the impact of the CMI has been on the user and the organization. However, based on the extensive interim and end reflections, we can conclude that the CMI has increased and improved the available information regarding patient groups enormously and that this information has contributed to the improvement of the various phases of the strategic management cycle. Although the perceived effects of the CMI differed per manager, it can be concluded that the CMI contributed to the following: identification of possible case-mix changes, providing the appropriate arguments, agreements were made about patient care, an increase of cost consciousness and cost savings, an improved registration of diagnoses and care activities, a greater appreciation for their work management and better rates (A-list DBCs). However, no

substantial case-mix decisions resulted immediately from the functioning of the CMI. This was probably due to the several barriers which were experienced by the user – apart from the (perceived) poor quality of the data – such as the lack of skills and knowledge, lack of decision-making power, the persistent complexity and volatility of the DBC system, existing organizational structure/culture, and legal barriers. Respondents also reported negative effects of the CMI, such as confusion and discussion about the data, information overload, and selective and incorrect use of the information. Overall, the CMI project was perceived as moderately successful for the users themselves, whereas the majority of the respondents perceived the CMI project as (very) successful for the organization. Reasons why the respondents perceived the CMI to be more successful for the organization than for themselves are probably related to the fact that they observed a corporate-wide system, used by various users and for different purposes, both within their own division and beyond. Moreover, there was the general belief that a CMI is necessary in the context of the present competition and financial pressure. On balance, the positive effects of the instrument outweighed the negative effects, but the perceived success of the CMI project differed very much per manager.

The research period was a relevant contextual factor for this case study because it had a major impact on the results. The research took place just after the implementation of health care reforms, which included the introduction of a new reimbursement system, product structure (DBC and DOT), and the liberalization of care. There was a mixture of a complex internal environment and a chaotic outside world. Several organizational and environmental variables were therefore very unstable and unpredictable over the course of time. Eventually, the free market of hospital care did not really come through. As a result, the aims of the CMI changed during the research project, as did the basic material for designing it, such as the DBC data, data sources, and definitions. These factors complicated the design of the CMI and implied that eventually some aims of the CMI – such as making real case-mix decisions and budgeting – could not be fully achieved and examined.

To assess the applicability of the case study results for other hospital organizations we redesigned the AMC's Portfolio Matrix and implemented this information tool at a selected number of medical specialties at the University Medical Center of Groningen (UMCG) and Free University Medical Center (VUmc). The comparisons between the three UMCs showed some interesting similarities and differences. The similarities were that the Portfolio Matrix was considered a powerful tool because it presented their case-mix in a simple way and contributed to the dialogue about case-mix decisions. However, in the design and implementation of the Portfolio Matrices, different choices were made. The differences were determined by factors such as differences in the characteristics of

the Board of Directors, organization culture, quality of the data, and position on the health care market, and it made an impact on the contents of the CMI and the adoption and use of it. Although in the design and implementation of this type of portfolio matrices different choices had to be made, this part of the CMI can be implemented in a wide range of academic health care settings.

This study contributes in several ways to the management accounting discipline and has several practical implications. First, through this research, we gained in-depth knowledge about the possible benefits of a CMI in the context of Dutch UMCs. It demonstrated that the (DBC-based) market mechanisms can be a driving force for UMCs to change their organization, but there are also characteristics of market mechanisms that can reduce or even obstruct the process of management accounting change and the success of a CMI. Second, this research relates to both the design and the implementation of a CMI, whereas prior accounting research mostly focused on the implementation of an already-designed CMI. This resulted in new knowledge about the design of CMIs. Through continuous iterations in the reflective cycle, we gained in-depth knowledge about what types and combinations of information are useful to whom and about how the information system could be implemented in a responsible way. The study demonstrates that a CMI can fulfill multiple functions for multiple stakeholders at the same time. Through the research, the advantages and disadvantages of self-design of a CMI by a UMC became apparent. Third, the outcomes and the factors that contribute to the success of a CMI were examined in-depth, with both qualitative and quantitative methods. As a result, detailed insights were gained about the factors that hindered or facilitated the success of a CMI, and about the ways through which obstructions can be reduced. Finally, we conclude that the design and implementation of a CMI should be based on scientific and practice-based evidence. To achieve this, the design-oriented knowledge that was gained was translated into practical guidelines for a successful implementation of a CMI in Dutch university medical centers. The guidelines are meant for hospital managers (a Board of Directors, medical managers, chief physicians, project managers, and IT managers) as well as (international) regulators (the Ministry of Health, the Ministry of Education, and other health authorities such as the NZa and NMa), that can directly or indirectly influence the success of CMIs in hospitals.

## Samenvatting (Dutch summary)

### Deel I: Achtergrond en onderzoeksontwerp

De Nederlandse gezondheidszorg staat onder grote financiële druk. Als gevolg hiervan zijn sinds 2005 diverse hervormingen en omvangrijke wetswijzigingen doorgevoerd. In de ziekenhuissector werd de liberalisering van de zorg geleidelijk ingevoerd. Ook werd een nieuw vergoedingensysteem, de Diagnose Behandel Combinaties (DBC's), geïntroduceerd ter vervanging van het budgetsysteem. De toenemende concurrentie en financiële druk vereisten ook aanpassingen aan de wijze waarop ziekenhuizen in het algemeen werden bestuurd. Case-mix informatie werd steeds belangrijker om de juiste beslissingen te nemen ten aanzien van het type en de volumes van de patiënten (case-mix), planning, monitoring, proces optimalisatie en legitimering. Voor verschillende ziekenhuizen was het DBC-systeem een stimulans om case-mix informatiesystemen te introduceren. In een case-mix informatiesysteem (CMI) worden financiële, medische en patiëntgegevens verzameld op patiëntniveau. Deze gegevens kunnen op verschillende niveaus worden geïntegreerd, gecorreleerd en geaggregeerd.

In de Nederlandse (academische) ziekenhuizen was geen kennis beschikbaar over het type case-mixinformatie dat ontworpen kon worden en hoe een dergelijk ontwerp succesvol kon worden geïmplementeerd. Wel waren in de literatuur verhalen te lezen over mislukkingen en succes van CMI's in andere landen. Sommige succesvolle implementaties hadden geleid tot positieve uitkomsten, zoals betere geïnformeerde keuzes, het verhogen van kostenbewustzijn, het rationaliseren van de operationele processen en kostenbesparingen. Maar er waren ook mislukte implementaties met negatieve effecten als gevolg, zoals machtsconflicten en discussies over de gegenereerde gegevens. In het algemeen kan worden gesteld dat er weinig onderzoek was gedaan naar de effecten van CMI's. Hierdoor bleven veel belangrijke onderzoeksthema's onontgonnen. Om die reden werd in het Academisch Medisch Centrum (AMC) in Amsterdam in de periode 2006-2014 een ontwerpgericht onderzoek uitgevoerd.

De doelstellingen van deze diepgaande langdurige casestudie waren:

1. Het ontwerpen en implementeren van een CMI voor het hoger (medisch) management, namelijk de afdelingshoofden, divisie managers en centrale managers;
2. Het verkrijgen van gedetailleerde ontwerpgerichte kennis over een CMI.

In de casestudie werd de methodologie van het ontwerpgericht onderzoek toegepast. Het gaat dan om het verwerven van kennis op basis van een reflectie op de regulatieve cyclus die betrekking heeft op een gestructureerd organisatorisch probleemoplossend proces binnen een organisatie. In dit onderzoek bestond de regulatieve cyclus uit volgende fasen: procesontwerp, objectontwerp, implementatie en evaluatie. Deze cyclus werd meerdere

malen herhaald. In aanvulling op de reguliere evaluaties vonden twee uitgebreide reflecties plaats op de uitkomsten en mogelijke succesfactoren van het CMI-project. Bij de evaluaties en reflecties werd gebruik gemaakt van kwalitatieve en kwantitatieve onderzoeksmethoden, pilot-groepen, (semigestructureerde) interviews en vragenlijsten. Onze onderzoekscontext was uniek voor wat betreft het vergoedingensysteem (de Diagnose Behandel Combinaties), type organisatie (universitair medisch centrum) en momentum (direct na de hervormingen in de gezondheidszorg).

## Deel II: Casestudie AMC 2006 - 2014

Tijdens het doorlopen van de fasen van de regulatieve cyclus werd het CMI iteratief ontworpen en geïmplementeerd door pilotgroepen. In de eerste fase van de casestudie - de periode tussen 2006 en 2008 - werd de *Standaardrapportage Patiëntenzorg* en *Portfoliomatrix* ontworpen. Bij het ontwerp van deze informatieproducten werden de patiëntengroepen van de medische specialismen centraal gesteld. Dit vanuit de gedachte dat het type en volume van patiënten (case-mix) een grote invloed heeft op de kerntaken en financiën van het AMC. De afdelingshoofden definieerden vervolgens een aantal hanteerbare patiëntengroepen in termen die aansloten bij hun klinische denk- en belevingswereld. Er was een behoorlijke consensus tussen de managers over het soort informatie dat minimaal in het CMI beschikbaar moest zijn (*minimale dataset*). Die informatie betrof systeemgegevens (zoals patiëntkenmerken, capaciteit, zorgmarkt en financiën) en niet-systeemgegevens (zoals relevantie van de zorg). In de *Standaardrapportage Patiëntenzorg* werd dit type informatie per patiëntengroep naast elkaar gepresenteerd om onderlinge vergelijking mogelijk te maken en om strategische alternatieven te evalueren. De *Portfoliomatrix* werd ontworpen om snel inzicht te geven in de medische en financiële relevantie per patiëntengroep. Voor elk kwadrant van de *Portfoliomatrix* konden acties worden gedefinieerd om de portfolio te optimaliseren. Eind 2006 werd de pilot positief geëvalueerd. Er werd besloten om de *Standaardrapportage Patiëntenzorg* en *Portfoliomatrix* uit te rollen naar alle medische specialismen als ondersteuning bij het opstellen van hun jaarplannen. Tussen 2006 en 2008 werd de *Standaardrapportage Patiëntenzorg* en *Portfoliomatrix* drie keer geactualiseerd en naar de managers verstuurd. In 2008 namen 26 medische specialismen deel aan het project en waren er inmiddels 350 patiëntengroepen gedefinieerd. Er werden trainingen georganiseerd om de managers te laten zien welke soorten case-mix informatie beschikbaar waren en hoe die in de praktijk gebruikt konden worden. Om de toegankelijkheid van de informatie te verhogen werd eind 2008 het CMI ook door middel van Cognos<sup>35</sup> aan de gebruikers beschikbaar gesteld.

<sup>35</sup> Het AMC gebruikt Cognos als management informatie systeem. Cognos is een merknaam die wordt gebruikt door IBM voor activiteiten op het gebied van business intelligence en business performance management. De software is ontworpen om het gebruikers mogelijk te maken zonder technische kennis bedrijfsgegevens te extraheren, analyseren en rapporteren.

Eind 2008 vond een interim-reflectie plaats waarbij 35 topmanagers (afdelingshoofden, divisie managers en centrale managers) werden geïnterviewd en geïnterviewd. Uit de reflectie kwam naar voren dat de *Standaardrapportage Patiëntenzorg* en *Portfoliomatrix* door vrijwel alle managers werden gebruikt. Het CMI werd vooral gebruikt voor het verkrijgen van meer inzicht en ondersteuning bij besluitvorming, maar in mindere mate voor legitimering. Twijfels over de kwaliteit van de aangeboden informatie, vooral de DBC- en kostengegevens, bleken een groot obstakel te zijn voor de acceptatie en gebruik van de informatie. De slechte kwaliteit van de gegevens werd onder andere veroorzaakt door fouten in computersystemen zoals verkeerde algoritmen, onjuiste koppelingen tussen zorgactiviteiten en DBC's en het 'weglekken' van gegevens. Het duurde ook lange tijd tot een akkoord met de zorgverzekeraars bereikt was over volumes en prijzen van de DBC's (B-lijst) met als gevolg dat de tarieven pas laat in het lopende jaar beschikbaar kwamen in het CMI. Ook werden tot dan toe de tarieven van de DBC's uit het A-segment alleen gebruikt voor administratieve doeleinden en niet om te werkelijke opbrengsten te bepalen. Deze opbrengsten waren immers nog steeds gebaseerd op het budgetstelsel. Dit verminderde de bruikbaarheid van het CMI aanzienlijk, omdat het hierdoor niet mogelijk was de financiële dekking per zorgproduct of patiëntengroep te bepalen. Ook gaven verschillende managers aan dat ze onvoldoende kennis en vaardigheden hadden om het CMI te gebruiken bij hun besluitvorming. Bovendien vonden zij het moeilijk om keuzes daadwerkelijk in de praktijk te implementeren. Ongeveer twee derde van de respondenten beschouwden het CMI project als (zeer) succesvol voor zichzelf, maar er werd ook geconcludeerd dat verschillende verbeteringen nodig waren om het succes van het CMI te verhogen. De interim-reflectie toonde eveneens aan dat de verwachtingen van de managers ten aanzien van het CMI verschilden. Sommigen verwachtten dat het CMI een 'antwoordmachine' zou zijn, anderen een 'dialoogmachine' en weer anderen een 'budgetverhogende machine'.

In de tweede fase van de casestudie - de periode tussen 2009 en 2004 - werd de ontwerp van de *Standaardrapportage Patiëntenzorg* en de *Portfoliomatrix* vernieuwd en verbeterd. In de *Standaardrapportage Patiëntenzorg* werden nieuwe soorten informatie (zoals type verwijzer, wachttijden, marktaandeel, omzetprognoses en percentages topreferente zorg) en een aantal normen (zoals budgetten en wachttijden) toegevoegd. Aangezien gegevens over omzetprognoses en topreferente zorg niet in de computersystemen werden geregistreerd, moesten hiervoor rekenmodellen ontwikkeld worden met hulp van geavanceerde statistische technieken. Dit resulteerde in het *Prognosemodel* en het *Topreferentiemodel*. Vervolgens werd de *Standaardrapportage Patiëntenzorg* niet alleen per medisch specialisme opgesteld, maar ook per divisie en AMC-breed. De *Standaardrapportages Patiëntenzorg* konden voortaan op elk moment en op elk niveau (AMC, afdeling of medisch specialisme) door de gebruikers zelf worden gedownload.

Dit verhoogde de actualiteit en de toegankelijkheid van de Standaardrapportage Patiëntenzorg aanzienlijk.

Er werden ook nieuwe informatieproducten ontwikkeld, zoals de *Verwevenheidsanalyse*, de *Benchmarkanalyse Zorgprofielen* en de *Portfoliochecklist*. De Verwevenheidsanalyse werd ontwikkeld om de managers inzicht te geven in de klinische verwevenheid tussen de patiëntengroepen. Deze analyse kon worden gebruikt om te bepalen waar afstemming van het medisch beleid tussen specialismen nodig was en om ondersteuning te bieden bij het maken van case-mix beslissingen. De Benchmarkanalyse Zorgprofielen werd ontworpen om de zorgprocessen te optimaliseren en de kosten te verlagen. In deze analyse konden de kosten en activiteiten per zorgproduct van het AMC worden vergeleken met die van de andere universitaire medische centra (UMCs). De Portfoliochecklist was een instrument om de prestaties van de huidige case-mix op een systematische manier te beoordelen op basis van het CMI. De uitkomsten hiervan konden vervolgens vertaald worden naar beleidsbeslissingen om de case-mix of onderliggende zorgprocessen te optimaliseren. Gedurende deze periode werd het CMI steeds meer ingebed in de strategische managementcyclus en gebruikt voor het vergroten van organisatorische inzichten, dialogen over portfoliokeuzes, externe legitimering, procesoptimalisaties, kostenreducties en wetenschappelijke kosteneffectiviteitsstudies.

In 2012 moesten alle bestaande informatieproducten worden herontworpen vanwege de vervanging van het DBC-systeem door het DOT-(DBC's Op weg naar Transparantie) systeem. Dit had een uiterst ongunstige impact op het CMI-project. Het betekende niet alleen een grote technische aanpassing van het CMI, maar ook een inhoudelijke wijziging omdat de gebruikers dit nieuwe DOT-systeem en de verwante case-mix informatie opnieuw moesten leren begrijpen. Hoewel het DOT-systeem zeker voordelen had, werden de gegevens door de gebruikers nog steeds als onbetrouwbaar gezien, meer nog dan de DBC-gegevens. Bovendien kostte het nog steeds veel tijd om te onderhandelen over volumes en prijzen met de zorgverzekeraars, met als gevolg dat in de loop van het jaar essentiële gegevens nog steeds ontbraken. Dit beperkte het aantal mogelijke toepassingen en het gebruik van het CMI op verschillende manieren. De continue en drastische veranderingen in het DOT-systeem en de bijbehorende tarieven genereerden te veel onzekerheden om interne prestatiebudgettering op een verantwoorde manier in te voeren. Als gevolg hiervan besloot de Raad van Bestuur in 2012 om haar plannen voor de koppeling van interne budgetten aan de DOT-productie op te geven. Hierdoor kon een belangrijk doel van het CMI project, namelijk het CMI te gebruiken voor planningsdoelinden, niet worden gehaald en werd de urgentie tot het gebruik ervan minder. Daarnaast kleefden aan het gebruik van onvolledige gegevens managerial risico's en moesten disclaimers aan de informatieproducten worden toegevoegd. Een

voorbeeld van een dergelijke disclaimer was dat op basis van de case-mix informatie geen directe portfoliobeslissingen genomen konden worden. Andere belemmerende factoren waren dat managers nog steeds verschillende juridische en praktische belemmeringen tegenkwamen bij het managen van de case-mix en dat in het AMC nieuwe prioriteiten werden gesteld, zoals de invoering van het elektronisch patiëntendossier en de voorgenomen bestuurlijke fusie met het VUmc. Het CMI werd slechts in beperkte mate gebruikt voor capaciteitsplanningen. Als redenen hiervoor werden genoemd dat de productie van de medisch specialismen door de jaren heen vrij stabiel was en men hiervoor geen geavanceerde planningstool nodig had, dat een aantal specialismen hun eigen planningssysteem gebruikten en dat de CMI-gegevens niet betrouwbaar genoeg werden bevonden.

Tussen 2009 en 2014 werden ook voor de business analisten informatieproducten ontworpen om hen beter in staat te stellen het hoger management te ondersteunen bij het CMI-gebruik. Voor hen werden de *Intranetpagina Management Informatie Patiëntenzorg* en verschillende *Datakubussen in Cognos* ontworpen. De Datakubussen bevatten de gedetailleerde gegevens van de Standaardrapportage Patiëntenzorg en boden de mogelijkheid om 'door te steken' naar de onderliggende gegevens op patiëntniveau, als ook om medische gegevens, patiëntengegevens en financiële gegevens onderling te correleren. In 2014 maakten ongeveer 40 business analisten regelmatig gebruik van deze producten.

In 2014 werd het CMI als technisch voltooid beschouwd en werd geconcludeerd dat de hoogst haalbare doelen waren bereikt en het project kon worden beëindigd. Op dat moment namen 49 medische (sub)specialismen, behorende tot 10 divisies, deel aan het CMI project. Daarna werden verschillende maatregelen getroffen om het CMI te borgen voor de toekomst, zoals het aanwijzen van verantwoordelijken voor het CMI in de organisatie en het waarborgen dat de case-mix informatie in 2015 beschikbaar bleef als het nieuwe elektronische patiëntensysteem (EPIC) zou worden ingevoerd.

### Deel III: Het uiteindelijke case-mix informatiesysteem van het AMC

Het uiteindelijk ontwikkelde case-mixinformatiesysteem van het AMC bestond uit een reeks van informatieproducten met betrekking tot de patiëntenzorg. Het CMI vervulde meerdere functies ter ondersteuning van verschillende soorten en type gebruikers. Daarbij werd een onderscheid gemaakt tussen de producten die primair bedoeld waren voor de (medische) topmanagers en business analisten. De producten voor de topmanagers waren bedoeld om hen te helpen in de verschillende stadia van de strategische managementcyclus. Voor de afdelingshoofden en divisie managers had het CMI vooral een *beslissingsondersteunende functie*. Dat wil zeggen dat het CMI hen inzicht kon geven in de case-mix en de onderliggende zorgprocessen en hen kon ondersteunen bij (beleids) beslissingen met betrekking tot de case-mix en procesoptimalisatie. Voor de centrale managers had het CMI vooral een *beheersingsfunctie*. Dat wil zeggen dat het CMI kon worden gebruikt voor het plannen (capaciteit, geld) en monitoren van de beleidsplannen. Het systeem was ook bruikbaar voor externe legitimeringsdoeleinden, bijvoorbeeld bij de onderhandelingen met de zorgverzekeraars. Om al deze functies te vervullen werden verschillende producten ontwikkeld die op zeer geaggregeerd niveau kant en klare informatie opleverden. De Standaardrapportage Patiëntenzorg en Portfolio Matrix waren voor de managers de belangrijkste CMI producten en werden maandelijks naar hen gestuurd. De Verwevenheidsanalyse werd gegenereerd voor alle medische specialismen en om de twee tot drie jaar geactualiseerd. De Benchmarkanalyse Zorgprofielen en Portfoliochecklist werden geïmplementeerd voor een beperkt aantal medische specialismen. De producten voor de business analisten werden ontworpen om de managers in hun gebruik van het CMI te ondersteunen door het geven van achtergrondinformatie en het maken van diepgaande analyses. Alle informatieproducten maakten deel uit van hetzelfde CMI waardoor de informatie altijd gebaseerd was op dezelfde bronnen en definities en waarbij de gegevens werden uitgedrukt in dezelfde klinische taal, namelijk in termen van patiëntengroepen. Dit alles maakte het mogelijk om verschillende soorten gegevens aan elkaar te koppelen en met elkaar te vergelijken. Met deze totale set aan producten was een omvangrijke hoeveelheid informatie met betrekking tot de patiëntenzorg vanuit verschillende perspectieven beschikbaar: zowel strategisch als operationeel, zowel historisch als prospectief, zowel standaard als ad hoc, zowel van de eigen organisatie als van andere ziekenhuizen.

### Deel IV: Reflectie en discussie

In april 2014 vond een eindreflectie op het CMI project plaats waarbij 53 (medische) topmanagers (afdelingshoofden, divisie managers en centrale managers) werden geënuquêteerd. De eindreflectie richtte zich op de ontwerp- en implementatievariabelen, de organisatorische en omgevingsvariabelen en de uitkomsten van het CMI. Het merendeel van de respondenten gebruikte het CMI vooral om inzicht te krijgen in hun case-mix en gebruikte het systeem in zekere mate ook voor monitoring, interne legitimering en ondersteuning bij besluitvorming. Vooral de centrale managers gebruikten het CMI voor (jaarlijkse) planningsdoeleinden, monitoring (A3 score card), procesoptimalisatie (SLIM-project), de voorbereiding van de bestuurlijke fusie met VUmc, interne legitimatie (Interne Visitatiecommissie) en externe legitimatie (onderhandelingen met zorgverzekeraars). Net als bij de interim-reflectie waren er twijfels over de kwaliteit van de CMI-gegevens. Het CMI werd op verschillende manieren gebruikt voor externe legitimeringsdoeleinden, bijvoorbeeld om het aandeel topreferente zorg te verantwoorden in de jaarrekening en om de tarieven DBC's uit het A-segment te beïnvloeden. Het CMI vond ook haar weg in wetenschappelijke kosteneffectiviteit studies. Het CMI werd uiteindelijk niet gebruikt voor begrotingsdoeleinden en de toewijzing van capaciteit. Het plan voor interne prestatiebudgetten werd afgeblazen en hierdoor verloor het CMI haar betekenis. In het algemeen waren de respondenten het eens met de stelling dat het CMI toegevoegde waarde had, zowel voor henzelf als voor de organisatie. Het CMI werd vooral relevant geacht in de context van de huidige marktconcurrentie en financiële druk.

Het is moeilijk exact vast te stellen wat de precieze effecten van het CMI zijn geweest voor de gebruiker en de organisatie. Uit de uitgebreide interim- en eindreflecties kunnen wij echter wel afleiden dat door het CMI de beschikbare informatie met betrekking tot patiëntengroepen aanzienlijk is toegenomen en verbeterd en dat deze informatie heeft bijgedragen aan de verbetering van de verschillende fasen van de strategische managementcyclus. Hoewel de waargenomen effecten van het CMI per manager verschilden, kan worden geconcludeerd dat het CMI heeft bijgedragen aan het identificeren van mogelijke case-mix veranderingen, het verbeteren van de dialoog over patiëntenzorg, meer kostenbewustzijn en kostenbesparing, een verbeterde registratie van diagnoses en zorgactiviteiten, een grotere waardering voor het werk van de managers en betere tariefstellingen (DBC's uit het A-segment). Er werden echter geen belangrijke case-mix beslissingen genomen op basis van het CMI. Naast de (gepercipieerde) slechte kwaliteit van de gegevens was dit waarschijnlijk te wijten aan barrières zoals: het gebrek aan vaardigheden en kennis, het ontbreken van beslissingsbevoegdheid, de aanhoudende complexiteit en de volatiliteit van de DBC-systeem, de bestaande organisatiestructuur /cultuur en juridische belemmeringen. De respondenten rapporteerden ook negatieve

effecten van het CMI, zoals verwarring en discussie over data, informatie overload en selectief en onjuist gebruik van de informatie.

Over het algemeen beschouwden de respondenten het CMI-project als gematigd succesvol voor hen persoonlijk en als (zeer) succesvol voor de organisatie. De reden dat de respondenten het CMI succesvoller beschouwden voor de organisatie dan voor henzelf moet waarschijnlijk gezocht worden in het feit dat zij het CMI voor meerdere doeleinden en voor de hele organisatie bruikbaar vonden, dus niet alleen binnen hun eigen divisie maar ook daarbuiten. Bovendien was de algemene opvatting dat een CMI nodig is in tijden van marktconcurrentie en financiële druk. Al met al werden de positieve effecten van het instrument zwaarder gewogen dan de negatieve effecten. Echter, het gepercipieerde succes van het CMI project verschilde sterk per manager.

De onderzoeksperiode zelf was een relevante contextuele factor voor deze casestudie, omdat het een belangrijke invloed had op het resultaat. Het onderzoek vond net na de hervormingen in de gezondheidszorg plaats, waaronder de invoering van een nieuwe bekostigingssystematiek, productstructuur (DBC en DOT) en de liberalisering van de zorg. Het was een mix van een complexe interne omgeving en een chaotische buitenwereld. Verschillende organisatorische en omgevingsvariabelen waren gedurende de onderzoeksperiode dan ook uiterst instabiel en onvoorspelbaar. Uiteindelijk is de marktwerking van de ziekenhuiszorg niet echt van de grond gekomen. Dientengevolge veranderden de doelstellingen van het CMI tijdens het onderzoek, net als het basismateriaal voor het ontwerpen van het CMI, zoals de DBC-data, databronnen en definities. Deze factoren compliceerden het ontwerp van het CMI en hadden als gevolg dat sommige doelen van het CMI - zoals het daadwerkelijk nemen van case-mix beslissingen en budgettering - niet volledig konden worden bereikt en onderzocht.

Om de toepasbaarheid van onze onderzoeksresultaten voor andere ziekenhuizen te beoordelen, hebben wij de Portfoliomatrix van het AMC bij een geselecteerd aantal medische specialismen van het Universitair Medisch Centrum Groningen (UMCG) en het Vrije Universitair Medisch Centrum (VUmc) herontworpen en geïmplementeerd. De vergelijkingen tussen de drie UMC's toonden enkele interessante overeenkomsten en verschillen. De overeenkomsten waren dat de Portfoliomatrix als een krachtig hulpmiddel werd beschouwd omdat het de case-mix op een eenvoudige manier presenteerde en bijdroeg aan de dialoog over case-mix beslissingen. Echter, in het ontwerp en implementatie van de Portfoliomatrices werden andere keuzes gemaakt. De verschillen werden bepaald door verschillen in bestuur, organisatiecultuur, de kwaliteit van de gegevens en de positie op de zorgmarkt. Al die elementen hadden impact op de inhoud van het CMI en de ontwikkeling en toepassing ervan. Hoewel in het ontwerp en

de implementatie van de Portfoliomatrix verschillende keuzes werden gemaakt, kan dit onderdeel van het CMI in een breed scala van academische gezondheidszorginstellingen worden geïmplementeerd.

Deze casestudie draagt op verschillende manieren bij aan de management accounting discipline en heeft een aantal praktische implicaties. In de eerste plaats hebben wij door dit onderzoek gedetailleerde kennis gekregen over de mogelijke voordelen van een CMI in de context van Nederlandse UMC's. Wij hebben laten zien dat de (DBC-gebaseerde) marktmechanismen een drijvende kracht voor de UMC's kunnen zijn om hun organisatie te veranderen. Maar er zijn ook kenmerken van marktmechanismen die het veranderingsproces van management accounting en het succes van een CMI kunnen verminderen of zelfs belemmeren. Ten tweede was dit onderzoek gericht op zowel het ontwerp als de implementatie van een CMI, terwijl eerder accounting onderzoek vooral gericht was op de implementatie van een reeds ontworpen CMI. Dit heeft geleid tot nieuwe kennis over het ontwerp van CMI's. Door middel van continue iteraties in de reflecterende cyclus, kregen wij gedetailleerde kennis over welke soorten en combinaties van informatie nuttig zijn voor wie en hoe het informatiesysteem op een verantwoorde wijze kan worden geïmplementeerd. De studie toont aan hoe een CMI meerdere functies voor meerdere gebruikers tegelijkertijd kan vervullen. Uit het onderzoek zijn ook de voor- en nadelen naar voren gekomen van het zelf ontwerpen van een CMI door een UMC. Ten derde werden de resultaten en de factoren die bijdragen aan het succes van een CMI tot in detail bestudeerd, zowel met kwalitatieve als kwantitatieve methoden. Dientengevolge werden inzichten verkregen in de factoren die het succes van een CMI bevorderen of belemmeren en de manieren waarop weerstanden kunnen worden verminderd. Tot slot concluderen wij dat het ontwerp en de implementatie van een CMI moet worden gebaseerd op wetenschappelijk en praktijkgericht bewijs. Om dit te bewerkstelligen, is de opgedane ontwerpgerichte kennis vertaald in praktische richtlijnen voor een succesvolle implementatie van een CMI in Nederlandse universitaire medische centra. De richtlijnen zijn bedoeld voor ziekenhuismanagers (Raad van Bestuur, afdelingshoofden, projectmanagers en IT-managers) en (internationale) regelgevers die directe of indirecte invloed kunnen hebben op het succes van CMI's in ziekenhuizen (het Ministerie van Volksgezondheid, het Ministerie van Onderwijs en andere zorginstanties, zoals de NZa en ACM).

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Title	Source	Year
Richtlijnen voor kwaliteitsborging in gezondheids(zorg)onderzoek: kwalitatief onderzoek	Netwerk kwalitatief onderzoek AMC - UvA	2002
Annual accounts	www.amc.nl	2005 - 2014
Budget letters	Internal memo	2005 - 2014
Reporting letters	Internal memo	2005 - 2014
Kwantificering patiëntenzorgprofielen	Internal memo	2005 <sup>1</sup>
Medische profilering en zorgportfolio	Internal memo	2005 <sup>2</sup>
Strategic goals 2006 – 2011	www.amc.nl	2006 <sup>1</sup>
Bespreking patiëntenzorgprofielen met medische afdelingen	Internal memo	2006 <sup>2</sup>
AMC patiëntenzorgprofielen: consequenties van de jaarplannen 2009	Presentation	2008
Eindverslag pilot portfoliostrategie en patiëntenzorgprofielen 2010	Internal memo	2010
Strategic goals 2011 – 2015	www.amc.nl	2011 <sup>1</sup>
Opdracht tot bouwen informatieproducten Patiëntenzorgprofielen	Internal memo	2011 <sup>2</sup>
SLIM: Kostenreductie en kwaliteitsverbetering in het medisch proces	Internal presentation	2013 <sup>1</sup>
SLIM: analyse van kosten & activiteiten	Internal presentation	2013 <sup>2</sup>
Structuurnota	Internal memo	2013 <sup>3</sup>
Beter beslissen met patiëntenzorgprofielen	Personnel magazine Status	2013 <sup>4</sup>
Managementinformatie patiëntenzorg AMC	Internal memo	2013 <sup>5</sup>
Kostenreductie en kwaliteitsverhoging in het medisch proces (SLIM project)	Internal memo	2013 <sup>6</sup>
Jury Report Value Based Healthcare Prize about the CMI project	Jury Report	2014
Evaluation Strategy AMC 2011 - 2015	Internal memo	2015

**University Medical Center Groningen (UMCG)**

Title	Source	Year
Medisch beleidsplan	Internal memo	2010 <sup>1</sup>
Document voorstel stafconvent	Internal memo	2010 <sup>2</sup>
Presentatie finance & control	Internal memo	2010 <sup>3</sup>
Evaluatie pilot Zorgportfolio (RvB)	Internal memo	2010 <sup>4</sup>
Handleiding Portfoliomatrix UMCG	Internal memo	2010 <sup>5</sup>
Jaarrekening 2010	www.umcg.nl	2010 <sup>6</sup>
Adviesnotitie Portfolio: verdere ontwikkeling van het model en borging in de PCB cyclus	Internal memo	2011
Jaarrekening 2013	www.umcg.nl	2013

**Ministry of Health, Welfare and Sport (VWS), Dutch Health authority (NZa), Netherlands Federation of University Medical Centres (NFU), Authority for Consumers & Markets (ACM)**

Title	Source	Year
Liberalisering electieve zorg	VWS	2004
Waardering voor betere zorg	VWS	2007
Waardering voor betere zorg II	VWS	2008 <sup>1</sup>
Waardering voor betere zorg III	VWS	2008 <sup>2</sup>
Voortgangsrapportage DBC's	VWS	2009 <sup>1</sup>
Advies uitbreiding B-segment	VWS	2009 <sup>2</sup>
Korting ziekenhuizen 2011	VWS	2010 <sup>1</sup>
Waardering voor betere zorg IV	VWS	2010 <sup>2</sup>
Bestuurlijk hoofdlijnenakkoord 2012 /2015	VWS	2011 <sup>1</sup>
Zorg die loont	VWS	2011 <sup>2</sup>
Voortgang invoering prestatiebekostiging	VWS	2012
Invoering prestatiebekostiging medisch specialistische zorg	VWS	2013
Curatieve zorg 2.0	Inspectie der Rijksfinanciën	2010
Publieke functies van UMCs in een marktomgeving	NFU	2006
University medical centers in The Netherlands	NFU	2008
Samenwerken en concurreren in de zorg	NMa (ACM)	2010
Advies stabiele transitie naar prestatiebekostiging	NZa	2008 <sup>1</sup>
NZa monitor 2008	NZa	2008 <sup>2</sup>
NZa monitor 2009	NZa	2009 <sup>1</sup>
Uitvoeringstoets van budget naar prestatie	NZa	2009 <sup>2</sup>
Voorlopig oordeel DOT productstructuur	NZa	2010

**Dutch press**

Title	Source	Year
Wat kost een blinde darm	Trouw	2008
Ziekenhuis gaat zorg selecteren	De Volkskrant	2008
Het zorgkostendebacie	Groene amsterdammer	2014

**Websites**

Organization	Source
Centraal Bureau voor Statistiek	www.cbs.nl
Zorgatlas	www.zorgatlas.nl
Zorgwijzer	www.zorgwijzer.nl
OECD	www.oecd.org

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# **Curriculum vitae**

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**Curriculum Vitae**

Drs. F.F. Asselman (1968) is a business economist and has worked as a senior staff advisor at the Academic Medical Center (AMC) in Amsterdam since 1999.

In 2003, he was project manager of a project called *Unit Cost Calculation*. This project took place between 2003 and 2006. In this project, a comprehensive hospital-wide unit cost calculation model and computer system were developed for the AMC. At that time, the AMC was one of the frontrunners of hospitals in the Netherlands on this topic. In January 2008, Franck published his book *Cost Calculation in Hospitals* that has led to much attention in the national media and positive reviews in various journals. In 2006, he became manager for the project *Patient Care Profiles*. The aim of the project was to design and implement a computerized case-mix information system for the top (medical) managers to support them in the different phases of the strategic management cycle: analyzing, decision-making, planning, monitoring, and legitimization. After finishing this project in 2013, he started working for the Strategy & Policy department, which included setting up alliances with other hospitals and the preparation of the intended merger with the Free University Medical Center (VUmc) in Amsterdam.

Franck is regularly a guest lecturer for several post-masters courses, including *Controlling in the Public Sector* and *Strategic Innovation in Cure and Care*. Furthermore, he is a trainer at management development programs and organizes management games. He has also published several articles in journals and newspapers.

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# Appendix 1

Examples of the Standard Report Patient Care

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### Appendix 1: Examples of the Standard Report Patient Care

The Standard Report Patient Care was designed for top (medical) managers in order to provide insight into the developments of the most relevant topics of patient care (see Section 7.3.1). The Report consisted of six chapters: Volumes, Patient characteristics, Production, Process, Finance and Health Care Market and was available at three levels: corporate (one), division (eight) and medical (sub) specialties (forty-seven). In total, the Report contained 39 different figures. Most figures consisted of an explanation (about data sources, definitions, how to use it), a graph, and a data table. In this Appendix, several examples of the graphs are presented and explained.

### Examples from chapter 1: Volumes

This chapter provided information about volumes of care products and patients. The volumes were presented in different ways like trends (past twenty-four months), forecast, the distinction between new and existing patients, and non-focus points, etc. In total, this chapter contained six different figures.

Figure 1.1: Actual and forecasted number of DBCs (\*)

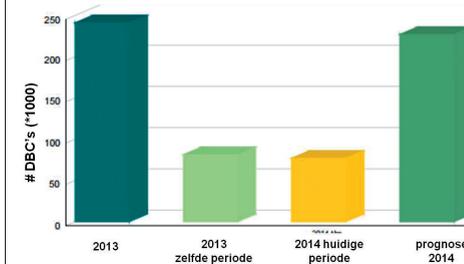


Figure 1.1 shows the actual and forecasted number of DBCs in the current year. The actual number of initial DBCs can be compared with the previous year. At the corporate level, the forecasted number of DBCs can be compared with agreements with health insurers and can give rise to increase or decrease volumes.

Figure 1.2: Number of initial and follow-up DBCs (\*)

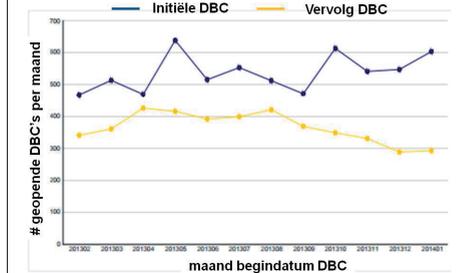


Figure 1.2 shows the number of DBCs started in the previous twelve months, broken down by initial and follow-up DBCs. The number of initial DBCs relates to patients with a new demand for care, the number of follow-up DBCs are existing demands for care.

Figure 1.3: Volumes per focus point and non-focus point (\*)

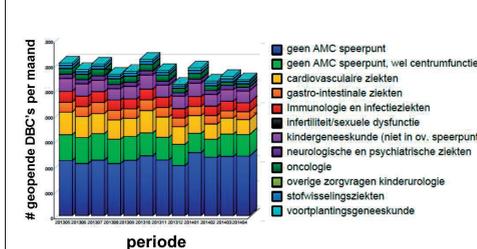


Figure 1.3 shows per month (x-axis) the number of opened DBCs (y-axis), broken down by type of focus point and non-focus point (in dark blue). It gives insight as to whether the intended strategic aims are realized.

Figure 1.4: Realization minimum volumes surgery (\*)

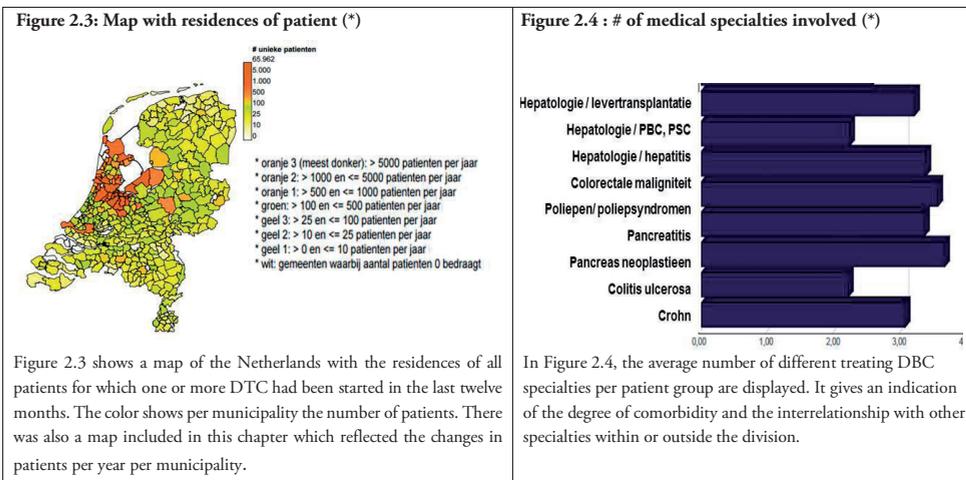
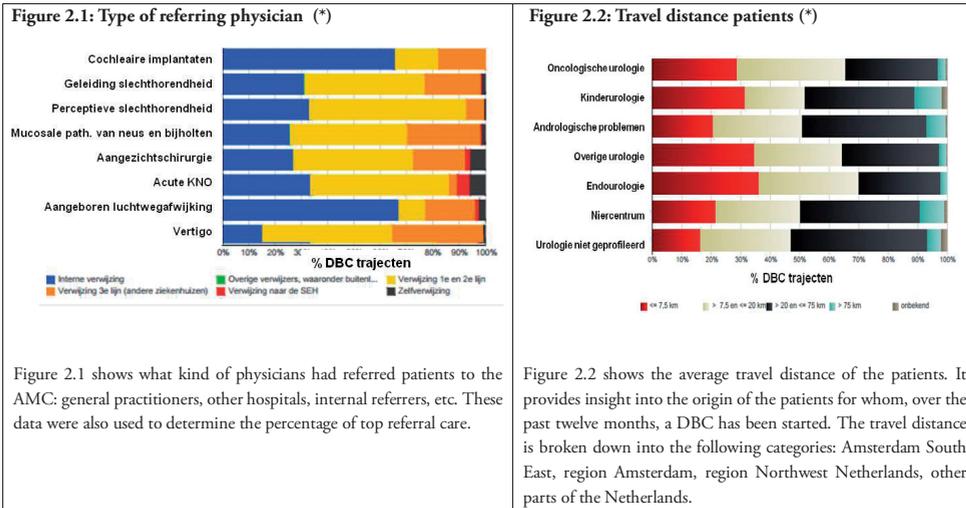
soort	Minimum-volume 2014	Trend 2014	afwijking trend/ minimumvolumes
Endoocrien: (bij)schildklier	20	64	Geen minimumvolume
Endoocrien: Bijnier	10	29	Geen minimumvolume
Gioca: Colitis Ulcerosa		49	Geen minimumvolume
Gioca: Crohn		88	Geen minimumvolume
Gioca: Lever	20	67	Geen minimumvolume
Gioca: Maag	20	13	-7
Gioca: Oesofaguscarcinoom	20	76	Geen minimumvolume
Gioca: Whipple	20	82	Geen minimumvolume
Mamma: Mammacarcinoom	50	9	-41
Trauma: bekken	20	42	Geen minimumvolume

Figure 1.4 shows, for the type of diagnosis / treatments where minimum volumes have been defined by the professional and / or health insurance, the forecast of volumes in 2013 versus the minimum volumes. If the forecasts of volumes are higher than the minimum volumes, the color is green, or otherwise red.

(\*) All figures contain fictitious data

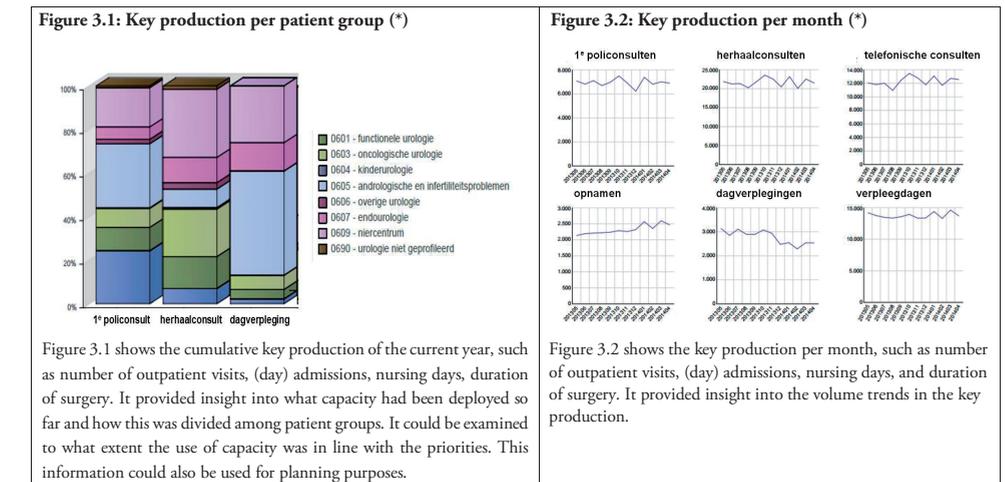
### Examples from chapter 2: Patient characteristics

This chapter provided information about the characteristics of the patients treated, such as travel distance to the hospital, age, referrer, and number of medical specialties involved. These characteristics were selected because they could be indicators for complexity of care. In total, this chapter contained six different figures. Below, some examples of the graphs are presented and explained.



### Examples of chapter 3: Production

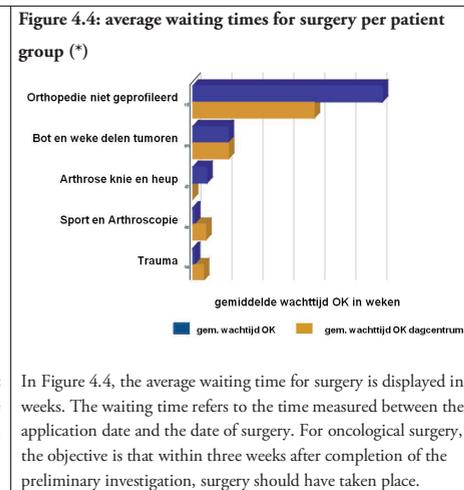
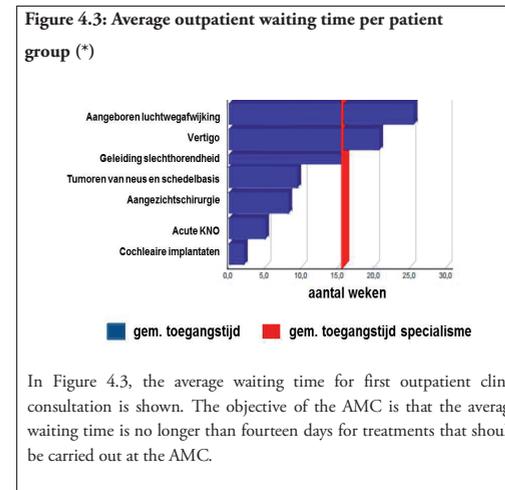
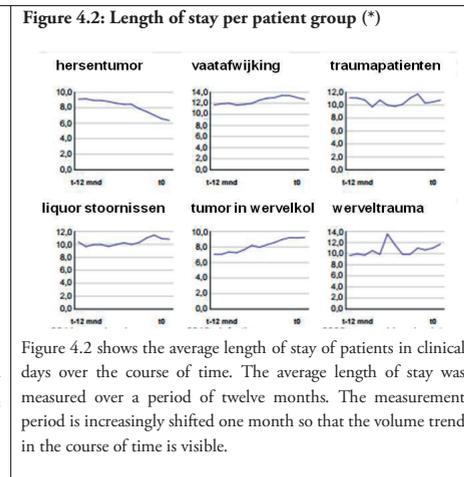
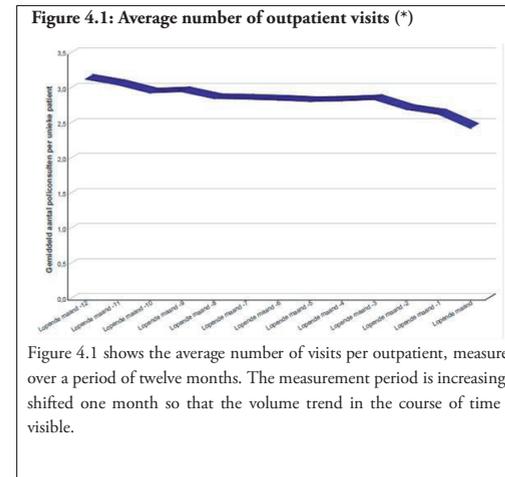
This chapter provided information about the key production of the polyclinic – clinic, operating room, and intensive care – such as number of outpatient visits, (day) admissions, nursing days, and operating time. It gave insight into what production was done and how it was divided between organizational levels and/or patient groups. In total, this chapter contained three different figures. Most figures consisted of an explanation (about data sources, definitions, how to use it), a graph, and a data table. Below, some examples of the graphs are presented and explained.



(\*) All figures contain fictitious data

### Examples from chapter 4: Process

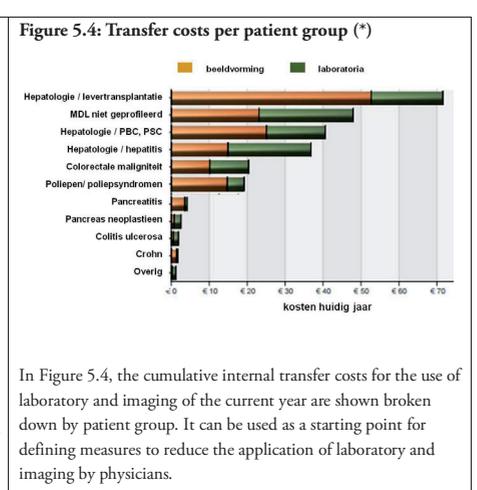
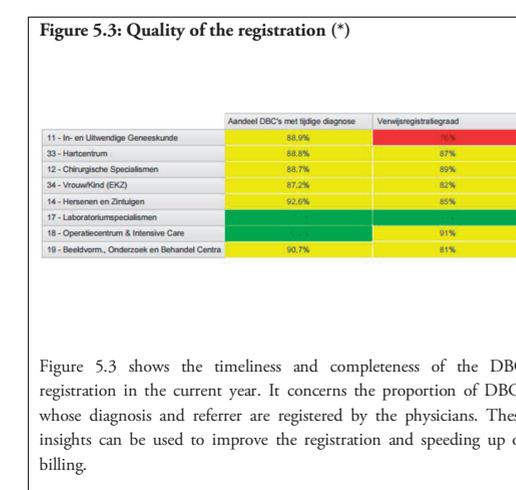
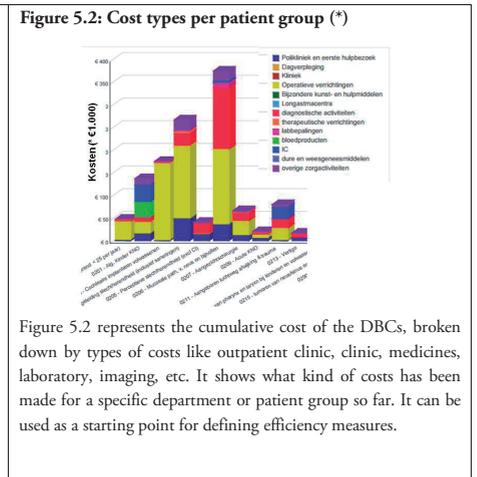
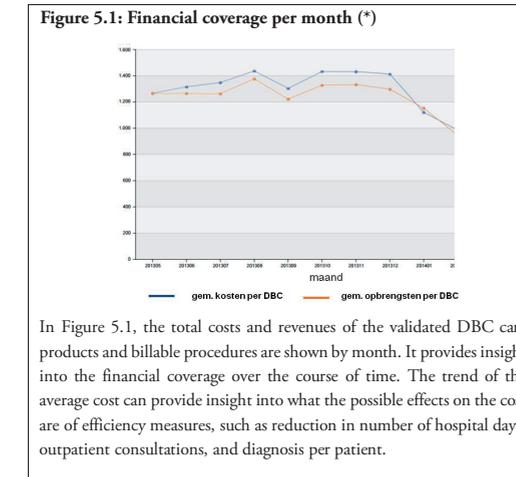
This chapter provided information about the process of care such as average length of stay, average number of outpatient visits, and waiting times for the outpatient clinic and surgery. In total, this chapter contained nine different figures. Most figures consisted of an explanation (about data sources, definitions, how to use it), a graph, and a data table. Below, some examples of the graphs are presented and explained.



(\*) All figures contain fictitious data

### Examples from chapter 5: Finance

Chapter five provides financial information about the patient groups and underlying care products, such as costs, returns, top five profitable/ unprofitable care products, and types of costs. In total, this chapter contained fifteen different figures. Most figures consisted of an explanation (about data sources, definitions, how to use it), a graph, and a data table. Below, some examples of the graphs are presented and explained.

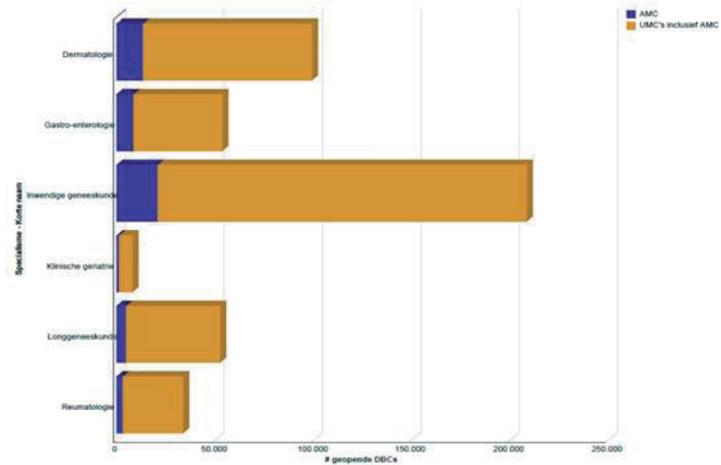


(\*) All figures contain fictitious data

### Example from chapter 6: Health care market

This chapter provided information about market shares per medical specialty or patient groups in the region or the whole country. In total, this chapter contained two different figures. Below, one example of the graphs is presented and explained.

Figure 6.1: Market share per patient group (\*)



In this figure, the market share per patient group is displayed based on the number of DBCs started. The figures are based on the national Dutch hospital data (DIS). The figure shows both the market share of the AMC compared to other university medical centers and compared to all hospitals in the Netherlands. These insights can, for example, be used for determination of the portfolio strategy and negotiations with insurers.

(\*) Figure contains fictitious data



The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every sale, purchase, and payment must be properly documented to ensure the integrity of the financial statements. This includes recording the date, amount, and purpose of each transaction.

The second part of the document provides a detailed breakdown of the company's revenue streams. It identifies the primary sources of income and analyzes their contribution to the overall financial performance. This section also includes a comparison of current revenue trends with historical data to identify any significant changes or patterns.

The third part of the document focuses on the company's operating expenses. It details the various costs incurred in the course of business operations, such as salaries, rent, utilities, and marketing. This analysis helps in understanding the efficiency of the company's cost management and identifies areas for potential savings.

The fourth part of the document discusses the company's profit margins and the factors that influence them. It examines the relationship between revenue, expenses, and net income, highlighting the impact of operational decisions on the bottom line. This section also includes a discussion on the company's pricing strategy and its effectiveness in maximizing profitability.

The fifth part of the document provides a summary of the company's financial position and outlook. It highlights the key findings from the analysis and offers recommendations for improving financial performance. This includes suggestions for optimizing revenue, reducing expenses, and managing risk.