Performance measurement of the Business Intelligence function
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**Cover:**

Like an athlete, organizations are continuously searching for improvements that optimize their performance. Athletes measure time to gain insight in their actual performance and to assess changes in their training. Accurate measurement is an essential first step in every optimization process. Optimization and assessment of the organizations Business Intelligence function, can only be successful if accurate measurement is organized.
Management summary

Despite the significantly increased attention and continuing growth of Business Intelligence application, there is a lot of discussion and criticism about the actual added value it delivers. The lack of insight in the added value of Business Intelligence can be overcome when Business Intelligence performance measurement is organised. The first and most common reason for measuring the Business Intelligence function is to prove that it is worth the investment. Business Intelligence managers need measures to justify their department’s existence. The second purpose for the measurement of Business Intelligence activities is to help to manage the Business Intelligence processes; which is, to ensure that the Business Intelligence products satisfy the users’ needs and that the processes are efficient.

The main goal of this research is to construct a comprehensive performance measurement framework which enables organizations to measure the added value of their Business Intelligence function. This framework reaches a level of detail which provides organizations with concrete performance indicators.

Based on the scarce literature which is currently available on performance measurement of the Business Intelligence function no valid model or framework was identified. Therefore additional research was done on more general performance measurement and general Business Intelligence organizational literature. To set a limit to the scope of the research the Capgemini Public definition of a Business Intelligence function was used as a starting point. The Business Intelligence function is a container term for all intelligence related activities which are carried out within the business process. These activities can be very diverse and they do not have to be identified or institutionalized as (business) intelligence activities within the existing organization. Another limitation was made on the examination level of the performance measurement framework, it is targeted to measure the performance of a Business Intelligence Competence Center (BICC). In practice a BICC consists of a cross-functional team which has a mandate to coordinate and strategically align all Business Intelligence-related initiatives.

A literature assessment on general performance measurement models proved that the value-for-money analysis is the best suited model for comprehensive performance measurement of the Business Intelligence function. Based on this model the existing literature on Business Intelligence performance measurement and organizing BICC’s is assessed according to the stages and processes of the value-for-money analysis. This led to a comprehensive framework which identifies what generic performance areas might be worthwhile measuring in the context of a BICC. After the theoretical setup the framework was validated and completed by Capgemini Business Intelligence experts based on their market experience. The resulting framework offers an extensive set of potential performance areas which can be tailored to a company specific BICC performance measurement model.

The validity and tailoring possibilities of the framework are tested against a business case. The DB(B)C FZ business case contains a Business Intelligence oriented project which was executed by a BICC like project team as an assignment of the Dutch Justice department. The team was tasked with the implementation of the diagnoses, treatment, security combination (DB(B)C) approach for all forensic care organizations.
Despite the fact that the business case has got a limited scope and does not verify the validity, completeness and measurability of the whole framework, it proves that the framework is a useful tool when identifying performance areas within a BICC. It offers a structural and catalyzing approach with recognizable generic performance areas which guide an organization towards their own tailored and comprehensive performance measurement model.

Downsides of the framework are the need for in-depth knowledge before it is successfully applied and the fact that the extensive set of measures encourages users to define non-relevant measures. These limitations can be overcome with training and a product by product approach when executing the tailoring process.

Further research is needed to prove the validity and completeness of the performance measurement framework. This research should focus on applying the framework to multiple BICC’s which vary in size and scope. Each application will validate the value of the existing performance measurement areas. Over time some areas will be proved to be irrelevant and new performance areas will emerge over time. Each revision of the framework will lead to a more stable and sophisticated approach.

The current performance measurement framework extends the existing literature with a renewing and practical concept for the comprehensive measurement of the Business Intelligence function. From a business perspective the framework can guide organizations to implement their own Business Intelligence performance measurement model that enhances the transparency of their Business Intelligence function and it creates insight in the actual performance.

This insight will uncover existing problem areas and it can be used to identify potential optimization areas. The cyclic approach structurally measures the effect of changes over time to assess the success and to uncover negative effects that occur on related performance areas. This knowledge can be used for further optimization and it supports the organization in defining their Business Intelligence strategy.

The insight can additionally be used to prove and assess the actual added value based on the initial business case. The assessment identifies whether target where met and if discrepancy occur the measurement model can be used to analyze the cause. This fact based approach will prove the actual success/ performance of the project which will probably convince the stakeholders of the projects success. The results can easily be shared across the organization and the detailed performance/success information on historical projects is a powerful sales tool.

The developed performance measurement framework does not pretend to be fully comprehensive and correct, but it is a first step towards a complete and validated solution for performance measurement of the Business Intelligence function. It has got a degree of scientific backing and it is assessed on a theoretical and practical level by Capgemini Business Intelligence experts and in a real world business case.

Hopefully the constructed Business Intelligence performance measurement framework provides a solid basis for further research, which will eventually lead to a practical and comprehensive framework which is widely adopted.
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**APPENDIX A - A GENERAL BUSINESS INTELLIGENCE IMPLEMENTATION** 101
1. Introduction

Since the early 1990s the use of Business Intelligence technologies has become widely spread across organizations worldwide. The fast increasing data volumes and a highly competitive business environment forced organizations to improve their Business Intelligence activities.

Many of the early adopters of Business Intelligence focused on the technical challenges which had to be addressed in order to create data warehouses and support fact-based decision making. This resulted in a strong technical approach towards Business Intelligences, which was mainly the responsibility of the IT department. As many of the technological challenges had been overcome and Business Intelligence awareness rose, organizations started to deploy Business Intelligence in other parts of their organization. Nowadays Business Intelligence is widely spread throughout almost all business processes within an organization and it has transformed from a technical tool into a strategic asset. Business Intelligence has become essential for organizations in order to manage and operate in an efficient and effective way. As Dresner et al. (2002) stated, Business Intelligence does not only help organizations to uncover problems, but also to discover (strategic) possibilities and enhance performance.

The appliance of Business Intelligence can be very diverse in today’s organizations and it is sometimes not even recognized as a Business Intelligence process. Therefore it is difficult to get a general understanding of the term Business Intelligence. The following example illustrates a typical case of Business Intelligence application to clarify the term.

The Dutch customs organization is tasked with the screening of container shipments in the Rotterdam harbor. 6.5 Million containers pass this harbor each year and it is impossible to screen every container for illegal goods like drug, cigarettes or fake designer clothes. As a result not all illegal goods are discovered and it is still tempting for criminals to illegally import goods. To discourage the illegal import the efficiency of the customs organization must be enhanced. With this target in mind a Business Intelligence solution is designed and implemented to support the organization in the container selection process. The system uses historical container data (like contents, destination, transport organization etc.) that is gathered by the container inspectors and the system combines it with other data sources. The data is stored systematically and analyzed based on statistical models. This eventually results in container profiles that have got a statistically higher probability to contain illegal goods. These profiles are used in the container selection process and the “hit rate” on illegal goods per screened container improves significantly. The system is self optimizing because it is continuously updated with the latest container picking information.

The basic process steps in a Business Intelligence system are: gathering data, transforming it into structured information and deducting knowledge like in the container screening case. More insight in the general implementation of Business Intelligence solutions is provided in appendix A.

A recent survey (April 2010) by Gartner uncovered that nearly 50% of organizations foresee that their Business Intelligence budgets will increase over the next 12 months. For the fourth year in a row, Business Intelligence applications have been ranked the top technology priority in the 2009 Gartner Executive Programs survey of more than 1,500 chief information officers (CIOs) around the world (Moore 2009).
These figures show that Business Intelligence is still a strategical differentiator and even more important when times are tough. It can help organisations find bottlenecks and inefficiencies or expose areas which are profitable. Gartner continues to see traction for solutions such as spend analytics, risk and fraud. According to Ian Bertram, Gartner’s managing vice president: "The rapid growth in information generated from enterprise applications, the popularity of metrics-driven business initiatives and the growing need for regulatory compliance will also continue to drive growth in Business Intelligence”.

Despite this significantly increased attention and continuing growth of Business Intelligence function, there is a lot of discussion and criticism about the actual added value it delivers. According to Gartner many organisations are still trying to get value from their Business Intelligence investments. Further investments by these organisations will be constrained until they determine how to get value from the investments they have already made. This statement underlines the theory that lack of accountability leaves the Business Intelligence budget unprotected against cost-cutting attacks (Davidson 2001, Flandin et al. 1992).

The previous paragraph indicates that there is a lack of insight in the way Business Intelligence delivers value to the organisation. One of the main reasons for this transparency lack is that the effects Business Intelligence is assumed to create consist primarily of nonfinancial, and even intangible, benefits such as improved quality and timeliness of information (Hannula & Pirttimäki 2003, Nelke 1998). The nonfinancial effects should lead to financial outcomes (e.g., cost savings) and there might be a time lag between the production of the intelligence and the financial gain.

The lack of insight can be overcome when Business Intelligence performance measurement is organised. The first and most common reason for measuring the Business Intelligence function is to prove that it is worth the investment (Sawka 2000). Business Intelligence managers need measures to justify their department’s existence. Similarly, executives need to know whether it is rational for them to invest in Business Intelligence, because it is still a rather new managerial discipline. (Davison 2001)

The second purpose for the measurement of Business Intelligence activities is to help manage the Business Intelligence process; which is, to ensure that the Business Intelligence products satisfy the users’ needs and that the process is efficient (Herring 1996). Namely, a Business Intelligence process can be costly if the gathered information is not accurate or does not match the information needs.

When applied effectively Business Intelligence performance measurement enables organizations to determine the benefits and effectiveness of their Business Intelligence function. It also provides insight in the progress which is made on the implementation of the Business Intelligence solution. It provides organizations with a basis for evaluating, comparing, controlling and improving their performance. Measurement also helps to advance leadership and to satisfy stakeholders
1.1 Research goal

The main goal of this research is to construct a comprehensive performance measurement framework which enables organizations to measure the added value of their Business Intelligence function. This framework reaches a level of detail which provides organizations with concrete performance indicators. These indicators can be used for calculations and strategic decision making. Ultimately the performance framework can be used to calculate and prove the added value that the Business Intelligence function delivers to the organization.

1.2 Central Research questions

In order to construct the Business Intelligence performance measurement framework, existing literature is examined and aligned to real world situations. The main research questions during this research and alignment are:

- What is Business Intelligence (function)
- What theory is currently available regarding:
  - Performance measurement of the Business Intelligence function
  - Performance measurement on a more general level
  - Business Intelligence measurement metrics
  - Added value models for Business Intelligence
- Is it possible to align the general and Business Intelligence specific theories into one framework which enables the measurement of added value of the Business Intelligence function?
- Is the resulting framework applicable and effective in real world situations?

1.3 Social and scientific relevance

As stated in the introduction there is a huge need for insight in the added value of the Business Intelligence function. There are continuous discussions which doubt or even deny the success of Business Intelligence as a strategical differentiator. Most of today’s companies assess the value and success of the Business Intelligence function based on subjective findings which live with a select group of employees. The lack of objective measurement feeds the discussion and endangers the position of the Business Intelligence function within the organization. According to a survey by Marin and Poulter (2004), only a few organizations have some metrics in place to measure the value of Business Intelligence.

In the Business Intelligence literature, authors have identified Business Intelligence performance measurement as an important task (Solomon 1996, Viva Business Intelligence Inc. 2000), but a common view among scholars is that it is difficult to carry out (Gartz 2004, Hannula & Pirttimäki 2003, Simon 1998). The executed literature research on performance measurement of Business Intelligence showed that there is currently very scarce literature available on this subject and that there is no comprehensive model or framework for measuring the full Business Intelligence process. In this research area the DeLone and McLean Model of Information Systems Success (2003) and the Competitive Intelligence Measurement Model (CIMM) (Davison 2001) are just the start of a comprehensive framework. Lönnqvist and Pirttimäki (2006) propose a balanced performance based measurement model as a potential measurement approach for the Business Intelligence function. They also stated that there is a lack of case studies to assess whether a balanced performance measurement model could be applied to the Business Intelligence function.
This research aims to set up a generic and comprehensive balanced performance measurement framework for the full Business Intelligence function. It will use existing literature and it will add the knowledge of Capgemini Business Intelligence experts in the areas which lack relevant literature. With this approach the research will contribute to the scarce scientific information which is available on this subject. In addition it will contribute to the requested case study information and practical findings on the subject of Business Intelligence performance measurement.

On the social level the resulting Business Intelligence performance measurement framework might be able to objectify the added value of a Business Intelligence solution. It may also give an enhanced insight in the performance of the Business Intelligence function within the organization.

Hopefully this enhanced ability to assess the added value of the Business Intelligence function, will temper the discussion and enable Business Intelligence organizations to prove their efficiency and importance to the organization.

1.4 Scope

Because of the dynamic nature of the Business Intelligence research field and the ongoing discussion about topics which relate to this research, it is necessary to set a strict scope.

First of all the scope is limited to the Capgemini Public Business Intelligence approach as the basic way for applying Business Intelligence to an organization. This might not be the ideal way for applying and organizing Business Intelligence, but it is a way which works at big government institutes and it sets a solid baseline for the research. Discussions about the approach are left out of the scope of this research.

The second part of the scope is the examination level in the research. It is limited to the Business Intelligence Competence Center (BICC) level. In practice a BICC consists of a cross-functional team which has a mandate to coordinate and strategically align all BI-related initiatives. More information about the BICC can be found in chapter 4 “The Business Intelligence Competence Center” of this research.
1.5 Approach

Our literature study showed that there is very little scientific literature available on the topic performance measurement of the Business Intelligence function. Because of the current lack in relevant literature, the nature of the research will be theory developing.

First of all the theory development is based on the limited Business Intelligence performance measurement theories which are currently available. In order to enhance the theoretical framework it is combined with the more general performance measurement theories and the existing theories on Business Intelligence performance metrics. To get a more in-depth view on the benefits which the Business Intelligence function delivers the theoretical measurement framework will be incorporated with existing added value models. During the literature research all relevant literature is plotted on the Business Intelligence approach which Capgemini Public recommends to its clients.

All steps of the literature research eventually lead to an integrated performance measurement framework for measuring the Business Intelligence function. In the next stage of the research this integrated framework is tested against one real world customer case in the public sector. Parallel to the business case the usefulness of the framework is assessed during interviews with Business Intelligence experts. The results of these two assessments will be analyzed, and general conclusions about the framework are drawn. These conclusions proved to be valuable inputs for improvement possibilities on the integrated performance measurement framework. This will eventually led to a more sophisticated performance measurement framework for measuring the Business Intelligence function.

The steps result in a research model which is drawn in figure 1

![Figure 1: “The research model for measuring the Business Intelligence function”](image-url)
2. Business Intelligence

There is a general understanding of Business Intelligence that it has to do with knowledge, information technology, business and analysis. Several definitions exist because Business Intelligence can be looked at from different perspectives. Each definition has its own perspective and a different focus. (Giessen 2008)

Some definitions highlight data extraction, transformation and integration or contain the terms “technology”, “tools” or “data warehousing”. For example the definition which is being used by The Data Warehousing Institute (TDWI) is:

“Business Intelligence is an umbrella term that encompasses the processes, tools, and technologies required to turn data into information, and information into knowledge and plans that drive effective business activity” (Eckerson & Howson 2005).

Although it is common to use technologies, tools and data warehousing to support its process, it is not the essence of Business Intelligence. Business Intelligence is essentially about information and about business knowledge. (Giessen 2008) Technologies and applications are the means through which data can be transformed into information and ultimately into business knowledge (See paragraph 2.1 Business Intelligence value creation). For example the Ghoshal and Kim (1968) definition stresses the business and information relevance of Business Intelligence:

“Business Intelligence (BI) refers to a managerial philosophy and a tool used to help organizations manage and refine business information with the objective of making more effective business decisions” (Ghoshal & Kim 1986).

In contrast to this definition there are other authors which leave out the aspect that Business Intelligence is about knowledge which helps to improve business performance. For example the definition:

“Business Intelligence is the process of turning data into information and then into knowledge.” (Golfarelli et al. 2004)

This is also technologically focused as it emphasizes the process of creating knowledge out of data and it does not define what kind of knowledge should be created.

Since this research is about measuring the performance of the Business Intelligence function as part of the organizations main business process, this research adopts a merged definition with a strong business perspective. It is all about the result which the Business Intelligence function eventually delivers to the organization. For this research Business Intelligence is defined as:

Business knowledge derived from analyzing an organizations internal and/or external information that can be used to improve effectiveness and/or efficiency of the organization. (Giessen 2008)

This definition is workable for the research and it also incorporates the possibility to use external information in addition to the internal information. This part is often left out of the definitions but can bring extensive benefits to the organizations Business Intelligence function.
2.1 The Business Intelligence value creation

The main goal of applying Business Intelligence within an organization is to create added value for the organization. In general the added value is not achieved directly by the Business Intelligence function itself but by the effect which the usage of the information has on the business when used. The value is created as a result of using the intelligence and carrying out actions based on it (Kelly 1993). Kelly also recognized the conditional nature of the value of Business Intelligence, as the information must be integrated into a decision or choice in order for its value to be materialized.

Many of the effects which Business Intelligence is assumed to create consist primarily of nonfinancial and even intangible benefits, such as improved quality and timeliness of information. These nonfinancial effects should as much as possible lead to financial outcomes (e.g., cost savings, increase revenue/profit), there may be a time lag between the production of the intelligence and the financial gain. (Hannula & Pirttimäki 2003, Nelke 1998).

In practice the goal of the Business Intelligence function is to support the organization with information products which provide enhanced business insight. It enables decision makers to make better choices and take more successful actions. In most literature the insight is called knowledge. Knowledge is “actionable information” which allows us to make better decisions (Jashapara 2004) or gain insights (Loshin 2003). This occurs by “providing information at the right place, at the right time and in the appropriate format” (Jashapara 2004, Tiwana 2000).

The succession of steps within a Business Intelligence process which leads to knowledge are: turning data into information, then into knowledge. Roughly comparable processes are described by several authors (Beek 2004, Hamer 2005, Philips & Vriens 1999).

The following differences between data and information should be considered:

- Data are “known facts or things used as a basis of inference or reckoning” (Jashapara 2004)
- Information can be considered as “systematically organized data” (Meadows 2001) or data which is endowed with meaning, relevance and purpose (Jashapara 2004).

Figure 2 shows the described knowledge creation process
3. The Business Intelligence function

As mentioned earlier the scope of this Business Intelligence performance measurement research will be limited to one approach for applying Business Intelligence to organizations. The approach which will be used is the Capgemini Business Intelligence approach for the public market. The last four years this approach is successfully implemented within multiple organizations of the Dutch government.

The top level concept within the Capgemini approach is the Business Intelligence function. The Business Intelligence function is a container term for all intelligence related activities which are carried out within the business process. These activities can be very diverse and they do not have to be identified or institutionalized as (business) intelligence activities within the existing organization. They can be informal and widely spread in the business process.

As mentioned in the previous chapter Business Intelligence does not create value by itself. It only delivers added value when it is incorporated in choices and actions of the business. The same goes for the Business Intelligence function, its products are designed to support decisions within the business process. The business process uses these products to optimize the influence on the environment of the organization, which can lead to additional value creation. The influenced environment and the goals of the business process can be very diverse, like delivering products and service to a customer or delivering products and services to other processes within the process chain.

Figure 3 shows the position of the Business Intelligence function within a certain business process and influenced environment. The arrows stand for the influencing forces between the different processes. It shows that the Business Intelligence function can only influence the overarching business process and vice versa. The business process on the other hand can influence the environment (for example the government or a customer) and other related business processes. The figure gives insight in the indirect way the Business Intelligence function influences the external processes and it underlines the statement that a Business Intelligence function has no direct influence outside the business process.

![Figure 3: “The Business Intelligence function within the environment”](image)
The organization of the Business Intelligence function is divided into three major views (figure 4) (Arntz & Mol 2009).

The first view is the usage of the Business Intelligence environment; it is all about using the results of the Business Intelligence products within the upper level business processes of the organization. This usage will create the actual added value of the Business Intelligence function. The production view is focused on enhancing the existing Business Intelligence products. Based on questions which arise in the usage view, new information products will be developed or existing products are adjusted according to the users’ needs. The management view covers the governance of the Business Intelligence function. It is responsible for the strategic decisions and aligning the usage and production view.

The next three paragraphs will provide more detailed information on the three views of the Business Intelligence function.

### 3.1 Business Intelligence usage view

The main goal of the Business Intelligence usage within an organization is to supply advanced business knowledge to decision makers which enables them to make better choices leading to successful actions. This enhanced ability will eventually lead to more added value which the business process delivers to the organization. Turning the business knowledge into choices, hence into action is outside of the control of the Business Intelligence function itself. However, as stated in paragraph 2.1, these steps are essential to give insight in the effects which the Business Intelligence function delivers to the business process and the organization. This is why these steps are put into the scope of the usage view.

The process of turning knowledge into choices into action is designed to positively affect the scope of the Business Intelligence usage view. Based on this scope the desired objectives, like enhancing the organizations effectiveness and efficiency, can be set and measured. These measures provide an improved insight which enables the decision maker (actor) to make better decisions. In the end, the usage process can start over again in order to observe and interpret the effects which occur after the decision is made and actions are taken. This new knowledge can lead to new choices and actions which improve the business performance. This vicious cycle is known as the regulation circle (Veld 1985) and was adapted by Arntz and Mol (2007) to the Business Intelligence appliance cycle as visualized in figure 5 (Giessen 2008).
The vicious decision making cycle from an actor’s perspective contains four phases:

**Observe**
Observation of what is happening or has happened in the previous phase. In this phase the data is collected and processed into information as it is being organized systematically. Afterwards it is endowed with meaning, relevance and purpose. Technical solutions for observation and storage like data warehousing and the extract, transform and load (ETL) process for data collection and transformation can be used to support this phase.

**Interpret**
Subsequently the information which is available is being turned into knowledge when it is interpreted for decision making. Analytical tools and methods like reports, spreadsheets and data mining can be used to support the interpretation phase.

**Choose**
Choosing what influence should be exercised with the gained knowledge is the third phase. Although not part of the actual Business Intelligence process, this phase is essential for creating value out of knowledge as its goal is to influence the scope.

**Act**
Take action / exercise influence based on the decision made in the previous phase in order to influence the actor’s scope is the last phase of the decision making cycle of Arntz and Mol (2007).

Business Intelligence covers the observation and the interpretation phase and, when applied effectively, it increases or improves influence which an actor has on his/her scope in order to optimize the chance to realize the actor’s objectives.

The Business Intelligence appliance cycle is not a closed system, some changes in the scope and decisions are based on external sources. To fully understand these changes the external information and external influences must be taken into account.
External information is information which the decision maker takes into account during the decision process, but this information is not part of the scope and potentially not part of the Business Intelligence system. The decision maker can for example use macro economic trends to enhance the quality of the decision.

External influences are changes to the scope which are not the result of decisions and actions within the appliance cycle. For example big resilience measures at the government can influence the result of a consultancy firm. These changes inevitably happen to the scope and are outside of the control of the decision maker. They can have positive or negative effect on the scope. When optimization of the appliance cycle is done, insight in external information and external influences is essential in order to make the right changes within the cycle.

**The appliance cycle scope**
The scope which is covered by the Business Intelligence appliance cycle strongly depends on the objective that is set and the (organizational) view of the actor and vice versa. If the objective is to enhance the number of sales company wide, a marketing manager has got the ability to influence sales on a general level. He can setup a marketing campaign to promote the company brand. The scope of the marketing manager in this case will be all company sales because he is able to influence it and he is responsible for it. If a sales person has got the same objective, the scope will be different. If he is responsible for selling tents, he can only influence tent sales within the company’s sales strategy. He can for example increase sales by actively accompanying and advising customers during a showroom visit. The scope of the sales person will be only the tent sales within the company.

Like in the example there are multiple Business Intelligence appliance cycles within each organization. Appliance cycles can be defined on the same level besides each other, but they can also be nested like in the previous example. The nesting of appliance cycles is unlimited like the box in a box, “Droste effect” (Veld 1985)

Figure 6 shows an example of multiple appliance cycles within a certain scope.

![Diagram of multiple appliance cycles](image)

**Figure 6: “Multiple Business Intelligence appliance cycles - Droste effect”**

Although there are a great number of Business Intelligence appliance cycles within an organization, it is not recommended to define and measure them all to get a clear view on the performance of the Business Intelligence appliance. The costs of defining and measuring an appliance cycle must be weighed against the benefits which the process performance insight delivers. A company must choose a smart grain for measurement when defining appliance cycles (Arntz & Mol; 2007).
3.2 Business Intelligence production view

The production view is organized to produce the information products within the Business Intelligence function. It is a set of process cycles which respond to intelligence related questions that arise within the usage view. A Business Intelligence production cycle contains three layers which are necessary for the production of the new and enhanced information products. It is a conceptual model which is technology and platform independent.

The production cycle is organized to respond to two types of information requests. The first type is the structural information request, this type of question repeats on a regular basis. The production of this information product must be optimized for a fast and efficient response. This will generally lead to structural changes in reports, models and data sources. The second type is the ad-hoc information request; this request leads to a custom made information product. The product is composed by hand and does not lead to changes in the production infrastructure. Repeating ad-hoc information requests can eventually lead to structural information request.

Figure 7 shows the layers of the development cycles including arrows which indicate the process flow (Arntz & Mol 2009).

Questions and Answers

The first process step is the interpretation of information request (question). This leads to the specifications of the information product and underlying model(s). When the underlying model(s) become available the information product will be created. An information product can have many appearances like lists, tables, graphs and OLAP cubes.

Models

A model is a (re)structured representation of the relevant data that enables answering the question(s), it is designed to provide the information product with consistent and correct data. It can be reused for multiple information products and its goal is to simplify the data access and endow the data with meaning. Based on the specifications, a model can be created on existing data or it might require new data.

Data

The data layer contains the actual facts which must be gathered to feed the models with information. It captures the business process information and stores it for reuse in multiple models. Based on specifications the data layer can be extended with new data capture capabilities.
3.3 Business Intelligence management view

The management view is designed for the governance of the Business Intelligence function. The main task is to align the Business Intelligence function with the strategic goals of the organization. It translates the strategic goals into operational decisions which shape the Business Intelligence function.

Within this role the management view is responsible for organizing the usage and production view. This encompasses getting the organization, resources, tools and processes in place to support the business process with useful information products.

On a more operational level the management view is responsible for the alignment of the usage and production views. It prioritizes the questions which arise within the usage view and assigns the appropriate resource to the request for production. It monitors the type of requests that arise and assess it to the production capabilities. If possible and reasonable, enhancements to the production will be initiated in order to increase the capabilities and efficiency.

Another task is organizing and facilitating the metadata management. Metadata is essential for a correct production and usage of the Business Intelligence products; this is why the two views share the same metadata basis. The management view is responsible for the metadata management as it is part of the view alignment tasks. The creation of metadata is not exclusively executed as a task of the management view; it will also be done by the usage and production view.

The three views together result into the detailed Business Intelligence function which is shown in figure 8 (Arntz & Mol 2009).
4. The BI Competence Center (BICC)

A Business Intelligence function, as described in the previous chapter, can cover multiple business processes within diverse organizational areas. In essence the Business Intelligence function is interwoven with all business processes were intelligence is used for decision making. Every activity which is executed to produce the intelligence is, within the Capgemini definition, part of the Business Intelligence function. Traditionally the wide spread use of the Business Intelligence function led to a spread implementation of the Business Intelligence function. Departments and divisions have deployed Business Intelligence on their own, resulting in a variety of tools and technologies. Eventually information silos emerged that caused several problems. (Giessen 2008)

Choosing and implementing the right Business Intelligence tools and technologies is only one part of the formula for Business Intelligence success. Most Business Intelligence projects must integrate the requirements, data and priorities of multiple organizational units, which requires unique skills. However, most organizations have difficulty finding people with the right skills, situating them in the right place and leveraging available skills across projects and business units (Strange & Hostmann 2003).

Capgemini has gathered best practices while implementing Business Intelligence solutions and organizations within multiple companies. One of the most important best practices is the implementation of a Business Intelligence competence center (BICC) as the central organ for the execution of the Business Intelligence function. A BICC will help an organization to overcome the described problems which are related to the spread use and development of the Business Intelligence function.

Within the literature multiple definitions of the BICC exists, proposed by vendors, agencies or specialist journals. These definitions vary in focus and perspective. Giessen (2008) has analyzed multiple definitions of the BICC and combined the relevant parts of each definition in order to get a clear and comprehensive definition which is workable for the Capgemini organization. This led to the following definition:

*A BICC is a cross-functional team, in which different complementing competences, insights and perspectives are combined. It has specific tasks, roles, responsibilities and processes and a permanent formal organization structure. The BICC has a mandate to coordinate all Business Intelligence related initiatives and its overarching goals are to align Business Intelligence with the organization’s strategy and objectives to strategically leverage the benefits of Business Intelligence by supplying, supporting and promoting effective use of Business Intelligence across the organization.*

This merged BICC definition is based on the BICC definitions from Miller (2006), Dresner (2002) and Buytendijk (2001).
Giessen (2008) has identified multiple benefits which a BICC can deliver to an organization:

**Increased understanding of the Business Intelligence value**

The central approach will help the management and users to understand the importance of a robust and agile Business Intelligence infrastructure. Because the BICC is a formal organizational unit it enhances the executive’s insight in the critical role which Business Intelligence plays. The BICC can provide training and support to business users, which helps the users to know what data sources, technologies and techniques to use for analyses in order to ensure its effectiveness.

**Strategic business/IT-alignment**

The central BICC approach improves the alignment of Business Intelligence strategy with business strategy, because platform choices, development and supervision are organized centrally. The centralized management makes it less difficult to standardize technologies, data collection and data integration, hence easier to align different Business Intelligence deployments with each other. As a center of expertise a BICC can offer recommendations about what to use and how to use it. This improves effectiveness and increases user adoption because tools and technologies are better aligned with user needs and skills.

**Reduction of project risks**

A BICC can mitigate risks because it is responsible for coordinating and prioritizing between projects and divide (scarce) resources. It can establish best practices because people, technologies and processes are being centralized; hence success rates of Business Intelligence initiatives can be increased, risks can be mitigated and effectiveness and efficiency can be improved.

**Effective communication**

A BICC is a bridge between business, analytics and IT. Because it consists of members from different parts of the organization it is easier to set a common frame of reference and get the stakeholders aligned.

**Understanding of analyses**

By supporting business users to understand analyses and analytical results of (advanced) analytical products like predictive modeling and data mining, the effectiveness can be leveraged and added value can be created.

**Effective appliance and sharing of knowledge**

Because Business Intelligence is centralized in a BICC the knowledge sharing between Business Intelligence experts is being enhanced and it is easier for other members of the organization to access the knowledge.

**Culture**

A BICC has a mandate to coordinate all Business Intelligence related initiatives, which delivers them power and a central role within the organization. This way it is less difficult to enhance the fact-based decision making culture, overcome political frictions and act according to the strategy and in the best interest of the organization. Furthermore BICC’s can drive and support efforts for improving organizational culture and attitude towards Business Intelligence and the BICC. Effectiveness, technology adoption and working methods can enhance an organization wide innovative attitude and sharing openness.
Improved data quality

Data is “the heart” of the BICC and it is tasked with the management of data and its quality in order to ensure a solid basis for the delivery of Business Intelligence, hence decision making. The quality data is essential for the existence of a BICC.

Organization wide adoption and value delivery

The BICC standardization supports improvement of data quality and consistency which leads to improved decision making quality. The increased information quality and combined expertise of BICC members will increase user adoption. It becomes easier to deploy Business Intelligence across the entire organization and analysis possibilities improve as more parts of the organization apply Business Intelligence.

Because of the generic approach and the benefits which a BICC can deliver to an organization, the scope of this research will encompass the creation of a performance measurement framework which applies to a BICC. The research examines what kind of generic performance measurement framework is applicable to the generic organization of a BICC. Main goal is to measure the performance of the BICC in relation to the delivered value. Chapter 6 will go into more detail on how a generic BICC should be organized and which performance areas arise from the performance measurement framework.
5. Performance measurement models

To get a general understanding about how a Business Intelligence function delivers value to the organization, it is important to get insight in the underlying value creation process. All parts of the Business Intelligence function are there to eventually deliver added value to the business process and the organization. This chain of parts is organized in a way that it builds up an asset which will have an effect on the organization at the end of the chain. This effect can result in added value for the organization.

5.1 Performance measures

The process of the value creation can be assessed by defining measures on key aspects of the Business Intelligence function. This will be called a performance area.

A measure can have different appearances to express the value of assets or processes. The basic forms which are applicable to Business Intelligence are numbers, hours, money and percentage.

- Numbers are about countable actual things like realized products, trained end users.
- Hours are about time related aspects like hours spent on user training, available development hours.
- Money is about financial means like available budget and total development costs.
- Percentage (%) quantifies progress, like product percentage completed.

5.2 Basic ways to collect performance measures

Due to the complex nature of performance measurement it is not always clear how its performance can be measured. Sometimes it is quite difficult or impossible to measure the performance of the aspect itself. For example the value of information is very difficult to assess. (Kilmetz & Bridge 1999) In these situations an alternative way for the performance measure collection is needed.

According to Kemppilä and Lönnqvist (2003) there are four different ways for measuring the performance. Each measure is based on direct or indirect collection approach of an objective or subjective aspect.

The distinction between direct and indirect measures lies in the factor of the object which is measured. Direct measures are directly collected on the object itself. In the cases where direct measures are not logical or feasible, indirect measurement can be applied (Kaydos 1999). Indirect measurement encompasses the identification of a factor which is somehow associated with the primary factor. This indirect factor can be measured as an assessment of the primary factor.

The distinction between objective and subjective measures depends on whether they are based on quantitative data on operations or, alternatively, on beliefs, perceptions or attitudes. Subjective measures can for example be assessed with a five point Likert scale which tests the opinion of an end user in a survey.
Figure 9 shows all the buildup possibilities of a performance measurement metric.

![Diagram of performance measurement metrics]

**Figure 9: “The buildup of a performance measurement metric”**

The first and probably most basic way is to use a direct measurement approach in combination with an objective measure. In these cases the performance measure is directly applied to the measurement object with a quantitative and operational measure of the aspect. One example of a direct objective measure is number of products produced as a measure for the production performance.

A second way is the use of a direct measurement approach in combination with a subjective measure. With this type of performance measures collection a subjective assessment is done on a direct aspect of the measurement object. This can for example be a survey among employees about the production performance. They are asked how the production performance is affected in their opinion.

The third way is the indirect performance measurement approach in combination with an objective measure. In this case the associated factor is assessed based on an objective measure. In the production performance example it is possible to measure the unused capacity of a production facility. This unused capacity shows how well the production process is able to exploit resources. Better exploitation will deliver an enhanced production performance.

The fourth way of measuring is the indirect performance measurement approach which collects a subjective measure. In this approach the associated factor is assessed based on a subjective measure like a survey result. The production performance can for example be measured by asking the employees how well the production means are exploited in their opinion.
5.3 What should be measured?

As stated in the introduction the goal of this research is to construct a comprehensive performance measurement framework which enables organizations to measure the added value of their Business Intelligence function. According to Kaydos (1999) anything can be measured to a useful degree, especially in a business environment. The real question is not whether something can be measured, but whether it is worth the effort and money to do so. This indicates that smart choices must be made when selecting performance measures for the Business Intelligence function.

In the past a lot of research has been done in the area of selecting measures and composing measurement models and today it is still an object of vivid discussions. Overtime the performance measurement research led to the introduction of generic performance measurement approaches. These approaches identify areas where the performance should be measured in order to get a balanced view on the overall performance. The use of a generic performance measurement can guide this research in creating a comprehensive framework with measures which prove to be worthwhile measuring.

The next chapters will describe and assess two performance measurement models which can be used for the performance measurement of the Business Intelligence function.

5.4 The balanced scorecard

One of the most popular ways to gain insight on the performance of an organization or a process is the balanced scorecard approach. The balanced scorecard is a strategic performance management tool which can be used by managers to keep track of the execution of activities by staff within their control and monitor the consequences of these actions. The balanced scorecard tacks a mixture of financial and non-financial measures each compared to a 'target' value. Besides the financial performance, there are three non-financial categories: Customer, Internal Business Processes and Learning and Growth (figure 10).

![Figure 10: “The balanced scorecard”](image-url)
Kaplan and Norton (2004) described the categories as:

**Financial**

Financial performance is a lag indicator which provides the ultimate definition of an organization’s success. The Strategy describes how an organization intends to create sustainable growth in shareholder value.

**Customer**

Success with targeted customers provides a principal component for improved financial performance. In addition to measuring the lagging outcome indicators of customer success, such as satisfaction, retention and growth, the customer perspective defines the value proposition for targeted customer segments. Choosing the customer value proposition is the central element of strategy.

**Internal business process**

Internal processes create and deliver the value proposition for customers. The performance of internal processes is a leading indicator of subsequent improvements in customer and financial outcomes.

**Learning and growth**

Intangible assets are the ultimate source of sustainable value creation. Learning and growth objectives describe how the people, technology, and organization climate combine to support the strategy. Improvements on learning and growth measures are lead indicators for internal process, customer, and finance performance.

The objectives in the four perspectives link together in a chain of cause-and-effect relationship. Enhancing and aligning intangible assets lead to improved process performance, which, in turn, drives success for customers and shareholders.

Although the balanced scorecard is very popular within big European, American and Asian companies, it is frequently criticized by experts. One of the biggest concerns is that it does not paint the whole picture. The focus on just four categories leaves out some important organizational influences. One example is the environmental influence on the organization. The balanced scorecard is internally focused and assumes that all the added value is the result of the internal optimization. It leaves out important external factors like economic downturn when assessing the created result.

Another downside is the lack of traceability within the method. It tends to be a cause-and-effect model, but a causal link between the different categories and their measures is not covered in detail. A strategy map (Kaplan & Norton 2004) covers a part of the causal asset building process, but it is not detailed enough to give insight in the relation between measures. The same lack of traceability applies to the translation of strategical balanced scorecards towards more operation levels in the organization. On each organizational level the parent scorecard is translated into one or more level specific scorecards. This translation is done free format by the organizational unit and there is no clear linkage with the measures on the parent level. This way it is impossible to accumulate measures and define useful calculations. Because of the lack of traceability in the value creation chain the research is extended towards other performance measurement models with a clear focus on the causal effect.
5.5 The value-for-money analysis

A general value creation model for identifying and measuring the value creation chain is the value-for-money analysis (Mol 2004). It aims to disclose the causality between financial and non-financial input and the added value which is created. It gives insight in the processes which are used to do so.

The analysis categorizes performance indicators by stages of the production process: funding, (non-financial) input, output and effect. This model is commonly used by the Dutch government, like for instance in the new public management approach: “Van Beleidsbegroting Tot Beleidsverantwoording” VBTB (From Policy Budget to Policy Justification). The model is popular because it is designed to measure financial as well as non-financial effects. Whereas most of the government’s objectives are non-financial this model suits them better than other more financially orientated models.

Figure 11 shows the value-for-money analysis.

![Figure 11: “The value-for-money analysis”](image)

Within the value-for-money analysis there are four stages which contain a certain type of asset. Step by step the asset is transformed from one type of value into a new type of value. The types are:

**Funding**
The value creation process starts with funding. These are the financial means which need to be available to set up and execute the value creation process. Funding can be raised based on a budget assignment by the organization or based on revenues which originate for earlier information products.

**Input**
The next type of asset is input. Input contains the production means which need to be in place to create the products of the value creation process. Inputs used in production include buildings, machines, tools, staff and intermediate products.

**Output**
Outputs are the actual products which the value creation process delivers. These can be finished products which are delivered to the organization, like new report options and dashboards. Other products which are part of the output are intermediate products. These products do not leave the Business Intelligence functions processes and are used as new input means to improve the productivity.

**Effect**
At the end of the value creation process the products will have an effect on the organization. This effect will change the capabilities of the organization and enables them to create added value.
The transition from one type of value into another type of value is an important driving factor for the amount of value which is created by the process. Well organized and optimized transitions will enhance the added value for the organization (more value-for-money).

There are three types of transitions in the value-for-money analysis.

*Economy*
This transition turns financial means into production means. A good organized economy transition delivers the production means at low financial costs. Task like vendor contracting and hiring personnel are part of the economy transition.

*Efficiency*
The efficiency transition turns production means into (intermediate) products. This transition is about planning and assigning the right resource for a specific task. A higher efficiency can also be realized by defining the right intermediate products and reusing them in a smart manner.

*Effectiveness*
Effectiveness is the transition from products to the actual effect in the organization. A good effectiveness can be achieved when the information exchange between the business and the Business Intelligence function is optimized. This way the Business Intelligence function will know what to build and the customers will know how to use the products.

The value creation process is organized to create a certain effect in the organization. This effect is the last stage in the model. In a real world situation the effect value is not solely the result of all subsequent steps of the model. External influences can change the effect which will eventually appear in the business process. It is important to understand these external influences when optimizing the value creation process. This is why the model defines two types of effects, the endogenous effect and the exogenous effect.

*Endogenous effect*
The endogenous effect encompasses the effect which is the result of all steps within the value creation process. It contains funding, economy, input, efficiency, output and effectiveness. This effect can be used for the optimization of the value creation process.

*Exogenous effect*
The exogenous effect is the combination of all external factors which influence the effect in the business environment. Examples of exogenous factors are: political changes, economical changes, social changes, technical changes, environment factors and changed rules and regulations

Within the value-for-money analysis there are two types of results which assess the success of the value creation process. The first measure is the financial result and the second one is the enterprise result. The financial result is internally focused and assesses the steps from funding up until outputs. This result determines how well the process was able to change funding into actual products. The result can be used to optimize the value creation process.
The enterprise result covers all steps of the value creation model. This result determines how well the value creation process is organized and aligned with the business process. This result can be used to optimize the alignment between the business process and the value creation process.

Every value-for-money analysis has got a specific scope. This scope can for example be a process or an organizational unit, depending on the target of the measurement. The simple and uniform way of determining the added value causality between the process types makes comparisons between value-for-money analysis results possible. A top level value-for-money model can be easily divided into one or more detailed value-for-money analyses which give more insight in the asset building process. Because of the strict and simple structure it is possible to rollup detailed value-for-money analyses into a single value-for-money analysis which covers a broader scope.
5.6 Business balanced scorecard versus Value-for-money analysis

The previous paragraphs give insight in the characteristics of the balanced scorecard and the value-for-money analysis. It shows that both methods use a causal model for determining measures which give insight in the performance of a process. When the content of both models is compared, it shows that there are some similarities in the way they measure the process. (figure 12)

The financial performance category of the balanced scorecard is similar to the funding stage and the financial part of the effect stage in the value-for-money analysis. Internal business process and the learning and growth categories are covered by the measures in the input and output stage. The customer category is covered by the customer specific measures in the effect stage.

Figure 12: “The value-for-money analysis vs. business balanced scorecard”

As the model comparison shows, the value-for-money analysis covers a broader view on the process than the balanced scorecard. It covers all categories of the balanced scorecard and in addition it covers the exogenous effect. This exogenous effect is essential when the added value of the Business Intelligence function is assessed. The usage view of the Business Intelligence function (paragraph 3.1) underlines this importance as it identifies two categories of exogenous effect: external information and external influences. These forces influence the scope (business result) outside the influenced environment of the Business Intelligence function. This is why a fair assessment of the added value is only possible when the relevant exogenous effects are identified. This is an important benefit of the value-for-money analysis over the balanced scorecard.

Another benefit is the traceability of the value-for-money as it is a straightforward and simple approach which can be applied top down or bottom up within processes and organizational units. For example funding on a process level is the same as the funding within another process. The funding of all processes together will be the same as the funding of the overarching Business Intelligence function. This straightforward approach makes the model controllable and traceable.

The last benefit in favour of the value-for-money analysis is the adoption in the public market. It is well known by Dutch government organizations, as it is part of the VBTB management approach. For this reason it has got a good fit with the Business Intelligence approach for the public market.

Because of the previous aspects the value-for-money analysis is adopted as the appropriate approach for this performance measurement research.
6. BICC value-for-money analysis

As stated in the introduction, there is currently no comprehensive model or framework available for the performance measurement of the Business Intelligence function. The scarce literature which is available on this subject covers only small parts of the solution or suggests a high level approach. Unfortunately the underlying business cases are seldom found. The aim of this research is to align and extend the current Business Intelligence performance measurement knowledge into a comprehensive framework.

The first step in defining the comprehensive performance measurement framework is setting the scope of the framework. The value that Business Intelligence delivers has a conditional nature (Kelly 1993) therefore an essential question to ask is value to whom? Before the performance measurement framework can be deployed the stakeholders and the associated business interested must be identified. The scope of this research is limited to the performance measurement of an organization which has got a BICC in place for their Business Intelligence function. This way it is possible to identify generic stakeholders and processes.

To assure that the performance measurement framework covers all relevant aspects of the BICC, the value-for-money analysis is used to identify the areas which drive performance. This approach helps to ensure that all the BICC processes from funding up until the actual effect are assessed within performance measurement framework.

The next paragraphs will apply the value-for-money analysis on a generic BICC organization which fulfills a companywide Business Intelligence function. Each stage or transition identifies the processes and asset areas which might be relevant to a BICC organization. This identification is based on the literature which is currently available on the subjects of Business Intelligence performance measurement and on organizing a BICC.

Because of the scarce literature resources the emerging framework is far from complete. Therefore the framework is supplemented with the business knowledge of Capgemini Business Intelligence experts. These experts have got years of experience in organizing and applying Business Intelligence within big international companies.

Each paragraph starts with a textual description of the identified performance areas and its contributing sources. Afterwards a “mind map alike” figure is shown to give insight in the areas and their relations towards each other. All performance areas together form an extensive framework which offers potential performance areas for an organization specific performance measurement model. Based on the organizations specific situation the performance areas are assessed and the areas which prove to be relevant are incorporated in the performance measurement model.

This framework is a first step towards a comprehensive performance measurement model for the Business Intelligence function. It does not pretend to be complete and might lack some performance areas which are not yet identified as important. Application of the model in business situations will assess the current performance areas and might bring up new ones.
6.1 Funding

The first step in the value-for-money analysis is funding. Funding contains the financial means which need to be present to set up and execute the value creation process of the BICC. According to Dresner (2002) there are three ways of funding a BICC. The first is the single cost center (fixed budget), in this approach the BICC is funded on a company level and usage is not charged back to the internal customers. The costs will be charged back as overhead to the organizational units. The second way of funding is internal billing, within this approach users / organizational units are charged various fees for their specific usages of the BICC products. They have to (partially) fund projects which are identified as important to them and pay for products they use like ad hoc analysis and standard reports. The last funding option is subscription based. In this approach customer profiles are analyzed and each customer is assigned its fair share of the periodical costs. Because the costs are already shared it lifts financial barriers for using the BICC.

BICC’s do not have to choose one way of funding, in big or complex business environments multiple funding approaches may be combined to optimally fit the organization. Figure 13 shows the performance areas which are identified for funding the BICC.

![Figure 13: “Performance areas for funding a BICC”](image)

6.2 Economy

The economy transition turns financial means into production means. The main processes which turn financial means into production inputs are vendor management and human resource management. Miller (2006) has identified these processes as important functional areas within a BICC. The human resource management process area is responsible for workforce planning, recruitment, training and development, wages, employee benefits and performance appraisal. The goal of these tasks is to employ a stable and balanced workforce at reasonable costs which is capable to successfully run the BICC. The vendor management area can be diverse depending on the products and services which are purchased externally. Therefore basic input categories are identified for vendor management to enhance the insight. The categories are Training, IT infrastructure, Software, Externally purchased content (Data sets), Externally hired personnel and other facilities like housing, office supplies etc. The first three categories are based on functional areas which Miller (2006) defines, the other categories are identified by Capgemini Business Intelligence experts. Figure 14 shows the economy performance areas which are identified for the BICC.

![Figure 14: “Performance areas that identify the economy of a BICC”](image)
6.3 Input

The input stage contains the production assets which need to be in place in order to create the output products of the value creation process. After an examination of the diverse input areas it showed that there are five base asset areas: Personnel, facilities, materials, capabilities and work in progress.

The personnel asset area contains the internal and external employees which fulfill specific roles to enable the BICC processes. The basic roles which might occur within a BICC are: BICC manager, Secretary, Architects, Technology experts, Product manager, Analysts, Designers, Developers, Testers, Administrators, Data stewards, Quality manager, Knowledge management officer, Security manager, Training Consultant, IT manager, Project manager (Giessen 2008, Miller 2006).

The second base asset area is facilities. These facilities are assets which need to be in place to support the operation of the BICC. Miller (2006) identifies IT Infrastructure as a facility and Capgemini experts identify office space as a regular facility.

The third base asset area is materials. Materials are input assets which will be consumed by the BICC processes in order to create the output product. Miller (2006) identifies software (licenses) as a material and Capgemini experts identify licensed (external) content like dataset as a material. There are probably more materials which will be used like paper, lunches etc. These materials are not the main cost drivers of the BICC, therefore these assets can be booked under a miscellaneous asset area without further specification.

The fourth base asset area is capabilities. Capabilities are intermediate products and services which are internally produced or externally bought to enable and optimize the production of the BICC products. Internally produced capabilities are former output products, which were especially produced for this internal usage. The capabilities can be split in the following functional areas (Miller 2006):

Data acquisition
The data acquisition area contains the capabilities related to gathering and distributing data. Base asset areas are:

- Existing data flows
- Data flow development frameworks
- Data storage approach with underlying storage capabilities
- Stored content (data) which is generally available for reuse

Advanced analysis
The advanced analysis asset area contains the statistical capabilities of the BICC. This asset includes the appropriate tools and knowledge to perform forecasting, data mining, decision trees, what-if scenarios, statistical analysis, modeling and other predictive analytical tasks.

Frontend-BI application
The frontend-BI application asset area contains the capabilities to present the data to the customer. This capability will probably include a reporting platform with a standard reporting approach and data sharing facilities like OLAP cubes with an underlying approach.
**Frontend-BI distribution**

The frontend-BI distribution asset area contains the capabilities to share the end-products with the customers. Implemented and configured distribution channels like internet, extranet, intranet, mobile, e-mail and mail can act as frontend-BI distribution assets.

In addition to Millers functional areas, Capgemini experts identified additional asset areas like:

**Generic BI platform**

The generic Business Intelligence platform area contains generic applicable tools and data storage capabilities for the intermediate and customer specific BICC products. Product research and innovation is identified as another important asset area within the generic Business Intelligence platform.

**Architecture**

The architecture asset area contains the methods, processes, guidelines and repositories which provide a blueprint and approach for developing future BICC solutions.

**Products and services catalogue**

The products and service catalogue asset identifies what products and services are available to the customer. This is input asset is essential for the definition of intermediate products and the optimization of the BICC processes.

**Knowledge base**

The knowledge base capability is an asset area which provides best practices and documentation to the BICC processes. These knowledge base inputs will be used to maintain, improve and optimize the BICC processes.

**Generic**

The generic capabilities asset area is a container which holds all non BICC specific inputs which need to be in place in order to operate a BICC. In most cases these capabilities are facilitated by the organization which is exploiting the BICC. If the capabilities are not generally available, the BICC must create the capabilities by itself. Examples are: human resource facilities, finance facilities, IT support, sales support, legal support, security support.

**Work in progress**

The fifth and last base input asset area is work in progress. This input area is identified by Capgemini experts to balance the framework. Investments which did not yet result into customer products or intermediate products present a certain value. The value of these assets must be assessed in order to balance and enhance the insight in the production performance.

Figure 15 shows the base and subsequent performance areas which are identified for the BICC inputs.
Figure 15: “Performance areas which identify the input of a BICC”
6.4 Efficiency

The efficiency transition turns production means into (intermediate) products. There are three base process areas which embody the efficiency transition: demand, BI usage and BI delivery.

The demand base process area is identified by Capgemini Business Intelligence specialists. This process area receives the new requests from the business environment and actively manages them in order to optimize the execution of the request. Sub areas within this process are:

- Assessment of projects and changes, this area assesses the requests to identify if they are reasonable and achievable within the time and budget of the BICC.
- Management and prioritization of the requests, this aligns the requests and creates a logical or dependent order which enables efficient execution.
- Resource allocation, this process assigns the most appropriate resource to the request.

The second efficiency process area, Business Intelligence usage, is based on the usage view of the Business Intelligence function (Arntz & Mol 2009). It contains process areas which facilitate the actual usage of the products which the BICC delivers to its customers. The Business Intelligence usage process can be split into the function areas: maintenance, support and production scheduling (Miller 2006).

The last process area of the efficiency transition is Business Intelligence delivery (Miller 2006). The definition of this area is analogue to the production view in the Business Intelligence function model (Arntz & Mol 2009). This process area focuses on building the (intermediate) products and delivering them to the business process of the organization. According to the functional areas of Miller (2006) this process can be split into:

- Technical consulting processes which guide the customer in exploiting the BICC.
- Data acquisition processes which support the data integration process and implementation of the actual data stores and data integrations.
- Advanced analytics processes which execute tasks like statistical analysis, modeling, forecasting, optimization, data mining, data preparation for analytical purposes, and research and experimenting.
- Frontend-BI Application development processes which contain tasks like report building and configuration, data mart development etc.
- Frontend-BI Distribution processes which are responsible for implementing and configuring the distribution channel per product.
- Testing processes which assess the quality of the delivered output products.
- Project management processes which plan, organize and manage the BI delivery process.

Figure 16 shows an overview of the identified performance areas of the BICC efficiency transition.
Figure 16: "Performance areas which identify the efficiency of a BICC"
6.5 Output

Output assets are the actual products which the value creation process delivers. This can be finished products which are delivered to the organization or capabilities like intermediate products which are reused by the BICC processes.

The output stage contains three main asset areas, capabilities, deliverables and work in progress.

The capabilities asset area is identified as output in order to assess the value of the produced intermediate products. The output in this area is directly related to the internal capabilities which are used in the input stage. The sub areas data acquisition, advanced analytics, frontend-BI application, frontend-BI distribution, generic BI platform, architecture, products and services catalogue, knowledge base and generic, share the same definition as the input capabilities. For specific information on these sub areas see paragraph 6.3.

The second asset area deliverables contains the actual products which are delivered to the customers. The products can be divided into multiple product areas like:

- Self service reports which the customer can independently adapt to their information needs.
- Ad-hoc reports which support and answer new and non repetitive information needs.
- Complex analytical reports which answer information requests that require advanced analytical knowledge.
- Data products like OLAP cubes, datasets, listings, data bases, data marts and analytical models which can be used for production processes and information refinement outside the BICC.
- Training which clarifies the purpose and optimizes the effect of the BICC products.
- Technical consulting which guides users in exploiting the products and services of the BICC
- Business related consulting which helps customers to identify and investigate possible business cases for Business Intelligence products.
- Evangelization which spreads awareness about and creates commitment to the BICC and its products.
- Support which assists customers in case of a problem or operational request.
- Capability packages which enable the sales and sharing of BICC capabilities outside of the BICC. These packages contains the capability with for example related training and support

The product types self service reports, ad hoc reports, complex analytical reports, training technical consulting, business related consulting and support are adapted from the functional areas which Miller (2006) defined. The product types data products, evangelization and capability packages are contributed by Capgemini Business Intelligence experts.

The last output asset area is work in progress, like on the input side this is used to balance the framework and to assess the value of products which are not yet completed.

Figure 17 shows an overview of the described performance areas for the output stage.
Figure 17: “Performance areas which identify the output of a BICC”
6.6 Effectiveness

Effectiveness contains process areas which support the transition from products into the actual effect in the organization. Optimization in these process areas can enhance the effect of the delivered products. The following base process areas are identified: aligning Business Intelligence and corporate strategy, data stewardship, product and Exogenous effect.

The process area “aligning Business Intelligence and corporate strategy” (Miller 2006) contains processes which optimize the communication and alignment of the BICC with the customer organization. Processes like overseeing organization wide analytical approach, coordinating use and reuse of business metadata, setting standards and templates for Business Intelligence tools (Dresner 2002) and knowledge management (Miller 2006) are identified as process performance areas which contribute to Business Intelligence alignment.

The “data stewardship” process area is closely related to the business process and the effect a product achieves when used. Creating awareness for data stewardship processes and aligning it with the business environment will enhance the quality and effect of the product. Miller (2006) indentified data stewardship as a functional area which can be divided into the processes data standards definition, metadata management, data definition, data quality management and data governance. These processes can be used as performance areas which assess the data stewardship efficiency.

The “product” process area identifies product related characteristics which influence the achieved effect. Management of these characteristics gives insight in the way the effectiveness can be enhanced. DeLone & McLean (2003) identified the main success factors which drive the effectiveness of an IT product. These success factors can be used as performance areas. The success factors for the product are: information quality, service quality, system quality, use, user satisfaction, individual impact, organizational impact. When these success factors are combined with the functional areas support, business use training and product evaluation (Miller 2006) a comprehensive view on the effectiveness of the product will emerge.

The last process area which drives the effectiveness is the “exogenous effect”. Exogenous effects are all the external influences which change the effect a BICC product achieves. These effects must be identified in order to correctly assess the added value of the Business Intelligence function. Capgemini Business Intelligence experts identified the following exogenous effect types:

- Competition. Competitors can act on the same market and influence the effectiveness
- Social. Change in the social opinion influences the effectiveness
- Economical. Economical downturn can for example temper the effectiveness
- Political. Political decisions and new regulation can result in changes to the effectiveness
- Technical. Technical changes like product improvement can influence the effectiveness
- Environmental. The growing need for sustainability can influence the effectiveness
- Legal. Legal changes can force product changes which influence the effectiveness.
- Other. Non identified influences must be assessed if they influence the effectiveness.

Figure 18 contains an overview of the described performance areas which influence the effectiveness of the BICC.
Figure 18: “Performance areas which identify the effectiveness of a BICC”
6.7 Effect

The BICC value creation process is initiated to create certain effects in the customer organization. These effects will chance the capabilities of the organization and enables it to create added value. The effect that the customer organization is aiming to achieve can be very diverse, but there are some main effect areas which are applicable to all customers.

Herring (1996) stated that effect areas differentiate into: time saving, cost saving, cost avoidance and revenue enhancement. Miller (2006) identified increased decision making speed as an essential effect in today’s business environments.

Capgemini Business Intelligence experts completed the list with intangible effects which are becoming increasingly important as a result of the increased pressure on a company’s social responsibility. The identified effects in this area are social effects, compliancy, political effects, sustainability and the reputation effect.

Other effect areas which were identified by Capgemini experts are risk reduction, increased market share, increased competitiveness, increased productivity and increased customer intimacy.

Supervisor C.A.T. Takkenberg identified increased stability as another effect area. Business Intelligence can for example deliver fact based insight in a production forecast, which leads to a realistic production planning. This will deliver tranquility and leads to increased stability of the organization.

A combination of the previous list results into a comprehensive set of performance areas for the effect stage. Figure 19 shows an overview of the identified effect performance areas.

Figure 19: “Performance areas which identify the effect of a BICC”
6.8 Financial result

The financial result is an internally focused performance area which assesses the steps from funding stage up until output stage. This result determines how well / efficient the value creation process is able to change funding into actual products.

The performance areas within the financial result are based on the performance areas in the underlying processes. These underlying areas together create a rollup view which enables overall internal optimization of the BICC value creation process.

Miller (2006) suggests that reduced software costs and increased staff efficiency are financial results of the BICC. Another major result which is identified by Capgemini Business Intelligence experts is the sponsor satisfaction based on areas like increased shareholder value.

Figure 20 shows an overview of the identified financial result performance areas.

![Figure 20: “Performance areas which identify the financial result of a BICC”](image)

6.9 Enterprise result

The enterprise result covers all steps of the value creation model. This result determines how well the value creation process is organized and aligned with the business process. It measures all stages from input up until the actual effect. This result can be used to optimize the alignment between the business process and the BICC value creation process.

Identified performance areas are aligning the Business Intelligence and corporate strategy (Miller 2006) and stakeholder satisfaction. Stakeholder satisfaction for example covers employee satisfaction and morale (Herring 1996).

Figure 21 shows an overview of the identified performance areas of the enterprise result.

![Figure 21: “Performance areas which identify the enterprise result of a BICC”](image)
7. BICC performance measurement

The previous chapter offered a BICC specific measurement framework which is based on the value-for-money analysis. It covers a generic implementation of the full BICC process, from funding up until the actual effect that occurs in the business process.

In order to develop an effective measurement model in a real world situation the generic framework must be tailored to suit a specific situation. Depending on the size and goals of the BICC a set of processes and asset areas can be selected for measurement. A small BICC organization will for example choose high-level processes and assets, because extensive measurement can be costly and might exceed the benefits it delivers. A big BICC organization on the other hand will choose a finer grain of processes and assets in order to get a good insight in the performance and tuning possibilities of a specific process.

Another determining factor for choosing processes and assets is the goal which the measurement is trying to achieve. It is wise to start the measurement in areas where the biggest potential gain and quick wins are expected. This might be for example a cost intensive process or an obvious problem area. Choosing the right measures is a difficult task, because it is costly and nearly impossible to measure every process and asset in detail. A lot of pro and cons must be weighted and all measures are more or less compromises (Uusi-Rauva 1996).

As business requirements change, there is a constant need for more advanced, or “a different kind of” intelligence. This underlines the statement that the BICC is a continuous process, not a project (Bogza 2008) and the measurement model will probably change over time. The targets of the BICC might change and different processes and value points become important/available. There is a need for a continuous improvement cycle which assesses the measurement model and indentifies new BICC performance measures. This way the measurement model will evolve and mature to a sophisticated model which brings the appropriate insight in the added value of the BICC.

7.1 Model setup

The first step in applying a BICC performance measurement process is the selection and tailoring of the appropriate measures which suit the size and targets of the BICC. Once this is done, the measures will be placed in a performance measurement matrix (figure 22). This matrix contains all stages and transitions of the value-for-money analysis. Each stage or process cell will encompass the identified and tailored measures for that specific stage or process. For each measure a target value will be established and the actual performance can be placed underneath as a comparison. This way the performance measurement matrix will give an integral view on the performance of the BICC in a specific point in time (Arntz & Mol 2007).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Target</th>
<th>Result</th>
</tr>
</thead>
</table>

*Figure 22: “The value-for-money performance measurement matrix”*
The second step is starting the actual measurement, to set a baseline for the performance measurement cycles. The identified measures are assessed, based on the current situation in the BICC. The results of the first measurement are input for the continuous improvement cycle which evaluates the usability of the model and assesses the result in relation to the target value. Based on the evaluation the appropriate adjustments in the model can be made and target values can be adjusted to identify realistic goals.

After the first measurement and the evaluation of the model it will become clear how much time and how many resources it will take to determine a specific measure. Based on this knowledge a decision can be made on the time intervals (cycle speed) of the performance measurement cycle. These cycle speeds can vary a lot depending on the size and goal of the BICC. It might be reasonable to measure every hour, every day, every month, every year or anything in between. The cycle speed can even vary per measure as some measures can be gathered automatically and other measures require a lot of time and resources. Automatically gathered measures are inexpensive and do not stress the employees and clients of the BICC, therefore they can be gathered with a high frequency. Some subjective measures on the other hand might require resource intensive questionnaires which are costly and stress the user and the employees, these measures should be gathered at a low frequency. For each measure the costs and benefits must be assessed in order to determine the appropriate cycle speed.

7.2 Gathering the data set

When the cycle speeds are established, the actual performance measurement cycles can be started. During each cycle the performance measurement matrix is filled with the actual performance of the selected measures. Due to the differing cycle speed for each measure, not all measures need to be filled during each cycle. All subsequent cycles establish a data set with measures that is related to a moment in time (time dimension). Figure 23 shows the performance measurement dataset structure (Arntz & Mol 2007).

![The performance measurement dataset structure](image)

The resulting dataset provides organizations with a basis for evaluating, comparing, controlling and improving their Business Intelligence functions performance. Analysis on the dataset can reveal performance trends which occur over time and statistical techniques can identify interrelations between measures. This information can be used to support assumptions and prove certain effects.
7.3 The accountability cycle

As stated in the introduction, the first and most common reason for measuring the Business Intelligence function is to prove that it is worth the investment (Sawka 2000). Business Intelligence managers need measures to justify their department’s existence. Similarly, executives need to know whether it is rational for them to invest in Business Intelligence, because it is still a rather new managerial discipline (Davison 2001).

The data that is gathered over time with the tailored performance measurement model can provide figures which support the added value of the Business Intelligence function. To institutionalize the process of proving the added value an accountability cycle can be introduced. Within this cycle the performance measurement dataset is analysed and transformed into management reports which share the performance with the rest of the organisation on a regular basis. The process can assess the current data set and suggest new performance measures or targets that improve the insight in the added value.

7.4 The improvement cycle

The second purpose for the measurement of Business Intelligence activities is to assist in managing the Business Intelligence process; which is, to ensure that the Business Intelligence products satisfy the user’s needs and that the process is efficient (Herring 1996). Namely, a Business Intelligence process can be costly if the information gathered is not accurate or does not match the information needs.

Analogue to the accountability cycle a formal improvement cycle can be introduced to assess the Business Intelligence process performance on a regular basis. This cycle will stimulate a continuous improvement mindset within the BICC and validates the current performance measures and targets. This will keep the performance measurement model actionable, realistic and up to date.
8. Empirical research approach

The nature of this thesis is theory developing because of the scarce literature which is currently available on the subject of Business Intelligence performance measurement. In the previous chapters existing Business Intelligence specific and general performance measurement theories are combined to create a theoretical framework for measuring the Business Intelligence function. Capgemini Business Intelligence experts validate the framework based on their experiences and suggested enhancement. The resulting framework looks comprehensive and stable enough for a first test in a real world situation.

When designing an empirical research for this real world test a few choices must be made to determine a suitable research approach. The first choice to be made is between depth and breadth of the research. Since the resulting framework is pretty complex and it is largely based on new insights and theories, there is definitely a need for a thoroughgoing investigation. This need favours for an in-depth research. Due to the limited time which is available for the thesis it is not possible to perform an extensive research within multiple BICC’s. This favours for a narrow research scope with a qualitative research instead of a quantitative research. The single case study research approach as described by Doorewaard & Verschuren (2007) is the right approach for an in-depth qualitative empirical research.

Capgemini Nederland B.V. implements Business Intelligence solutions and organizations within multiple companies. They offered the research of one of their projects as a suitable real world business case within a public organization. The business case is called Diagnosis Treatment Combinations forensic care (DB(B)C FZ). It encompasses usage of Business Intelligence as one of the drivers for a structural change in the forensic sector towards a more demand based organization of the forensic care. DB(B)C FZ is a long running project (over three years) which is assigned to the Capgemini Public health cluster by the Justice department of the Dutch government. The project team is assigned with the integral task of facilitating and coordinating the implementation of the DB(B)C approach in the whole forensic care sector. The project creates the centralized parts of the technical implementation and it is tasked with the associated organizational transformation. The case is perfect for the research because it is a full Business Intelligence solution with a limited scope. In addition the project team meets all the characteristics of a Business Intelligence competence center (BICC).

The research is structured according to the following steps:

1. An analysis of the existing DB(B)C FZ documentation to find indications of possible performance areas
2. A first interpretation on the content of the performance measurement framework based on the documentation
3. Conducting workshops at various disciplines of the DB(B)C FZ project. The target is to validate the initial filling and to complete it with the discipline specific knowledge.
4. A validation of the overall performance measurement model by the different disciplines
5. An assessment of the usability of the theoretical framework.

The following BICC roles where represented during the workshops:

- One project manager
- One data warehouse developer
- One advanced analysis employee
- Two account managers
9. The DB(B)C FZ business case

Within the Netherlands the national department of Justice is responsible for the forensic care system. This government organization facilitates the detention of convicted criminals and prepares them for a safe return to society. There are multiple forensic care organizations within the Netherlands which provide a great variety of specialized forensic care products which are generally based on detention in a combination with mental healthcare. For example the treatment of repetitive shoplifting can consist of a number of detention days in combination with psychological help to overcome a kleptomania disease.

Because of this great variety the forensic care system is becoming increasingly complex and it becomes unclear what care is offered by an organization and what the quality and success of this specialized care is. This complexity leads to a sub optimal care provisioning system which not always suits the patients’ needs. To overcome this problem the Justice department has initiated an integral Forensic Care Renewal Programme, in Dutch it is called Vernieuwing Forensische Zorg (VFZ)

The main goal of the VFZ programme is to optimize the care provisioning in order to reduce the recidivism among the convicted criminals. This recidivism reduction will be achieved based on the following four sub-targets:

- Achieving adequate capacity for the provision of forensic care
- Ensuring that the right patient is at the right place
- Quality care which is focused on the safety of society
- A good alignment with the regular Dutch care system

The overall result of these targets is that forensic care under criminal law (FZ) is changing drastically towards a demand based care system. In the near future the need of the client will determine the appropriate forensic care organization in which the client can be placed for treatment.

A central role in this future demand based forensic care system is reserved for “Diagnosis, Treatment and Security Combinations” (in Dutch DB(B)C). The DB(B)C approach provides a common registration language for the indication and application of (forensic) care. It captures characteristics of the diagnosed illness, the provided treatment, the detention, the costs and the quality of the care. The introduction of the DB(B)C approach aims to achieve a uniformity of standards and terminology which will improve the continuity and process flow. It will lead to more transparency in the characteristics of provided forensic care which enables the Justice department and the forensic care organizations to optimize the whole forensic care system. The results of the centralized DB(B)C approach / registration will form the statistical background for multiple choices which must be made in the VFZ programme.

Ultimately the DB(B)C approach will lead to a transparent and solid product structure for all forensic treatments which contains standard prices per care product. This structure will be used to implement a more transparent financial compensation model for the whole forensic care sector.

The DB(B)C FZ project is tasked with the implementation and operational execution of the DB(B)C approach for the whole forensic sector. Because of its data centric characteristics Business Intelligence plays an important role in the DB(B)C approach. This is why a central Business Intelligence function (Chapter 3) is organized which facilitates the implementation and execution phases of the DB(B)C FZ project.
The following paragraphs provide more detailed information about the DB(B)C FZ specific implementation of the Business Intelligence function.

9.1 The DB(B)C FZ usage view

The usage view of the DB(B)C FZ Business Intelligence function transforms the DB(B)C information products into choices and actions which affect the forensic care treatments. Figure 24 shows the DB(B)C FZ specific implementation of the usage view.

![Diagram of DB(B)C FZ usage view]

When the Business Intelligence usage view is applied the following DB(B)C FZ specific model content emerges:

**Objective**

In order to achieve adequate capacity for the provision of forensic care and to ensure that the right patient is at the right place, transparency in the provided forensic care is essential. The transparency will clarify what kind of care is needed and successful in relation to a specific forensic diagnosis. In addition to this it will become clear which forensic organizations provide a specific type of care and how successful they are in applying this care. The insight in the needed care and the availability of care within forensic organizations will enable a more sophisticated capacity planning which will lead to adequate provisioning of forensic care. The transparency in the provided care and the success of a forensic organization will simplify the process of placing the patients in the right place for their specific diagnoses. Therefore the enhancement of the transparency is the main objective of the DB(B)C FZ Business Intelligence function.

In addition to the transparency objective the actual implementation of the DB(B)C approach is an objective on its own. With the implementation of the DB(B)C approach the registration of forensic care provisioning will be aligned with the registration of the Dutch somatic care and mental health care. This alignment enables a better cooperation between the forensic care and the other care sectors. For example a transition of the patient at the end of the detention period towards regular mental health care is simplified because of the aligned care indication rules.
**Scope**
The scope of the usage view is the nationwide set of forensic care treatments. The DB(B)C FZ project uses data from forensic care treatments to gain insight in the care which is currently provided. On the other hand the Justice department and the forensic care organizations influence the forensic care treatments in order to optimize their performance.

**Actor**
The actors in the DB(B)C FZ usage view are the Justice department and the forensic care organizations. The Justice department is an actor as it uses the produced information products to make decisions on rules and regulations in order to optimize the provided care and to enhance the quality of the DB(B)C registration process. The forensic care organizations use the information products to make choices and to take actions in order to optimize their forensic care process and registration.

**Observe**
The observation phase consists of the collection and processing of forensic treatment data. This data is collected through a generic registration model which is implemented by all forensic care organizations. The collected data is merged into one integrated data warehouse environment for the whole forensic sector. In this environment the data is validated on technical and business specific validation rules. More information on the data collection and data enrichment process will follow in paragraph 9.4 DB(B)C FZ knowledge creation.

**Interpret**
The data which is collected in the observation phase is transformed into information products during the interpretation phase. These information products provide the actors with knowledge on the quality of the collected data, the characteristics of historical forensic treatments and future trends. This insight is provided by multiple reports which capture organization specific DB(B)C characteristics and compare them to the national average. Additionally more advanced analysis products like the product structure and the product prices are created to optimize the DB(B)C registration and to provide the formal DB(B)C FZ product structure with statistical backing. These products will eventually be used to create a consensus on general and transparent forensic treatment products with the appropriate financial compensation.

**Choose**
Based on the knowledge and external influences the Justice department makes choices on the formal product structure which will be used for the care provisioning and the financial compensation. When products in certain care areas lack statistical backing the department makes choices which lead to changes in the rules and regulations for the DB(B)C registration. Registration can for example be stimulated with new compliancy rules or extra financial compensation when the data quality increases. The forensic organizations make choices in the way they provide their care. Based on the reports it might become clear that other organizations are more successful because of a different care approach. The measure can be used to optimize the organizations own care provisioning process and the effect trend can be analyzed over time.

**Act**
The set of choices that the Justice department has made are put in to action by formalizing the product structure and starting the financial compensation based on the established prices. Additionally new rules and regulation are formalized to influence the forensic treatment registration.

Based on the choices, forensic care organizations will effectuate new guidelines and care provisioning plans within their organizations to create awareness and to drive the organization to a more optimized way of working.
**External information**

When choices are made in relation to the formal product structure and pricing, the most important external influence is the DB(B)C FZ expert group. The expert group consists of forensic care experts which work in all kinds of forensic care organizations. They use their in-depth forensic care knowledge to assess the results and recommendations of the DB(B)C FZ Business Intelligence function. Based on this assessment recommendations are reported to the Justice department which are taken into account when making the choices. The same expert group assesses the results of the current implementation of the DB(B)C approach based on their experience. It provides recommendations on the optimization of the DB(B)C FZ registration process.

**External influences**

Because the forensic care is provided by the government it is often subject of political discussion and changes. National elections and resilience measures might affect the targets and available budget for the whole forensic care sector. On a smaller scale the targets and budget for implementation of the DB(B)C approach are also affected. These influences must be taken into account when assessing the effect of the taken actions on the product structure and registration process.

**9.2 Production view**

The production view is tasked with the creation of information products within the Business Intelligence function. It responds to intelligence related questions which arise within the usage view. Currently the usage view has got two objectives. The first objective is the implementation of the DB(B)C approach in order to align the forensic care system with other care sectors. The second objective is the enhancement of the transparency in the provided forensic care.

These objectives result in two types of products which are produced within the production view. The first type is the registration related product which enables the DB(B)C FZ project and the forensic organizations to implement the DB(B)C FZ approach for the whole forensic sector. The second type is the DB(B)C optimization related product, these products enable the Justice department and the forensic organizations to optimize their performance on providing forensic care. Figure 25 shows the development cycles which respond to these two types of information products.

*Figure 25: “The DB(B)C FZ development cycles”*
The registration model

The registration model is a technical product which describes the basic registration of DB(B)C related information. The model defines which data elements are relevant in perspective of a DB(B)C in the forensic care sector. It consists of a data model (entity relationship diagram) and supporting descriptions which define the relevant entities and attributes that capture the characteristics of a DB(B)C. The entities and attributes are specified down to field level details like data type, field length and “not null” constrains.

Within the DB(B)C FZ function the product is used for the development of the centralized data warehouse databases and data marts. It is provided to the forensic organizations and their software suppliers in order to share knowledge about the DB(B)C registration. This enables them to efficiently develop DB(B)C compliant registration software for the forensic care sector.

The code lists

The DB(B)C FZ code lists extend the registration model with base tables for the DB(B)C registration. The content of these tables facilitates the alignment of metadata for all forensic care institutes. Each table defines what types of crimes, activities, professions, diagnoses, products and care types are commonly known in the forensic care sector. It limits the number of types which are valid within in the DB(B)C registration and it sets a standard for naming these types. The base tables are composed out of existing care standards and naming conventions which were complemented with specific forensic care knowledge and terminology.

The validation rules

The DB(B)C FZ validation rule set is the last product which guides the DB(B)C registration and specification for the forensic care sector. This rule set contains technical rules which define low level limitations that ensure the technical quality of the registration. Examples of technical rules are referential integrity, date formatting and mandatory fields.

On a higher level the validation rule set contain business validations that ensure the quality of the data based on business specific knowledge. Examples of business rules are specific time registrations which are not allowed for specific care types and maximum number of registration days that a DB(B)C can have. The validation rules product is used within the Business Intelligence function for setting up the technical and business validation of the data within the data warehouse environment. The product is also provided to forensic care organizations and their software suppliers to optimize their registration software. It is input for the end user registration limitations of the registration software and it enables the organizations to assess the data before it is submitted to the central data warehouse environment.

The self service reports

Self service reports enable forensic organizations to assess their DB(B)C FZ data. Based on the registration model, the code lists and the validation rules, it indicates what the content quality of the delivered data is and which issues exist within the dataset. It offers possibilities to drill down on errors towards an in-depth view on the actual field level information of the uploaded data. This information can be used to fix problems in the organization’s registration processes and supporting software, which will lead to optimization of the DB(B)C registration process and enhancement of the DB(B)C data quality.

Another function of the self service reports is to provide insight in the actual performance of the forensic organization. The performance on the forensic care execution of the specific care organization is compared to the national average. This will for example give insight in the number of treatment days per diagnose and hours spent by a certain forensic discipline. These reports are designed to provide the forensic care organization with new and interesting information which encourages them to optimize the way they apply their forensic care.
The data monitor

Data quantity and quality of forensic care treatments is essential for the deduction of a stable DB(B)C product structure. In order to get insight in the quality of the filling of the complete data warehouse environment a data monitor report / document is created after each data processing cycle. This data monitor provides information on data deliveries in general (number of facts and the distribution of the target groups), data quality and quantity, and the “filling” of the future product structure based on the most recently available data. This information can be used to make timely adjustments within the project and DB(B)C approach if it appears that the filling and statistical backing of the DB (B) C is insufficient or unbalanced.

The DB(B)C FZ Business Intelligence function uses this information to optimize their account management tasks (for example they can visit more organizations in a target group which lack data deliveries). Organizations will be motivated by the product to start delivering data if they are aware of the problems that exist in their target group. The data monitor might even guide the Justice department into the definition of new rules and regulations for the DB(B)C FZ approach if major issues exist for a longer period. The document will help the Justice department to define effective rules as it gives insight in the existing data quality problems.

The DB(B)C FZ product structure

The DB(B)C FZ product structure plays a crucial role in the DB(B)C FZ approach as it is the language for the communication about the supplied forensic care and it is the basis for the new financial compensation model. All data uploads together form the scientific basis for the deduction of a formal product structure which suits the forensic care system. The DB(B)C FZ product structure contains a limited set of generic products which will be used to treat illnesses which cause criminal behaviour. With this baseline of products it becomes transparent which treatments are performed per patient and how successful the forensic organization is delivering the care. The creation of the product structure is an analytical process that assesses the content and quality of the historical forensic data. It deduces potential generic products and their appropriate cost price. The complete set of product is input to the expert group validation process and it will eventually lead to a formal product structure.

Forensic care organizations have to fit their treatments into this formal product structure in order to get their financial compensation.

9.3 Management view

The management view is tasked with the governance of the Business Intelligence function. To align the Business Intelligence function with the strategic goals of the Justice department an expert group is organized within the management view. The expert group consists of DB(B)C FZ project managers, representatives of the Justice Department and forensic care experts. On a monthly basis the overall progression is analyzed and issues and improvement suggestions are discussed. The expert group sets the strategic base line and priorities for the upcoming months. On a more detailed level the project managers translate the strategic base line and priorities into a project planning which assigns the appropriate resources over time. The project manager arranges the business alignment sessions with forensic end users and software suppliers in order to optimize the fit of the DB(B)C FZ approach. They provide the team members with the needed facilities like financial means, office space and tooling. On a regular basis the project managers monitor the progression and discuss emerging issues with the team members. The progression is reported to the expert group and issues with high importance or that proved to be non resolvable by the team are also escalated to the expert group. This management approach optimizes the alignment between the DB(B)C FZ implementation process and the actual usage of the DB(B)C products.
9.4 DB(B)C FZ knowledge creation

As described the main goal of the DB(B)C FZ approach is to create transparency in the provided forensic care. This transparency provides knowledge to the Justice department and the forensic care organization for making the right choices on forensic capacity provisioning and it enables them to place the patient in the most appropriate forensic care location. The enhanced forensic treatment transparency is achieved by a DB(B)C FZ specific knowledge creation process. The process turns forensic treatment data into a DB(B)C FZ registration model which is used for the deduction of the generic product structure with standard characteristics and prices. Figure 26 shows the generic knowledge creation process as it is applied to the DB(B)C FZ specific knowledge creation process.

![Diagram of the DB(B)C FZ knowledge creation process]

**Figure 26: “The DB(B)C FZ knowledge creation”**

In order to get a better view on how the DB(B)C FZ approach creates the knowledge out of forensic treatment data the subsequent steps are discussed in more detail with the help of an example. The example is a simplified and fictional version of the real knowledge creation process as it is too complex to discuss in full detail.

**Data**

The basis for the knowledge creation process is data. The data is formed by the actual facts that are available in the registration system of the forensic care organization. In the example the registration system of a very small forensic care institute consists of four tables (figure 27).

The patient table contains patient specific information like name, sex and address.
The personnel table contains details of the care providing staff like name, profession and salary.
The dossier table contains the forensic characteristics of the assigned detention like date arrived, detention type, diagnoses, the clinician which provides the care (one on one), the committed crime and the conviction date.
The care table contains the treatments which are applied to the patient; it contains information like care description, hours spent and the date performed.

A subset of the data in these tables forms the basis for the knowledge creation process.
Information

The second step in the knowledge creation process is information; this step contains structurally organized data which is endowed with meaning. The transformation from data into information is done by the forensic care organization in cooperation with the DB(B)C FZ Business Intelligence function. The Business Intelligence function provided the organization with a forensic specific registration model like the one in figure 28.

In the first step of the transformation the forensic care organization translates the tables of their registration system into the DB(B)C FZ registration model. In the example the table dossier is split into a DB(B)C table, a crime table, a danger table and a detention table. Fields like date arrived and sex are translated to start date and gender. A field like hours spent on specific care is translated to minutes spent on care in the DB(B)C FZ registration. Some privacy related information like client name is left out of the DB(B)C FZ registration.

The next step in the transformation is the conversion of organization specific terms into generic DB(B)C FZ codes. The DB(B)C FZ Business Intelligence function creates the code lists product in cooperation with forensic care organizations and the expert group. The forensic care organizations use the formalized code lists to translate their specific terms into DB(B)C FZ codes for diagnosis, treatment, crime, detention, danger and care. In the example the diagnosis “kleptomaniac” is translated into the code DN1002 and the crime “repetitive shoplifting” is translated into the code CR003.

The last step in the transformation from data into information is the validation of the data. The DB(B)C FZ Business Intelligence function assesses the delivered data based on the technical and business validation rules.
In the example the forensic case of the patient “John Doe” violates a certain business rule as the registered care is not applicable to the related DB(B)C. The DB(B)C has got a start date of 1-2-2009 and an end date of 1-2-2010, the registered care is dated on 12-12-2008 therefore it is not valid and left out of the dataset for further analysis.

**Knowledge**

The last step in the knowledge creation process is the translation from information into knowledge. The first type of knowledge which is provided by the Business Intelligence function is the self-service report. In the example the DB(B)C “upload and validation” report will indicate that there is a registration error for DBBC_Id 10001. The forensic care organization can investigate this error by drilling down on it. Eventually they will see that there is an invalid care registration on 12-12-2008. They can correct it in order to optimize the data quality.

The second type of knowledge which is provided is the product structure and prices. The combined information of all forensic organizations and analytical processes like coefficient of variance analysis are used to extract product groups and prices. These product groups and prices are assessed on their statistical backing and a probability indication is assigned to each product and price. In the example the forensic treatment data of John Doe is used for the deduction of a product group. This deduction might lead to a product group of kleptomaniacs that are repetitive shoplifters with a schizophrenic background. The treatment data like number of detention days and the applied care are used to determine the general characteristics of this product group.

Ultimately the financials which are spend on John Doe are used as one of the inputs to determine price of the product. The data of John Doe in combination with comparable forensic cases will contribute to the statistical backing of the identified product group: “kleptomaniacs that are repetitive shoplifters with a schizophrenic background”.

### 9.5 The DB(B)C FZ implementation approach

Based on previous successes in the somatic and mental healthcare, the department of Justice asked Capgemini to aid in the development and implementation of the DB(B)C-system in the forensic care sector. The first step in the project was a usability assessment of the DBC implementation in the mental healthcare sector. As expected large parts of this implementation suited the needs of the forensic care sector. The approach and underlying products are used as a baseline for the DB(B)C FZ project.

Capgemini formed a cross functional team which guides the implementation of the DB(B)C approach and execute the appropriate changes to the baseline products.

The team consisted of the following team members:

- One engagement manager for the strategic alignment of the project
- Two project managers who guide the implementation of the DB(B)C FZ project
- Five account managers with forensic knowledge, who support the forensic care institutes in adopting, aligning and implementing the DB(B)C approach
- One data warehouse architect who designs the technical implementation
- Two data warehouse developers which implement the technical facilities for uploading, validating and reporting the forensic data
- Two advanced analysis employees, which provide the statistical products and justification of the DB(B)C result

The implementation of the DB(B)C approach is an iterative process which enhances and optimizes a set of products and processes each increment.
The first increment contained the adjustment of the mental health care implementation towards the forensic care situation. In this increment the DB(B)C registration model for forensic data was adjusted. The base code lists of the implementation where customized towards forensic terms. The (technical and business) data validation rules of the implementation where adjusted.

Based on these changes a new nationwide upload and data warehouse platform was developed with the name DGAAO (DB(B)C Gegevens Aanlever en Analyse Omgeving). This central platform receives historical forensic care treatment data on a monthly basis from, in potential, all forensic care organizations. It integrates the data into one comprehensive data warehouse and it validates the data based on technical and business validation rules. After the validation the dataset is prepared for self service reports and advanced analysis. These self service reports are available on the portal of the DGAAO. Forensic care organizations can use the self service reports to increase the quality of their DB(B)C dataset and to compare their performance to the national average. More advanced self service reports are available to the account managers which enables them to support the customer. For the analytical questions within the DB(B)C FZ project the advanced analysis datasets and the related analytical “matlab” models were adjusted towards a new form which suits the forensic care sector’s needs.

Parallel to the implementation of the DGAAO the forensic care organizations adjusted their registration systems according the specifications of the new registration model, code lists and validation rules. The account managers guided the organizations and their software suppliers during the implementation process and performed tests. The tests were offered to assess the validation rules that the software suppliers implemented. The goal of the implementation process was to create a validated export which was ready for the upload towards the DGAAO.

During the second increment the developed DGAAO was put into production and the organizations started to use their adjusted registration systems. Month after month more organizations came up to speed with delivering data towards the DGAAO.

Account managers, organizations and software suppliers collaborated to optimize the quality of the exports by using the self service reports. The advanced analysis employees used the new data to get early insight in the content and quality of the delivered data and the future product structure.

Based on these experiences enhancements of registration models, code lists and validation rules were indentified and assessed by a forensic care experts group. This process resulted into an improved version of the registration model, the code lists and the validation rules. At the end of the increment a new version of the DGAAO was created and the organization adjusted their systems according to the improved registration model, code lists and the validation rules. Support and testing by the account managers was offered during this update. After this first period advanced analysis employees applied and adjusted their analysis models to deduct a forensic care specific product structure. New products emerged from the historical data on the combinations of diagnoses, treatments and security. The product structure was validated by the forensic care expert group and adjusted if necessary.

The subsequent increments were similar to the second increment and the DB(B)C FZ approach was further enhanced to suit the forensic care specific needs. The sentiment of the activities within the increments over time shifted from getting the upload to work and getting the correct data in, towards getting more data quality and hooking up the last small forensic organizations.
9.6 The current situation

When writing this thesis the project team is in the last increment of the project. Most of the forensic care organizations are supplying their data and the quality of the data has reached a statistically acceptable level. The final DB(B)C product structure is deducted, based on the final dataset. The suggested product structure and prices for 2011 are currently under review by the expert group. When it is formalized the enhanced product structure will lead to a solid basis for financing forensic care based on the product group which is indicated for the patient in 2011. The gained insight in the actual usage of DB(B)C FZ products will enhance the ability to get the patients in the forensic place which is best suited for their specific diagnosis. Furthermore the insight will optimize the abilities to achieve adequate capacity for the provision of forensic care in the upcoming years.

At the end of this year the project results will be handed over to the government organization “DB(B)C Onderhoud”. This organization is already tasked with the support and optimization of the DBC approach for the somatic and mental healthcare sector.
10. DB(B)C FZ framework application

Within this chapter the performance measurement framework which emerged from the value-for-money analysis on a generic BICC will be applied to the DB(B)C FZ project. The framework will be used to identify the most important performance areas within the DB(B)C FZ BICC. Although it is possible to measure the DB(B)C FZ project in more detail, it is questionable if the benefits of measuring will be greater than the cost that is associated with measuring. The performance areas which are identified within this chapter proved to be worthwhile measuring based on the expert knowledge of the project team which forms the DB(B)C FZ BICC.

During the business case research it showed that the performance areas of the individual value-for-money stages and processes show a tight correlation towards each other. This is probably due to the strong cause and effect orientation of the value-for-money analysis. To get a clear insight in the identified performance areas it proved to be a best practice to describe the performance areas on a product by product basis. Within this approach the product specific performance measures are assessed on all value-for-money stages and processes. This enhances the user’s ability to place the specific measure in the right process or stage, it prevents overlap and it ensures consistency.

The strong traceability and simple approach of the value-for-money analysis allows the framework user to apply the model on a product level because it is simple to roll it up to the level of the BICC.

The results of the business case research will be represented on a product by product basis as well. This will give a comprehensive and simple view on the resulting DB(B)C FZ specific performance measurement model. The following paragraphs contain the products which are identified as worthwhile measuring for the DB(B)C FZ BICC.
10.1 The registration model

The assessment of the characteristics and usage of the registration model against the developed Business Intelligence performance measurement framework reveals that the product is used in multiple stages.

As described the registration model is used as an internal capability for the DGAAO development, therefore it is placed in the framework as an input and output capability.

Because the registration model is tailored with additional documentation and support for the shipment to the forensic care organizations and the software suppliers it is additionally placed in the framework as a capability package.

The characteristics of the product suit the definition of data acquisition and management capability because the model defines a DB(B)C specific data storage approach and it shares metadata about the attributes and entities of the data storage.

The identified product performance areas are:

- Input capability - data acquisition and management
- Output capability - data acquisition and management
- Output deliverable capability package - data acquisition and management with related documentation and support

These product performance areas are used as a starting point for an assessment on the value-for-money analysis cause and effect chain. Performance measures for all processes and stages which relate to the product are identified by the members of the DB(B)C FZ BICC.

**Funding**

The funding of the DB(B)C FZ BICC consists of a yearly project budget for all BICC tasks and products. The project budget is based on a forecast of the expected work. Therefore the funding performance area is project funding.

The identified performance measure for project funding in relation to the registration model development is total cost spent on hiring personnel because this is the main cost driver.

**Economy**

The transition from funding to input is limited to hiring the personnel which is needed for the development and organizational alignment of the registration model. All members of the DB(B)C FZ BICC are hired externally therefore the identified performance area is vendor management on external personnel.

The identified performance measure for vendor management on external personnel is rated per discipline.
**Input**

The input for the development of the registration model is limited to personnel and internal capabilities. The team members are consultants which are hired from the Capgemini organization. These consultants come with sufficient knowledge, the required tooling and hardware for their role. Therefore no additional (external) input is required. The internal capability which is used as input for the registration model is a previous version of the model which provides a suitable basis for the new registration model.

The identified performance measures for personnel are:

- Hours spent on (project) management for coordination and alignment within forensic sector
- Hours spent on account management for internal knowledge transfer and external business alignment
- Hours spent on development for translating requirements into a model with entities and attributes
- The identified performance measure for the internal capability is the existence of a previous version of the registration model (yes / no).

**Efficiency**

The efficiency of transforming input means into products like model changes and documentation updates is mainly affected by the nature of the updates and the underlying requirements. The update characteristics like number of changes and complexity of the changes determine how much time is needed. The characteristic of the requirements determine the potential need for rework and extra time needed on clarifying the requirements.

The identified performance measures for the demand performance area are:

- The total numbers of changes that the model update cycle contains
- The complexity of the updates, each update is identified as simple, medium or complex
- The stability of the requirements is measured by the number of requirement changes during the update cycle
- The timeliness of requirements is measured by the number of additional requirements which arise after the development is started
- The quality of the requirements is measured by the number of requirement alignment sessions which are needed during implementation and the number of revision cycles which are needed before a new version of the model is completed

**Output**

As described earlier the output of the registration model update process is a new revision of the registration model with the related documentation and support. This registration model is used as an internal capability for the development of the DGAAO and it is shipped as deliverable capability package towards the forensic care organization and their software suppliers for the development of registration systems.

The identified performance measures for the internal capability and the deliverable capability package are:

- The total number of versions of the registration model which are developed over time
- The size (number of pages) of the supporting usage guidance and documentation products.
**Effectiveness**

The effectiveness of the registration model is mainly influenced by the product adoption rate of the forensic care organizations. If organizations implement the model in the correct way effects like compliance with the somatic care DBC approach and enhanced transparency will be achieved. Product characteristics like usability and support are indirect performance areas which influence the adoption (Use) rate.

The identified performance measures for the product performance area are:

- The usage of the product is measured by the number of organizations which implemented the latest version of the model.
- The user satisfaction is measured with a survey which assesses the product's score on timeliness, usability, quality.
- The support effectiveness is measured by the number of support calls and account management questions.

**Effect**

The effect that the registration model is aiming to achieve is the alignment of the forensic DBC registration with DBC registration in the somatic care sector. This target is a political effect as it is defined by the Dutch government as the new and mandatory way of working. Another effect that the registration model must achieve is the enhanced transparency in treatments and costs. This transparency is the basis for the targeted care provisioning enhancement. The ultimate goal is to get the right patient in the right place.

The identified performance measure in the political effect performance area is the number of forensic care organizations which have implemented the registration model in their registration software. This indicates the percentages of forensic care organizations which are aligned to the somatic care DBC registration approach.

The identified performance measure in the productivity enhancement performance area is the number of DB(B)C which are registered according to the registration model. Each DB(B)C which is registered according to the model enhances transparency as it is available for comparisons and analytical research.
10.2 The code lists

The assessment of the code lists against the developed Business Intelligence performance measurement framework reveals that the product has got the same characteristics and usage as the registration model. It is used as an internal capability for the DGAAO development and therefore placed in the framework as an input and output capability. Because the code lists are tailored with additional documentation and support for the shipment to the forensic care organizations and the software suppliers it is additionally place in the framework as a capability package.

Like the registration model the characteristics of the product suit the definition of data acquisition and management capability because the code lists shares metadata about the type of content (data) which is valid within de DB(B)C data storage environment.

The identified product performance areas are:

- **Input capability** - data acquisition and management
- **Output capability** - data acquisition and management
- **Output deliverable capability package** - data acquisition and management with related documentation and support.

These product performance areas are used as a starting point for the assessment on the value-for-money analysis cause and effect chain. Members of the DB(B)C FZ BICC have identified the following performance measures for all processes and stages which relate to the code lists.

**Funding**

As mentioned the funding of the DB(B)CFZ BICC consists of a yearly forecasted project budget for all BICC tasks and products. Therefore the funding performance area is project funding.

The identified performance measure for project funding in relation to the code lists development is total cost spent on hiring personnel because this is the main cost driver.

**Economy**

The transition from funding to input is limited to hiring the personnel that is needed for the development and organizational alignment of the code lists. Because all members of the DB(B)C FZ BICC are hired externally the identified performance area is vendor management on external personnel.

The identified performance measure for vendor management on external personnel is rate per discipline.
Input

Like the registration model the input for the development of the code lists is limited to personnel and internal capabilities. The hired team members come with sufficient knowledge, the required tooling and hardware for their role. Therefore no additional (external) input is required. Same as the registration model the internal capability which is used as input basis for the code lists is a previous version of the code lists.

The identified performance measures for personnel are:
- Hours spent on (project) management for coordination and alignment within forensic sector
- Hours spent on account management for internal knowledge transfer and external business alignment
- Hours spent on development for translating requirements into a set of code lists
- The identified performance measure for the internal capability is the existence of a previous version of the code lists (yes / no)

Efficiency

The efficiency of transforming input means into new code lists and documentation updates is mainly affected by the nature of the updates and the underlying requirements. The nature characteristics like number of changes and complexity of the changes determine how much time is needed. The characteristic of the requirements determine the potential need for rework and extra time needed to clarify the requirements.

The identified performance measures for the demand performance area are:
- The total number of changes that the code lists update cycle contains
- The complexity of these updates, each update is identified as simple, medium or complex
- The stability of the requirements is measured by the number of requirement changes during the update cycle
- The timeliness of requirements is measured by the number of additional requirements which arise after the development is started
- The quality of the requirements is measured by the number of requirement alignment sessions which are needed during implementation and the number of revision cycles which are needed before a new version of the code lists is completed.

Output

As described earlier the output of the code lists update process is a new revision of the code lists with the related documentation and support. These code lists are used as an internal capability for the validation of the data which is uploaded towards the DGAAO and it is shipped as deliverable capability package towards the forensic care organization and their software suppliers for the development of registration systems.

The identified performance measures for the internal capability and the deliverable capability package are:
- The total number of versions of the code lists which are developed over time
- The size (number of pages) of the supporting usage guidance and documentation products
Effectiveness

Like the registration model the effectiveness of the code lists is mainly influenced by the product adoption rate of the forensic care organizations. If organizations use the code lists in the correct way a common “language” for registering and sharing DB(B)C information will emerge and the targeted transparency will be achieved. The developed code lists share the same basis as the somatic care code list, which will lead to the targeted compliance with the somatic care DBC approach. Product characteristics like usability and support are indirect performance areas which influence the adoption (Use) rate of the forensic care organizations.

The identified performance measures for the product performance area are:

- The usage of the product is measured by the number of organizations which implemented the latest version of the code lists
- The user satisfaction is measured with a survey which assesses the product’s score on timeliness, usability and quality
- The support effectiveness is measured by the number of support calls and account management questions

Effect

The identified performance measure in the political effect performance area is the number of forensic care organizations which have implemented the code lists in their registration software. This indicates the percentages of forensic care organizations which are aligned to the somatic care DBC registration approach.

The identified performance measure within the productivity enhancement performance area is the number of DB(B)C’s which are registered according to the latest version of the code lists. Each DB(B)C which is registered according to the model enhances transparency as it is available for comparisons and analytical research.
10.3 The validation rules

The DB(B)C FZ validation rule set is the last product that guides the DB(B)C registration and specification for the forensic care sector. The rule set contains technical rules which define low level limitations that ensure the technical quality of the registration. It contains business rules which assess the registration quality based on in-depth business knowledge.

Like the registration model and the code lists the validation rules are an internal data acquisition and management capability as it is used in setting up the validation of the DGAAO data. The product is also tailored as deliverable capability package for forensic care institutes. In this form the product and the supporting documentation offer a common language and implementation guidance towards forensic care institutes and their software suppliers.

In line with the registration model and the code lists the identified performance areas and example measures are:

**Funding**

The funding of the DB(B)CFZ BICC consists of a yearly forecasted project budget for all BICC tasks and products. Therefore the funding performance area is project funding.

The identified performance measure for project funding in relation to the validation rule development is total cost spent on hiring personnel because this is the main cost driver.

**Economy**

The transition from funding to input is limited to hiring the personnel which is needed for the development and organizational alignment of the validation rules. Because all members of the DB(B)C FZ BICC are hired externally the identified performance area is vendor management on external personnel.

The identified performance measure for vendor management on external personnel is rate per discipline.

**Input**

Like the code lists the input for the development of the validation rules is limited to personnel and internal capabilities. The hired team members come with sufficient knowledge, required tooling and hardware for their role. Therefore no additional (external) input is required. The internal capability which is used as input basis for the validation rules is a previous version of the validation rules.

The identified personnel performance measures are:

- Hours spent on (project) management for coordination and alignment within forensic sector
- Hours spent on account management for internal knowledge transfer and external business alignment
- Hours spent on development for translating requirements into a validation rules and supporting SQL code
- The identified performance measure for the internal capability is the existence of a previous version of the code lists (yes / no)
**Efficiency**

The efficiency of transforming input means into new validation rules and documentation updates is mainly affected by the nature of the updates and the underlying requirements. The nature characteristics like number of changes and complexity of the changes determine how much time is needed. The characteristics of the requirements determine the potential need for rework and extra time needed on clarifying the requirements.

The identified performance measures for the demand performance area are:

- The total numbers of changes which the validation rule update cycle contains
- The complexity of these updates; each update is identified as simple, medium or complex
- The stability of the requirements is measured by the number of requirement changes during the update cycle
- The timeliness of requirements is measured by the number of additional requirements which arise after the development is started
- The quality of the requirements is measured by the number of requirement alignment sessions that are needed during implementation and the number of revision cycles which are needed before a new version of the validation rules is completed

**Output**

As described earlier the output of the validation rule update process is a new revision of the validation rules with the related documentation and support. These validation rules are used as an internal capability for the validation of the data which is uploaded towards the DGAAO and it is shipped as deliverable capability package towards the forensic care organization and their software suppliers for the development of registration systems.

The identified performance measures for the internal capability and the deliverable capability package are:

- The total number versions of the validation rules which are developed over time
- The size (number of pages) of the supporting usage guidance and documentation products.

**Effectiveness**

Like the code lists and the registration model the effectiveness of the validation rules is mainly influenced by the product adoption rate of the forensic care organizations. Product characteristics like usability and support are indirect performance areas which influence the adoption (use) rate of the forensic care organizations.

The identified performance measures for the product performance area are:

- The usage of the product is measured by the number of organizations which implemented the latest version of the validation rules
- The user satisfaction is measured with a survey which assesses the products score on timeliness, usability and quality
- The support effectiveness is measured by the number of support calls and account management questions
Effect

The identified performance measure in the political effect performance area is the number of forensic care organizations which have implemented the validation rules in their registration software. This indicates the percentages of forensic care organizations which are aligned to the somatic care DBC registration approach.

The identified performance measure in the productivity enhancement performance area is the number of DB(B)C’s which are registered according to the latest version of the validation rules. Each DB(B)C that is registered according to the new validation rules enhances transparency as it is available for comparisons and analytical research.

10.4 The DGAAO capabilities

Being the central data warehouse environment, the DGAAO is the technical hart of the DB(B)C approach. It facilitates the upload of data by the forensic care organizations and it validates and processes the data into usable output capabilities. Because of the important role that the capabilities fulfill within the BICC, the DGAAO capabilities are identified as an important intermediate product and therefore worthwhile measuring. The purpose of the DGAAO is to standardize and optimize the data capturing and processing capabilities for reuse within multiple data intensive deliverables which are available to the end users. The centralized approach will reduce the development costs and it will enhance the quality of the deliverables.

The identified performance areas and example measures are:

Funding

- Project funding - funding needed for the development of the DGAAO (total costs)
- Project funding - funding needed for the usage of the DGAAO (total costs)

Economy

- External personnel - rate per DB(B)C FZ discipline (rate)
- Vendor management - rate per installed SQL server (setup costs and monthly costs)
- Vendor management - price additional storage (price for GB per month)

Input

- Personnel - Management for coordination and alignment (hours spent)
- Personnel - Account management personnel for input on business knowledge (hours spent)
- Personnel - Development personnel for translating requirements into capabilities (hours spent)
- Capabilities - Configured SQL Servers (number of available and used servers)
- Capabilities - Data storages (available and used GB per server)
- Capabilities - Dataflow tooling (available yes / no)
- Capabilities - Reporting and exporting facilities (available yes / no)
- Capabilities - Portal facility for publication (available yes / no)
Efficiency
- Demand - Stability of the requirements (number of requirement changes)
- Demand - Timeliness of the requirements (number of added requirements after start)
- Demand - Quality of the requirements (number of sessions needed during implementation)
- BI Usage - Scheduling (number of executed DGAAO data upload runs, time consumed per run)
- Delivery - Data integration (number of simple, medium and complex data flows, time needed to develop each dataflow)
- Delivery - Data store development (number of simple, medium and complex updates on data stores and data marts, time spend per data store and data mart)
- Delivery - Frontend-BI development (time spent on implementation of upload platform, time spent on implementing report platform)
- Delivery - Frontend-BI Distribution (time spent on implementing/configuring portal)

Output
- Deliverable - Upload portal (available yes / no)
- Capabilities - Data flows (number of realized data flows in ETL and data mart transitions, usage (number of actual runs) per dataflow)
- Capabilities - Data storage (number of data marts, number of facts, number of technical valid facts, number of technical and business wise valid facts)
- Capabilities - DB(B)C FZ specific reporting platform (available yes / no)
- Capabilities - Export facilities (number of specific data exports)

Effectiveness
- Product - Usage (number of reports based on the DGAAO, how often did a specific export run)
- Product - User satisfaction (survey score on usability of the upload portal)
- Product - Information quality (number of available validated facts)
- Exogenous - Political pressure (is the registration mandatory yes / no)
- Exogenous - Economical (total budget available for implementing DB(B)C’s)

Effect
- Enhanced data availability (number of available facts)
- Enhanced data quality (number of technical and business wise valid proved facts)
- Reduction of development costs per report and export (average price per export and average price per report)
10.5 Self service reports

The self service reports are available to the forensic organizations and the account managers of the DB(B)C FZ project. These self service reports enable forensic organizations to assess their DGAAO upload. It indicates what the quality of the delivered data is and which issues exist within the dataset. Another function of the self service reports is to provide insight in the actual performance of the forensic organization. The performance on the forensic care execution of specific care organization is compared to the national average.

The identified performance areas and example measures are:

**Funding**
- Project funding - funding needed for the development (total costs)

**Economy**
- External personnel - rate per DB(B)C FZ discipline (rate)

**Input**
- Personnel - Management for coordination and alignment (hours spent)
- Personnel - Account management personnel for internal knowledge transfer and external business alignment (hours spent)
- Personnel - Development personnel for translating requirements into entities and attributes (hours spent)
- Capabilities - Data storage (number of data marts used)
- Capabilities - Reporting facilities (number of reports which use the facility)
- Capabilities - Portal facility for publication (available yes / no)

**Efficiency**
- Demand - Complexity of the updates (simple, medium, complex)
- Demand - Stability of the requirements (number of requirement changes)
- Demand - Timeliness of requirements (number of added requirements after start)
- Demand - Quality of the requirements (number of sessions needed during implementation)
- BI Delivery - Additionally needed data integration (time spent on data related development)
- BI Delivery - Frontend-BI Application development (time spent on designing the report)

**Output**
- Deliverable - Self service reports (number available self service reports)
- Deliverable - Training (hours spent on training end users)
**Effectiveness**

- Product - Usage (number of hits on a report, essential for data monitor yes / no)
- Product - User satisfaction (survey score on timeliness, usability, quality)
- Product - Support (number of support calls and account management questions for the report)
- Product - Information quality (available validated facts in report)
- Exogenous - Political pressure (are their formal targets for data upload and quality yes / no)
- Exogenous - Economical (total budget available for implementing DB(B)C’s)

**Effect**

- Enhanced data availability (number of available facts)
- Enhanced data quality (number of technical and business wise valid proved facts)

**10.6 The data monitor**

Data quantity and quality of forensic care treatments are essential for the deduction of a stable DB(B)C product structure. In order to get insight in the quality of the filling of the complete DGAAS a data monitor report / document is created after each data upload cycle. This data monitor provides information on data deliveries in general (number of facts and the distribution of the target groups), data quality and quantity, and the "filling" of the future product structure based on the most recently available data.

Account managers use this information to optimize their account management tasks (for example they can visit more organizations in a target group which lacks data deliveries). Organizations might be motivated by the product to start delivering data if they are aware of the problems that exist in their target group. The data monitor might even lead to the definition of new rules and regulations for the DB(B)C FZ approach if major issues exist for a longer period. The document will help the Justice department to define the new rules and regulations the right way.

The identified performance areas and example measures are:

**Funding**

- Project funding - funding needed for the monthly complex analysis report (total costs)

**Economy**

- External personnel - rate per DB(B)C FZ discipline (rate)

**Input**

- Personnel - Management for coordination and alignment (hours spent)
- Personnel - Account management personnel for internal knowledge transfer and external business alignment (hours spent)
- Personnel - Advanced analysis personnel for translating requirements into analytical models and composing the monthly reports (hours spent)
- Capability - Previous version of the analytical models (number of used existing models)
- Capabilities - Reporting facilities (number of self service reports used)
- Capabilities - Data facilities mat lab extraction (number of facts in advanced analysis dataset)
**Efficiency**
- Demand - Complexity of the updates on the report (simple, medium, complex)
- Demand - Stability of the requirements (number of requirement changes)
- Demand - Quality of the requirements (number of sessions needed during implementation)
- BI Delivery - Additionally needed data integration (time spent on data related development)
- BI Delivery - Additionally needed statistical analysis (time spent on non automated analysis)
- BI Delivery - Frontend-BI Application development (time spent on designing the report)

**Output**
- Deliverable - Complex analytical report (number of created data monitors)
- Deliverable - Support (time spent on explaining the data monitor results)

**Effectiveness**
- Product - Usage (survey on the actual use by forensic organizations and account managers)
- Product - User satisfaction (survey score on timeliness, usability, quality)
- Product - Support (number of support calls and account management questions on the data monitor)
- Product - Organizational impact (number of times the monitor led to rules and regulations)
- Exogenous - Political pressure (are there formal targets for data upload and quality yes / no)
- Exogenous - Economical (total budget available for implementing DB(B)C’s)

**Effect**
- Enhanced data availability (number of available facts per target group and product)
- Enhanced data quality (the statistical backing percentage per product group)
10.7 The account management visits

The account management visits are organized to guide the forensic organization in implementing the DB(B)CFZ approach. On the client location the account manager meets representatives of the forensic organization who are tasked with the DB(B)C implementation. New developments and experiences with the existing DB(B)C approach are discussed. Issues that exist are analyzed and resolved by the account manager in cooperation with the developers and analytical experts. The end users are trained on location in using the self service reports. The goal of the visits is to identify improvement possibilities which can be input for the next expert group meeting and to help and encourage organizations to intensify and enhance their DGAAO data deliveries.

The identified performance areas and example measures are:

**Funding**
- Project funding - funding needed for the visits (total costs)

**Economy**
- External personnel - rate per DB(B)C FZ discipline (rate)

**Input**
- Personnel - Account management personnel for internal and external (hours spent)
- Personnel - Advanced analysis for support (hours spent)
- Personnel - Development personnel for support (hours spent)

**Efficiency**
- Demand - Request management and prioritization (visits per target group)
- BI Usage - Support questions (number of question answered by analytical development)

**Output**
- Deliverable - Business consulting (number of visits per organization)
- Deliverable - Evangelization (number new organizations visited)
- Deliverable - Support (number of questions answered)

**Effectiveness**
- Product - Usage (number of visits per organization)
- Product - User satisfaction (survey score on timeliness, usability, quality)
- Product - Support (number of questions answered)

**Effect**
- Enhanced data availability (number of available facts)
- Enhanced data quality (number of technical and business wise valid proved facts, statistical backing percentage per product group)
10.8 The validation test

The validation test is a technical consultancy product which is designed for software suppliers in the forensic sector. A software supplier can take part in the validation test process which is offered at the end of each adjustment increment of the registration model, code lists and validation rules.

The test will assess the supplier specific implementation of the registration model, code lists and validation rules within the end user product that the supplier delivers. With this assessment the supplier knows in an early stage if their product is compatible with the DB(B)C approach which will be used during the next increment. This will prevent late costly bug fixing, it enhances customer satisfaction and it ensures continuity.

The identified performance areas and example measures are:

**Funding**
- Project funding - funding needed for the validation test (total costs)

**Economy**
- External personnel - rate per DB(B)C FZ discipline (rate)

**Input**
- Personnel - Account management personnel for executing the test (hours spent)
- Personnel - Development personnel for the support (hours spent)
- Capability - Previous version of the validation test (available yes / no)

**Efficiency**
- Demand - Number of updates compared to last year (total number of updates)
- Demand - Complexity of the updates (simple, medium, complex)
- BI Usage - Support questions (number of question answered by the development team)

**Output**
- Deliverable - Technical consulting on model en rules next increment (number of tests)

**Effectiveness**
- Product - Usage (percentage of suppliers which take part in the test)
- Product - User satisfaction (survey score on timeliness, usability, quality)
- Exogenous - Competition between suppliers (number of organizations which are looking for a new supplier)
- Exogenous - Technological state of the supplier’s product (indication bad, average, good)

**Effect**
- Consistency in the data quality (number of valid facts per forensic organization in the first months of a new increment)
10.9 The DB(B)C FZ product structure

The DB(B)C FZ product structure plays a crucial role in the DB(B)C FZ approach as it is the language for the communication about supplied forensic care and the basis for the new financial compensation model. All monthly data uploads together form the statistical basis for the deduction of a product structure which suits the forensic care system. The DB(B)C FZ product structure contains a limited set of generic products which can be used to treat forensic illnesses that cause criminal behaviour. With this baseline of products it becomes transparent which treatments are performed per patient and how successfully the forensic organization is performing the application.

The creation of the product structure is an analytical process which assesses the content and quality of the historical forensic data. It deducts potential generic products. These products are validated by a group of experts and approved by the Dutch care authority. Forensic care organizations have to fit their treatments into these products in order to get their financial compensation.

The identified performance areas and example measures are:

**Funding**
- Project funding - funding needed for the product structure analysis, development and validation (total costs)

**Economy**
- External personnel - rate per DB(B)C FZ discipline (rate)

**Input**
- Personnel - Management for coordination, alignment and communicating result (hours spent)
- Personnel - Account management personnel for forensic specific knowledge (hours spent)
- Personnel - Advanced analysis personnel for translating requirements / data into a product structure and for clarifying the results towards the expert group (hours spent)
- Capability - Previous version of the product structure models (number of standard models)
- Capabilities - Data facilities mat lab extraction (number of facts in the advanced analysis dataset)
**Efficiency**
- Demand - Complexity of the updates on report (simple, medium, complex)
- Demand - Stability of the requirements (number of requirement changes)
- Demand - Quality of the requirements (number of sessions needed during implementation)
- BI Delivery - Additionally needed data integration (time spent on data related development)
- BI Delivery - Additionally needed statistical analysis (time spent on non-automated analysis)
- BI Delivery - Frontend-BI Application development (time spent on composing the product structure)

**Output**
- Deliverable - Complex analytical product structure (number created product structures)
- Deliverable - Supporting usage guidance and documentation (size of the documentation)

**Effectiveness**
- Product - Usage (total of products which pass the expert and care authority assessment)
- Product - User satisfaction (total of products which pass expert and care authority assessment)
- Product - Support (number of expert questions successfully answered)
- Social - Public opinion about the DB(B)C FZ approach (survey questions that test the expert’s opinion about the DB(B)C FZ approach)

**Effect**
- Alignment with somatic care system (only way of supplying care yes / no)
- Enhanced transparency in treatments and costs (survey on success)
- Ensurement that the right patient is at the right place (recidivism rates, average treatment time and average number of transfers per patient)
10.10 The business case research experience

During the business case research the DB(B)C FZ specific performance measurement areas were identified based on the newly developed performance measurement framework for the Business Intelligence function.

The first experiences with the performance measurement framework were positive because it is a great catalyst for activating a structured discussion on the important performance measurement areas of the DB(B)C FZ BICC. The DB(B)C FZ team members indicated that performance areas are recognizable and that the structured approach activates the discussion on performance areas.

The usability of the framework is not yet optimal because of the complex structure and the extensive set of performance areas. At a first glance it will not always be clear in what stage or process a performance area fits. In addition to that the repetition of certain performance areas suggests that there is a great deal of overlap in the framework. More in-depth knowledge of the framework is needed to notice that there is actually no overlap present in the framework, because the performance area in combination with the stage or process defines the measure. Even with this insight the team members are still struggling to find the right place for a specific measure.

Another pitfall in the framework is the extensive set of performance measurement areas. This proved to be an invitation to the framework user to define a measure for every performance area. This way of working results in an extensive set of performance measures which becomes very difficult to understand. In addition to that it will probably be very costly to start measuring all of these measures and the added value of certain measures is doubtedly.

Future users of the performance measurement framework must keep in mind that the framework is a first step towards a comprehensive framework. Therefore the usage of the framework asks for a flexible and creative approach in translating performance areas towards the business specific performance areas. In that process new performance areas might emerge and existing areas might prove not to be worthwhile measuring. Each identified business specific performance area measure must be validated on its added value with a cost and benefit analysis. This will prove if it is worthwhile measuring.

Besides these generic findings it is important to keep in mind that this business case assessment is very limited compared to the whole performance measurement approach of the Business Intelligence function.

First of all the business case only proves that it is possible to define performance measurement areas and associated measures based on the generic performance measurement framework. It does not prove that it is possible to actually measure the resulting set of performance areas within the DB(B)C FZ project. As a result the business case does not prove that the measures enhance the insight in the BICC. The possibilities to set up an accountable cycle and an improvement cycle based on the resulting dataset is left out of the scope of the business case as well. Another important limitation is the partial assessment of the performance measurement framework by the business case. During the business case not all performance measurement areas proved to be applicable to the DB(B)C FZ BICC. This was expected when setting up the framework as it is an extensive set of generic measures which must be tailored to a client specific situation. Therefore the business case only proves that the approach is applicable and that part of the framework is valid. It does not assess the validity of the whole framework.
11. Conclusion

Despite the significantly increased attention and continuing growth of Business Intelligence application, there is still a lot of discussion and criticism about the actual added value it delivers. The goal of this research is to construct a comprehensive performance measurement framework which enables organizations to measure the added value of their Business Intelligence function. This framework reaches a level of detail which provides organizations with concrete performance indicators. These indicators can be used for calculations and strategic decision making. Ultimately the performance framework can be used to calculate and proof the added value that the Business Intelligence function delivers to the organization.

11.1 Research questions

In order to develop this comprehensive performance measurement framework, the following research questions were defined:

- What is a Business Intelligence (function).
- What theory is currently available regarding:
  - Performance measurement of the Business Intelligence function.
  - Performance measurement on a more general level
  - Business Intelligence measurement metrics.
  - Added value models for Business Intelligence.
- Is it possible to align the general and Business Intelligence specific theories into one framework which enables the measurement of added value in the Business Intelligence function?
- Is the resulting framework applicable and effective in real world situations?

What is a Business Intelligence function

The scope of this Business Intelligence performance measurement research is limited to the Capgemini Business Intelligence approach for the public market. The top level concept within the Capgemini approach is the Business Intelligence function. The Business Intelligence function is a container term for all intelligence related activities which are carried out within the business process. These activities can be very diverse and they do not have to be identified or institutionalized as (business) intelligence activities within the existing organization. They can be informal and widely spread in the business process.

Within the Capgemini approach the organization of the Business Intelligence function is divided into three major views:

The first view is the usage of the Business Intelligence environment; this contains all activities related to using the Business Intelligence products within the organization’s business processes. Main concept within the usage view is the Business Intelligence appliance cycle. This cyclic model gives insight in the way the Business Intelligence user (actor) uses information to influence the business process (scope). This usage will create the actual added value of the Business Intelligence function.

The production view is organized to produce the information products within the Business Intelligence function. It is a set of process cycles which respond to intelligence related questions which arise within the usage view. The production cycle is organized to respond to two types of information requests. The first type is the structural information request which repeats on a regular basis, it is optimized for quick and efficient response. The second type is the ad-hoc information request; this request leads to a custom made information product which is composed by hand.
The management view covers the governance of the Business Intelligence function. It is responsible for the strategic decisions and for aligning the usage and production view.

In addition to the Business Intelligence function the concept of the Business Intelligence competence center (BICC) is introduced to set a scope for the research. Within the Capgemini Public Business Intelligence approach the BICC plays an important role in leveraging the full potential of the Business Intelligence function.

A BICC is a cross-functional team, in which different complementing competences, insights and perspectives are combined. It has specific tasks, roles, responsibilities and processes and a permanent formal organization structure. The BICC has a mandate to coordinate all Business Intelligence related initiatives and its overarching goals are to align Business Intelligence with the organization’s strategy and objectives to strategically leverage the benefits of Business Intelligence by supplying, supporting and promoting effective use of Business Intelligence across the organization.

Available theory on performance measurement of the Business Intelligence function

The literature research on performance measurement of Business Intelligence showed that there is currently very scarce literature available on this subject and that there is no comprehensive model or framework for measuring the full Business Intelligence process. In this research area the DeLone and McLean Model of Information Systems Success (2003) and the Competitive Intelligence Measurement Model (CIMM) (Davison 2001) proved to be just the start of a comprehensive model. Lönnqvist and Pirrtimäki (2006) propose a balanced performance based measurement model as a potential measurement approach for the Business Intelligence function. Because of the lack of literature the nature of the research became theory developing.

Available theory on performance measurement on a more general level

Literature on general performance measurement showed that a performance measurement model could be used to assess the performance of the Business Intelligence function. The business balanced score card and the value-for-money analysis were compared as potential models. The value-for-money analysis had the best fit because it has got a broader scope than the business balanced scorecard. In addition to that the simple approach and better traceability favored for the value-for-money analysis.

Business Intelligence measurement metrics

Within multiple articles indications were made on what could be measured in order to assess the performance of a Business Intelligence solution. All of these measures proved to be situation specific examples which had no real scientific backing. The examples were very high level and fragmented, therefore no comprehensive set of generic Business Intelligence metrics was found.

Added value models for Business Intelligence

During the literature research no Business Intelligence specific added value model was found.
Is it possible to align the general and Business Intelligence specific theories into one model which enables the measurement of added value of the Business Intelligence function?

The literature research did not provide a workable Business Intelligence specific performance measurement model or framework. Therefore a more generic performance measurement model was used as a basis. Because of its characteristics and fit the value-for-money analysis approach is used to develop a performance measurement model for the Business Intelligence function.

The existing literature on Business Intelligence performance measurement is assessed based on the value-for-money approach and it proves to be possible to fit important parts of this theory into the value-for-money analysis. In order to get the targeted comprehensive view on the added value, literature on organizing and applying BICC’s is used to complement the framework. Unfortunately it turned out that it was not possible to build the framework solely on literature; therefore the framework was supplemented with the business knowledge of Capgemini Business Intelligence experts.

The resulting framework sets a baseline with BICC performance areas per value-for-money stage or process. Performance areas were identified for the stages funding, input, output and effect. Additional performance areas were identified for processes economy, efficiency, effectiveness, financial result and organizational result.

Because of the comprehensive approach and the scope of a generic BICC the resulting framework contains a very broad set of performance areas. These areas might not be applicable or useful in every BICC situation. Therefore the resulting model must be used as a framework which identifies BICC performance areas that might be worthwhile measuring for an organization. An organization can use the performance areas of the framework to tailor their own Business Intelligence performance measurement model. When the identified performance measures are well chosen and measured over time it will eventually be possible to assess the added value and optimize the performance of the Business Intelligence function. The concepts of a formal accountability cycle and an improvement cycle can help organizations to leverage the full potential of the framework.

Is the resulting framework applicable and effective in real world situations?

The framework is tested against the real world DB(B)C FZ business case which is provided by Capgemini Public. The DB(B)C FZ project organization is tasked with the implementation of the DB(B)C approach in the whole forensic care sector. The DB(B)C is a healthcare model that determines and optimizes the financial compensation for forensic/medical treatments. Business Intelligence is one of the drivers within the DB(B)C approach and the project is executed by a small project team which fits the characteristic of a BICC. This makes it a very suitable business case.

The research on the DB(B)C FZ case showed that the framework is a useful tool when identifying performance areas within a BICC. It offers a structural approach with recognizable generic performance areas which guide an organization towards a tailored and comprehensive performance measurement model for their BICC. The first experiences with the performance measurement framework were positive because it is a great catalyst for activating a structured discussion on the performance measurement of the BICC.
11.2 Findings

Although the first experiences with the performance measurement approach were very positive, the usability of the framework is not yet optimal because of the complex structure and the extensive set of performance areas. In addition to that the repetition of certain performance areas suggests that there is a great deal of overlap in the framework. More in-depth knowledge of the framework is needed to notice that there is actually no overlap present in the framework. Another pitfall in the framework is the extensive set of performance measurement areas. This proved to be an invitation to the framework user to define a measure for every performance area. This leads to an extensive set of performance measures that is difficult to understand and probably not worthwhile measuring as a whole.

The usage of the performance measurement framework asks for a flexible and creative approach in translating performance areas towards the business specific performance areas. In that process new performance areas might emerge and existing areas might prove to be not worthwhile measuring. Each identified business specific performance area measure must be validated on its added value with a cost and benefit analysis. This will prove if it is worthwhile measuring.

Besides these generic findings it is important to keep in mind that this business case assessment is very limited compared to the whole performance measurement framework of the Business Intelligence function. The business case only proves that it is possible to define performance measurement areas and measures based on the generic performance measurement framework. It does not prove that it is possible to actually measure the resulting set of performance areas within the DB(B)C FZ project.

Another important limitation is the partial assessment of the performance measurement framework by the business case. Not all performance measurement areas proved to be applicable to the DB(B)C FZ BICC. As a result it does not assess the validity of the whole framework.

The goal of this research was to construct a comprehensive performance measurement framework which enables organizations to measure the added value of their Business Intelligence function. This framework should reach a level of detail which provides organizations with concrete performance indicators. These indicators can be used for calculations and strategic decision making. Ultimately the performance framework can be used to calculate and proof the added value which the Business Intelligence function delivers to the organization.

Due to the limited scientific information which appeared to be available and the limitations on the time for this thesis, it was not possible to reach the complete goal which was set at the start of the research. The research managed to construct a comprehensive performances measurement framework which enables organizations to measure the added value of their Business Intelligence function. But it is limited to the indication of performance areas which might be worthwhile measuring and it does not provide a set of concrete performance indicators. Therefore it is not yet possible to create calculations on the framework which prove the added value that the Business Intelligence function delivers.
11.3 Social relevance

With this research we managed to set up a generic and comprehensive balanced performance measurement framework for the full Business Intelligence function. It combines the scarce literature which is currently available with more generic performance measurement theory. These insights are validated and extended by Capgemini experts who represent multiple years of in-depth Business Intelligence experience. With this approach the research offers a new insight in the way the performance can be measured comprehensively on Business Intelligence projects and organizations.

The resulting performance measurement framework extends the existing literature with a renewing and practical concept for the comprehensive measurement of the Business Intelligence function. The contributed measurement approach can form the basis for future scientific research and it might inspire other researchers to validate and extend the framework based on their experiences and insights.

During the business case, we tested the validity and usability of the new performance measurement framework. While performing this test it indirectly validated the underlying literature of the performance measurement framework. This test proved that the used literature on general and Business Intelligence specific performance measurement is valid and applicable in a real world situation. The performed case study contributes to the scarce scientific backing of the used literature.

From a business perspective the research contributes a new and practical approach for the performance measurement of the Business Intelligence function. The structured approach can help organizations to implement their own Business Intelligence performance measurement model. These measurement models will enhance the transparency of their Business Intelligence function and it creates insight in the actual performance. This information can be used for optimization and accountability purposes.

An organization specific performance measurement model can guide optimization as it enhances the insight in the actual performance on a specific performance area. This detailed view can uncover existing problem areas and it can be used to identify potential optimization areas. The structured approach makes it easier to communicate about the problem area with the team members and it provides them with insight on the future goals. Because of the cyclic approach the effect of changes to the Business Intelligence process is structurally measured over time. The resulting information can be used to assess the success of a certain optimization action and it might uncover negative effects that occur on related performance areas. This knowledge can be used for further optimization and it supports the organization in defining their Business Intelligence strategy.

The enhanced accountability information on performance areas of the Business Intelligence function enables organizations to prove and assess the actual added value. The information can for example be used to assess the targets of the initial business cases based on the actual performance. The assessment identifies whether target where met and if discrepancy occur the measurement model can be used to analyze the cause. The fact based approach will uncover the actual success / performance of the project. This detailed information will probably convince the stakeholders of the projects success and the results can easily be shared across the organization.

The detailed performance / success information on historical projects is also a potential sales tool. It can be used to prove the organizations competences to potential customers and it can be used to persuade existing customers in starting new Business Intelligence improvement projects.
11.4 Recommendations

Based on the experience during the workshops with the DB(B)C FZ team members, it showed that the performance measurement framework is accelerating discussions and it tends to be an invitation to define an extensive set of performance measures. Due to these characteristics a focus on essential performance measures is needed.

Within the DB(B)C FZ situation a product by product approach turned out to be a good way of applying the framework. Within this approach the value of the product is discussed and a comprehensive view of the cause and effect relation within the product emerges. In addition participants of the discussion are focused on one performance subject and it is easier to find relevant performance areas and place them in the appropriate process or stage.

Another helpful addition on the generic Business Intelligence performance measurement framework would be the definition of a set example measures for each performance area. This will help the user in identifying an equivalent for their specific BICC.

Due to the limited time which is available for this thesis it was not possible to perform the actual measurement of the identified performance areas. Additional research is needed to determine if the identified performance areas are easy measurable and enhance the insight in the performance of the DB(B)C FZ BICC. The relation between measurement costs and the value the enhanced insight delivers must be assessed to prove if it is useful to start measuring a performance area.

As a subsequent step the resulting set of performance measures can be used to implement the concept of an accountability cycle and an improvement cycle. This will assess the completeness and concreteness of the DB(B)C FZ specific performance measurement model. Application of these two cycles might indicate that the performance model is incomplete and new measures must be gathered. This information is valuable input for the completion and assessment of the generic Business Intelligence performance measurement framework.

Another important next step is the validation of the complete Business Intelligence performance measurement framework. This can be done by applying the framework to multiple BICC’s which vary in size and scope. Each application will validate the value of the existing performance measurement areas. Over time some areas will be proved to be irrelevant and other new performance areas will emerge over time. Subsequent revision of the framework will lead to a more stable and sophisticated approach.

The suggested performance measurement framework does not pretend to be fully comprehensive and correct, but it is a first step towards a complete and validated solution for performance measurement of the Business Intelligence function. It has got a degree of scientific backing and it is assessed on a theoretical and practical level by Capgemini Business Intelligence experts and in a real world business case.

Hopefully the constructed Business Intelligence performance measurement framework provides a solid basis for further research, which will eventually lead to a practical and comprehensive framework which is widely adopted.
Acknowledgment

With the conclusion of this thesis on “The performance measurement of the Business Intelligence function” there will come an end to my Master of Science Study - Business Process Management and IT. Over the past three years this study enabled me to advance my skills in the area of information technology and management. It was a great supplement to my existing working experience at Capgemini Nederland B.V. Although it was sometimes hard to find some spare time next to my full time job, it was worthwhile investing in it. Especially the last stages of the thesis were very restraining and asked sacrifices from my environment and me. Undoubtedly I have been less available for family and friends.

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I would like to thank the DB(B)C FZ project team for their support during the business case research. They were willing to free up the time in their tight schedules and they provided me with valuable business knowledge. It was a great experience to work together with these professionals and their effort enabled me to test the applicability of the framework in a real world situation.

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References


Giessen, R. (2008), Designing Business Intelligence Organizations, Utrecht University, The Netherlands


Lönnqvist, A. & Pirttimäki, V. (2006), The measurement of Business Intelligence, Tampere University of Technology, Tampere.


Strange, K.H. & Hostmann B. (2003), BI Competency Center Is Core to BI Success No AV-20-5294, Gartner.


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Appendix A - A general Business Intelligence implementation

A general Business Intelligence implementation contains a variety of technologies and tools. From a technological perspective, the process can be logically visualized as in figure 29. The figure visualizes a simplified and basic architecture of a Business Intelligence implementation.

**Figure 29: “Typical Business Intelligence implementation”**

**Data sources**
These are the actual sources of data for the data warehouse. These can be very diverse like operational databases, legacy systems, transaction systems, ERP systems. Data sources contain detailed data that can be used for analytical purposes.

**Extraction, Transformation, Load (ETL)**
ETL connects the different data sources, it extracts, transforms and integrates relevant data and loads it in a standardized way into the data warehouse.

**Data warehouse and data-marts**
A data warehouse is centralized and specially prepared data storage that support decision making. All the loaded and validated data is stored in a generic data structure. On a smaller scale, subsets of these data warehouses, known as data marts are used to optimize data sets for specific (reporting) tasks and end users. Performance, security and a differencing data structure need can be reasons to use data marts.
**On-Line Analytical Processing (OLAP)**
OLAP is a combination of optimized technologies and applications used for the online retrieval and analysis of data. It is optimized for data intensive actions and it enables users to reveal business trends and statistics on a time scale.

**Data mining**
Data mining tools can be used to analyze large volumes of data in order to find patterns and relationships that enhance business insight and support decision making.

**Reporting**
Reporting tools are tools that extract, sort, summarize, and present selected data to the end users. Business Intelligence information is turned into graphs, charts, gauges and lists to support the decision making process.
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