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http://hdl.handle.net/10026.1/3255

http://dx.doi.org/10.24382/4828
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SUSTAINABILITY REPORTING PROCESS MODEL

USING BUSINESS INTELLIGENCE

by

THORSTEN JULIUS ALXNEIT

A thesis submitted to Plymouth University
in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

School of Computing and Mathematics (Faculty of Science & Environment)

In collaboration with
University of Applied Sciences Furtwangen, Germany

January 2015

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To my beloved parents. I hope they would have been proud of me.

Abstract

Sustainability Reporting Process Model using Business Intelligence

Dipl Inf. (FH) Thorsten Julius Alxneit

Sustainability including the reporting requirements is one of the most relevant topics for companies. In recent years, many software providers have launched new software tools targeting companies committed to implementing sustainability reporting. But it's not only companies willing to use their Business Intelligence (BI) solution, there are also basic principles such as the single source of truth and tendencies to combine sustainability reporting with the financial reporting (Integrated Reporting)

The IT integration of sustainability reporting has received limited attention by scientific research and can be facilitated using BI systems. This has to be done both to anticipate the economic demand for integrated reporting from an IT perspective as well as for ensuring the reporting of revisable data. Through the adaption of BI systems, necessary environmental and social changes can be addressed rather than merely displaying sustainability data from additional, detached systems or generic spreadsheet applications.

This thesis presents research in the two domains sustainability reporting and Business Intelligence and provides a method to support companies willing to implement sustainability reporting with BI. SureBI presented within this thesis is developed to address experts from both sustainability and BI. At first BI is researched from a IT and project perspective and a novel BI reporting process is developed. Then, sustainability reporting is researched focusing on the reporting content and a sustainability reporting process is derived. Based on these two reporting processes SureBI is developed, a step-by-step process method, aiming to guide companies through the process of implementing sustainability reporting using their BI environment. Concluding, an evaluation and implementation assesses the suitability and correctness of the process model and exemplarily implements crucial IT tasks of the process.

The novel combination of these two topics indicates challenges from both fields. In case of BI, users face problems regarding historically grown systems and lacking implementation strategies. In case of sustainability, the mostly voluntary manner of this reporting leads to an uncertainty as to which indicators have to be reported. The resulting SureBI addresses and highlights these challenges and provides methods for the addressing and prioritization of new stakeholders, the prioritization of the reporting content and describes possibilities to integrate the high amount of estimation figures using BI. Results prove that sustainability reporting could and should be implemented using existing BI solutions.

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List of Abbreviations

3BL	Triple Bottom line
7PMG	Seven Project Management Guidelines
API	Application Programming Interface
BI	Business Intelligence
BICC	Business Intelligence Competency Center
BISE	Business and information systems engineering
BPM	Business Performance Management
BPMN	Business Process Management Notation
BSC	Balanced Scorecard
CO	Controlling
CO2	Carbon Dioxide
CPM	Corporate Performance Management
CR	Corporate Responsibility
CSF	Critical Success Factor
CSR	Corporate Social Responsibility
CSV	Comma separated value
DW	Data Warehouse
EMS	Environmental Management System
ERP	Enterprise Resource Planning
ETL	Extract, Transform, Load
EU	European Union
GAAP	General accepted accounting principles
GRI	Global Reporting Initiative
HGB	Handelsgesetzbuch (German Commercial Code)
HR	Human Resources
HTML	Hypertext Markup Language
IAS	International Accounting Standards
ID	Identification
IFRS	International Financial Reporting Standards
ISO	International Organization for Standardization

IT	Information Technology
KPI	Key Performance Indicator
MDM	Master Data Management
NGO	Non-governmental Organization
OLAP	Online Analytical Processing
OLTP	Online-Transaction-Processing
PHP	Hypertext Preprocessor
PSA	Persistent Staging Area
QA	Quality Assurance
R&D	Research & Development
RDBMS	Relational Database Management System
ROI	Return On Investment
SBSC	Sustainability Balanced Scorecard
SLA	Service Level Agreement
SureBI	Sustainability Reporting Process with BI
UN	United Nations
URL	Uniform Resource Locator
WEF	World Economic Forum
XML	Extensible Markup Language

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ACKNOWLEDGEMENTS

This work and, indeed, the PhD, would not have been possible without the help and support of my Director of Studies, Dr. Martin Knahl and my supervisors Dr. Monika Frey-Luxemburger and Dr. Steven Furnell who spent a great deal of time proofreading and in constructive discussions providing new perspectives including those besides the consulting view. I learned very much through our conversations! Thanks also goes to Carole Watson for her expeditious support!

A special thanks to my girlfriend, Dr. Kathrin Schmalisch for her love, her patience, her unending support and for believing that was all worth it.

The work of this thesis was supported by many friends and family, therefore I extend a special "thank you" to my sister Silke Langer and her husband Andreas for the support. To my nephew Jonas and my niece Marie – this is what uncle Thorsten has been doing lately.

Last not least para la familia española – gracias por vuestros consejos y el apoyo desde Madrid.

AUTHORS DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment.

Relevant seminars and conferences were regularly attended at which work was often presented and several papers prepared for publication.

Word count of this PhD thesis: 51.985

Signed ....

Date ....

1 INTRODUCTION & OVERVIEW

Sustainability reporting, the reporting of non-financial information, is and has been a relevant topic causing concern for companies struggling with how to handle this predominantly voluntary form of providing transparent information about their sustainable development. The recent findings from the KPMG International Survey of Corporate Responsibility Reporting show that such reporting is now undertaken by 95 percent of Fortune Global 250 companies (KPMG, 2014a, p. 1). The requirement to further research methods designed to create this form of reporting utilizing IT solutions is described within this chapter followed by section 1.1 which gives an overview of the two main topics: sustainability reporting and Business Intelligence. Section 1.2 outlines the target audience for whom this thesis is developed. Furthermore, section 1.3 outlines the structure of this thesis, giving an overview of each chapter. Concluding, section 1.4 aims to give an overview about literature concerning the topics Business Intelligence, sustainability reporting and outlines the current state regarding the combination of sustainability reporting linked to Business Intelligence.

1.1 Implementation of Sustainability Reporting using Business Intelligence

This thesis aims to combine two major topics: sustainability reporting and Business Intelligence. As discussed in section 1.4, each topic has been addressed by research and documented in literature, however the combination of these two topics is rarely explored in current research and literature.

The topic of sustainability reporting, which is further described in chapter 6, can be described as voluntary reporting as opposed to mandatory financial reporting, describing the sustainability endeavors of, for example, a company. There are several reasons to report on sustainability indicators such as, for example, to improve a company's public reputation or perception (see also chapter 6). Although this kind of reporting is not obligatory in most countries, most of the larger companies worldwide report on sustainability as shown in Figure 1.1 and adhere to international reporting standards such as, in this case, the guidelines from the Global Reporting Initiative (GRI).

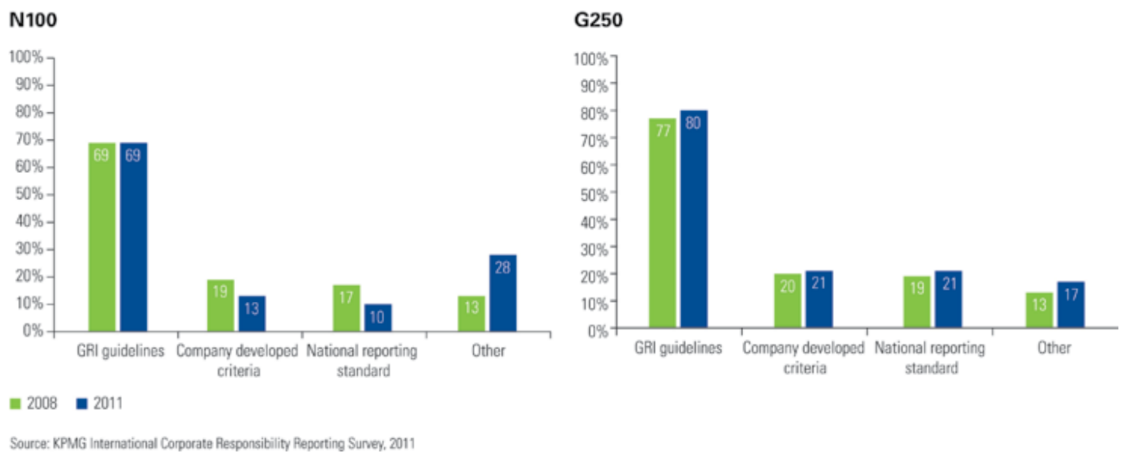


Figure 1.1: GRI continues as the global standard for reporting standards

As there are now a number of guidelines for sustainability reporting (see also section 6.13) describing the conceptual structure of a sustainability report, the main challenge for companies is how to implement this kind of reporting within their IT systems. Anticipating the detailed review of actual literature (see section 1.4), there are many consultancy firms addressing the topic of how to implement sustainability reporting with IT (see for example UNEP *et al.*, 2011; Accenture, 31.11.2011) , however they do not specifically provide any solutions.

In short, there are three possibilities to implement sustainability reporting with IT (KPMG, 2014b, p. 12):

- Office solutions such as spreadsheet applications (see also section 6.13)
- Dedicated sustainability reporting software (see also section 6.13)
- Fully integrated reporting in or with ERP systems

The option of fully integrated reporting in or with ERP systems reveals that the integration of sustainability reporting with BI, the add on systems for reporting on ERP systems, is one way highlighted by consulting companies, which isn't further researched in literature (see also section 1.4) and will be further described within this thesis. In the next section, the derivation as well as a detailed description of the research question is outlined, serving as foundation for this thesis.

1.2 Target Audience of this thesis

This thesis targets researchers as well as practitioners from companies who are facing the challenges of implementing sustainability reporting within their BI environment. For researchers, this thesis outlines the practical contributions and an implementation methodology for sustainability reporting using BI. Furthermore, as described in 1.4 there is little research about this topic resulting in a big research gap for researchers in this field. Universities and their students could benefit from the new application of BI systems and BI development. Decision maker in companies could use the SureBI method to implement sustainability reporting using their BI system instead of maintaining an additional sustainability software solution. The thesis reflects both the business requirements and IT requirements and is therefore suitable for decision makers from both IT and business departments.

1.3 Structure of PhD-Thesis

As this approach to research in sustainability reporting with BI is a novel contribution to knowledge, section 1.4 outlines a review of literature focusing on each of the topics as well as rare literature including both aspects only providing an overview of theories.

Furthermore, since this thesis combines two major topics (sustainability and Business Intelligence), this thesis aims to reach professionals from both perspectives via a two-pronged approach designed to cover both topics. To illustrate, chapter 3 gives an overview of Business Intelligence beginning from the historical development, through the concept of reporting, methods and models, the technical specifications of BI and BI software providers and concluding with evolving outlooks which are changing regarding BI systems. Chapter 4 describes the structure of a BI reporting project from various perspectives including stakeholder theory, organizational requirements, methods for controlling BI projects, methods to measure the maturity of a BI project as well as a description of existing implementation frameworks. From the Business Intelligence perspective, the two foregoing chapters form the basis for the novel reporting process for BI reporting projects which is fully illustrated in chapter 5. In regards to the two-pronged topic, chapter 6 contains a methodical overview of sustainability. This chapter begins with the historical development, possible motivations for reporting on sustainability followed by organizational requirements, the defining of sustainability data, stakeholders, available standards as well as the distribution of actual implementation approaches. Chapter 6 forms the basis for the conceptual sustainability reporting process in chapter 7. In chapter 8, the main contribution of this thesis, the novel SureBI is demonstrated, containing both a quick review (see section 8.4), as well as a detailed process description (see section 8.5). Again, as this thesis combines two major topics and that it is aimed at professionals from both sustainability and BI perspectives, this thesis structure was chosen to accommodate readers from both professions. It allows readers the flexibility to read the chapters applicable to their backgrounds and interests and omit those chapters deemed inapplicable. Chapter 9 outlines various evaluations of the novel SureBI (see chapter 8), including a general, a qualitative, and an IT evaluation. The IT evaluation, furthermore, includes the prototypical implementation of crucial process steps using the BI solution QlikView. Finally, the conclusion chapter (see chapter 10) summarizes and assesses the proposed approach.

1.4 Review of IT Implementation of Sustainability Reporting

Business Intelligence was first mentioned in 1958 (Luhn, 1958) and is well researched throughout literature.

Literature exists regarding Business Intelligence in general. Kemper (2010), for example, describes the whole life cycle of a BI system, starting with the BI history, data provision and modelling including practical examples and prospective upcoming developments. In contrast, Gluchowski et al. (2008) start with the business classification of reporting in detail, before describing BI in general and the data provision within the Data Warehouse. Gluchowski et al. (2008) conclude with practical applications and upcoming developments.

Furthermore, there is much literature which concentrates on the data aspect of Business Intelligence, focusing, among others, on data quality (Jukic, 2005) (see also section 3.6.4), the management of large amounts of data (TDWI, 2012; Torben Bach Pedersen, 2013) (see also section 3.6.3) and how to derive information from this data (see section 3.3.2) (Wang and Wang, 2008; Prasad *et al.*, 2009).

Furthermore, there is literature describing the organizational implementation of Business Intelligence (Gansor *et al.*, 2010) (see also section 4.6), as well as general literature about Business Intelligence strategy (Gonzales, 2004; Yeoh and Koronios, 2010). In addition there is literature about the evaluation of the maturity level of the company's BI system (TDWI -The Data Warehousing Institute, 2013; Hewlett Packard, 2012; Chuah, 2010; Chuah and Wong, 2012) (see also section 4.8).

This information is mainly from literature but can also be obtained from the BI software provider (see section 3.7) or from publications from consultancy companies providing useful statistics (see for example Gartner, 2014).

Regarding the IT implementation of Business Intelligence there is a large body of literature covering process models either for the whole implementation process (Gangadharan and Swami, 2004; Elliott, 2004) , but also for parts of the implementation, like, for example the ETL process (Bustamante Martínez *et al.*, 2012; Wang *et al.*, 2012), the Data Mining process

(Wang and Wang, 2008) or the Data Warehouse (Inmon, 2002). Furthermore, there are conceptual models from a financial point of view (Anandarajan *et al.*, 2003; Taschner, 2013; Tomic, 2006) (see also section 3.3) and literature focusing on the indicators on which a BI system should report (Bange, 2004; Schiff, 2005). Furthermore, there is literature about how to assure the governance of BI projects (Gutierrez, 2011; Hei and Linden, 2010) (see also section 3.4). As mentioned in section 1.3, an additional BI project reporting process (see chapter 5) is designed to make it comparable to the requirements of a sustainability reporting.

Regarding sustainability reporting, as further described in chapter 6, there is general literature regarding the history (see for example Elkington J., 1998) of this reporting and, the motivation on why companies should report on sustainability indicators (Vanhamme and Grobben, 2009; Bebbington *et al.*, 2008). Vanhamme and Grobben (2009) focus more on the possible effects of negative publicity whereas Bebbington (2008) focus more on how to set up a risk management strategy. Furthermore, there is literature about legal requirements and trends (Riess, 2012; Bader, 2010; UNEP *et al.*, 2011) (see also section 6.4) as well as strategic sustainability (Weitner and Darroch, 2009; Osburg, 2012; Keinert, 2008).

As in the case of Business Intelligence, there is literature about sustainability reporting projects involving organizational integration. This includes, for example, Colsman (2013) who focus on the measurement of controlling sustainability reporting and Schröder and Wall (2009) who describe the balancing act between shareholder and stakeholder value (see also section 6.6), the evaluation of the sustainability maturity of a company (Accenture, 2010; Karmasin and Weder, 2011) (see also section 6.8), and suggestions to define the business case when implementing sustainability (Schreck, 2009) (see also section 6.10).

From an IT implementation perspective, sustainability reporting is mostly researched regarding the conceptual setup of this kind of reporting. The enhancement of the classic Balanced Scorecard, oftentimes named as Sustainability Balances Scorecard (see also section 6.7) can be deemed as one implementation approach from a conceptual perspective (Figge *et al.*, 2002; Bieker, 2003). Furthermore, the definition of sustainability indicators (see also section 6.11.1), described by NGOs (ISO, 2013b), governmental organizations (Hesse, 2010; OECD, 2008) as well as consultancy companies (WBCSD, 2014) also aims to support the implementation process.

Regarding overall sustainability reporting processes, again literature (Maon *et al.*, 2009; Hohnen and Potts, 2007), but mostly NGOs (Global Reporting Initiative, 2013b) and consulting companies (WBCSD, 2015; idhasoft, 2013) offer processes focusing on the conceptual development of the content of a report.

From an IT implementation perspective, the only IT implementation manuals with thorough descriptions are from the provider of dedicated sustainability software solutions (SAP, 2013b; Credit360, 2012; BSI, 2013) (see also section 6.14) or are only applicable for dedicated industry sectors such as, for example, Taticchi (2013), which focuses on special parts of the sustainability discussion (such as green IT or environmental management) and Guenther et al. (2007) for the mining, oil and gas industry.

In fact, there is little literature which has a combined view on both Business Intelligence and Sustainability reporting and the literature which exists mainly formulates potential trends (CSR International, 2014) and is not thoroughly described within a paper (Petrini and Pozzebon, 2009) or only generally refers to management information systems (Caldelli and Parmigiani, 2004). Since there is very little literature about the reporting of sustainability indicators using Business Intelligence, this thesis represents a real contribution to knowledge.

Furthermore, the theories found within this thesis, unlike prior literature, views sustainability reporting as an integrated part of financial reporting (Busco *et al.*, 2013; Eccles and Saltzman, 2011; Eccles and Krzus, 2010), considers several consulting companies' approaches (EY and GreenBiz, 2014; KPMG, 2014b), as well as utilizes the author's project experience within a large consulting company. Furthermore Taticchi points out that it is essential to determine when analyzing models which of the new sustainability systems can deliver the radical changes required (Taticchi *et al.*, 2013, p. 50). This is also supported by Ahmed and Sundaram (2012, p. 612) who outlines that the existing concepts of implementing sustainability are applied unsystematically due to a lack of "*understanding and support for the design, development and implementation process, and lack of proper procedural and technological support for decision making for sustainability management*".

1.5 Conclusion

The combination of Business Intelligence with sustainability reporting can be deemed as a novel contribution to knowledge. Therefore, section 1.1 provides a quick overview of both topics and possible implementation approaches. Section 1.2 describes the target audience for which this thesis is developed and provides a foundation for real-world implementation. Section 1.3 then describes the structure of the presented thesis, describing the approaches used in every chapter. Concluding, section 1.4 outlines a review of the IT implementation of sustainability reporting, describing literature from both sustainability and BI, to prove the novelty of the presented work and the lack of literature addressing both topics. The next chapter gives an overview of BI as first methodic part, introducing the IT perspective of this thesis.

2 Research Design

This chapter aims to outline the applied research design of this thesis. Beginning with the description of general scientific frameworks in section 2.1, the review of research methods regarding information systems is conducted in section 2.2. Section 2.3 then describes the research objective of this work and the derivation of the research questions. Concluding, section 2.4 describes the methodological classification of the presented thesis deduced from the foregoing sections and furthermore describes the research process conducted within this work.

2.1 Scientific Theory Framework

The presented thesis is located in-between business studies and informatics (in Germany this discipline is generally referred to as "Wirtschaftsinformatik"). The differences between the German definition and the international research approaches in business and information systems engineering (BISE) are further described in section 2.2. Due to the sustainability and economic requirements together with the IT implementation approach, the work presented addresses practical problems of business information systems and can be further assigned to social research in general.

One method to further classify the research approach in general is the research pyramid described by Jonker and Pennink which describes four levels which can be used to structure the decision making process (Jonker and Pennink, 2009, p. 25). The first level, the description of the research paradigm or, in other words, in which domain the research is situated is described in the following. In general, a distinction between formal and real / applied-science clusters the main domains in scientific research. Formal science describes the rules for the construction of systems which are logically verifiable, but factual and not reviewable in reality. In contrast, real science or empirical science describes the observation of situations which actually exist in reality. According to Töpfer (2007, p. 5), real or empirical science can be further subdivided into "clear theoretic" and "applied / practical" science. The difference between these is that in the first case research is mainly done to explain a phenomenon. In the case of applied or practical science, the focus is also on the design of "*socio-economic-technical-ecological systems*" (Töpfer, 2007, p. 5).

The second level of the pyramid described by Jonker and Pennink (2009)describes the methodology that is conducted during the research (Jonker and Pennink, 2009, pp. 31–33). Generally, there are two directions a researcher can choose when starting a scientific project. First, there is the deductive approach, where a theory is set which is then proven by observations and / or findings. In contrast, the inductive approach describes observations and / or findings which lead to a theory (Bryman, 2012, pp. 24–26). Regarding the methodology used during the research approach, there is a general differentiation with quantitative and qualitative research. Quantitative research generally uses the deductive approach and can be described as objectification of a circumstance (Bryman, 2012, p. 36). Contrary to this, qualitative research aims to construct a new e.g. model / method and "emphasizes words rather than quantification in the collection and analysis of data" (Bryman, 2012, p. 36).

The third level of the research pyramid then describes the selection of an appropriate research method (Jonker and Pennink, 2009, pp. 33–34). One example of a research method in the case of qualitative research is presented by Bryman (2012) outlines the main steps of a qualitative research. Beginning with a general research question, relevant site(s) and subjects are selected. Then data appropriate for the research question is collected and interpreted. Concluding, after the conceptual and theoretical work, the findings and conclusions are written.

The fourth level of the research pyramid describes the research techniques, including the instruments to get the data needed for the research objective (Jonker and Pennink, 2009, pp. 34–38). These research techniques can be distinguished into the following four types (Bhattacherjee, 2012, pp. 73–103):

- Survey research

  Where data is gathered by conducting interviews or using questionnaires.

- Experimental research

  Explanatory research where laboratory or field experiments are conducted.

- Case research

  Case studies where a phenomenon is studied over time often combined with methods like interviews or prerecorded documents.

- Interpretative research

  An inductive method intended for theory building.

In the next section, the development of research approaches in business information systems is described in order to outline the difficulties in combining research and practical relevance. This is important since this thesis outlines an approach relevant for companies but also has to stand up to scientific scrutiny.

2.2 Path of Knowledge in Information Systems

As already described in the foregoing section, BISE is located in the social research realm, but there are further refinements which have to be defined regarding this research area. Furthermore, like economic research it can be assigned to applied research with an objective of investigation adjusted to practice (Winter, 2009, p. 195). In the last few years, there aroused critics about BISE regarding a well-developed research method, which are not lacking intellectual attractivity nor practical use of the outcome (Becker, 2009, p. 161).

Yet there is a consent that BISE research has to deliver a contribution for the design und usage of information systems suitable to improve the contestability of companies (Becker, 2009, p. 162). Therefore, the focus of much research in BISE includes behavioral and organizational considerations (Galliers and Land, 1987, p. 901).

In the case of BISE, there is a general differentiation between behavioral scientific and design-oriented research. In behavioral research, the behavior und effects of existing information systems to organizations and markets are researched. Contrary to that approach, design oriented research aims to gain knowledge by constructing and evaluating information systems in terms of models, methods or systems (Wilde and Hess, 2007, p. 281). To summarize, design-oriented BISE research tries to deliver results of practical relevance based on scientific precision (see also Österle and Otto, 2010, p. 283). Gregor, furthermore, states that the main difference of design research compared to other methodologies is that they focus on "*how to do something*" (Gregor and Jones, 2007, p. 313), which means concrete prescriptions on how artifacts[1] have to be designed or developed.

Regarding the research techniques, there are a great deal of methods used by researchers in the field of BISE, described in the following (Wilde and Hess, 2007, p. 282):

- Formal-conceptual and argumentative-deductive analyses

  For example, mathematic models to close research gaps.

- Simulation

  Description of real correlations within a model.

- Reference modeling

  Simplified representation of systems.

- Action research

  Multiple cycles of analyses, actions and evaluative steps, to resolve practical problems of economy and praxis.

- Prototyping

  Development and evaluation of a pre-system of an application system.

[1] Like e.g. models or methods.

- Ethnography

  Generation of insights purely by observation.

- Case study

  Observation of complex, hardly definable phenomena within its natural context.

- Grounded theory

  Production of new theories by intense observation of the object of investigation

- Qualitative / quantitative cross-cutting analysis

  Onetime survey including several individuals which are subsequently assessed quantitatively and qualitatively.

- Laboratory- / field experiments

  Observation of causality within a controlled environment.

The described research techniques, furthermore have to be proven adequate to achieve the practical advantages for BISE requirements, as described in the beginning of this section. Therefore, there are requirements developed by researchers which are described in the following.

The first possibility is to set up requirements for a system design technique, described by Fettke (2010, pp. 351–352). Fettke distinguishes between minimum and comparative requirements where the minimum requirements have to be fulfilled. The minimum requirements are described in the following:

- Effect

  The application has to reach a defined effect, otherwise the research objective cannot be regarded as fulfilled.

- Repeatability

  Multiple execution of the application must have the same effect.

- Impersonality

  The application has to reach the same goal, regardless of who conducts it. That does not exclude the requirement that the person must hold a special standard of knowledge.

Not only the described requirements regarding the system design have to be evaluated, but also the data with which the system is developed. "*The assessment of research quality is an issue that relates to all phases of the research process, but the quality of the data-collection procedures is bound to be a key concern*" (Bryman, 2012, p. 13). Therefore, Fettke (2010, pp. 353–354) proposes an additional method, to classify the content used to research within the development of systems, based on five levels. On the first level, data (or a statement) is not justified without conceptual or empirical support. Level two proposes that a statement is proven merely by a conceptual consideration without an empirical evidence. Within level three, the statement is backed up by exemplary experience which means, for example, that case studies are used to set up the statement. On level four, a variety of applications support the statement. Finally, level five describes statements, that are established without further constraints.

In summary, it can be said, that the presented thesis falls within the conflicted area of practical relevance and scientific precision. Therefore, the research techniques and methods described in this section are further set in context of this thesis in the next section and, furthermore, are taken up in the evaluation of SureBI in chapter 9.

2.3 Objective and Research Question

With the combination of the two major topics - sustainability reporting and Business Intelligence – a concept which is still not widely addressed by literature (see section 1.4), the question which this thesis strives to answer is what possibilities are there to help companies to implement sustainability reporting using BI solutions rather than using spreadsheet or dedicated sustainability software. Specifically, this thesis aims to answer the research questions surrounding how to implement sustainability reporting using BI. Therefore, a sustainability reporting process using BI – SureBI (see chapter 8) is developed, providing a detailed process to companies willing to use BI for the implementation of sustainability reporting. In other words, SureBI describes how such a solution has to be set up and which tasks have to be conducted in order to achieve this kind of reporting using an existing BI solution.

To structure the overall research design, research questions were developed. According to Bryman (2012, p. 9), the research questions defines what the researcher wants to know about written in terms of an explicit statement. The derivation of the research question was developed taking into consideration several factors. First, the industry perspective whereby many companies are unsure of how to implement this kind of reporting with their IT, but, at the same time, are spending more and more money to meet the demand of "*investors increasingly preferring to invest in transparent enterprises due to higher stakeholder-manager trust, more accurate analyst forecasting and lower information asymmetry*" (EY, Young LLP, Boston College Center for Corporate Citizenship, 2014, p. 13). Second, there are impending legal requirements (see also Figure 2.1), forcing companies in more and more countries to obligatory reporting on single sustainability indicators (see also section 6.4). As described in Figure 2.1, in France, for example, companies exceeding a defined amount (revenues of 1000 million euros) and a defined amount of permanent employees (average 500) have had to disclose certain social and environmental information since 2012.

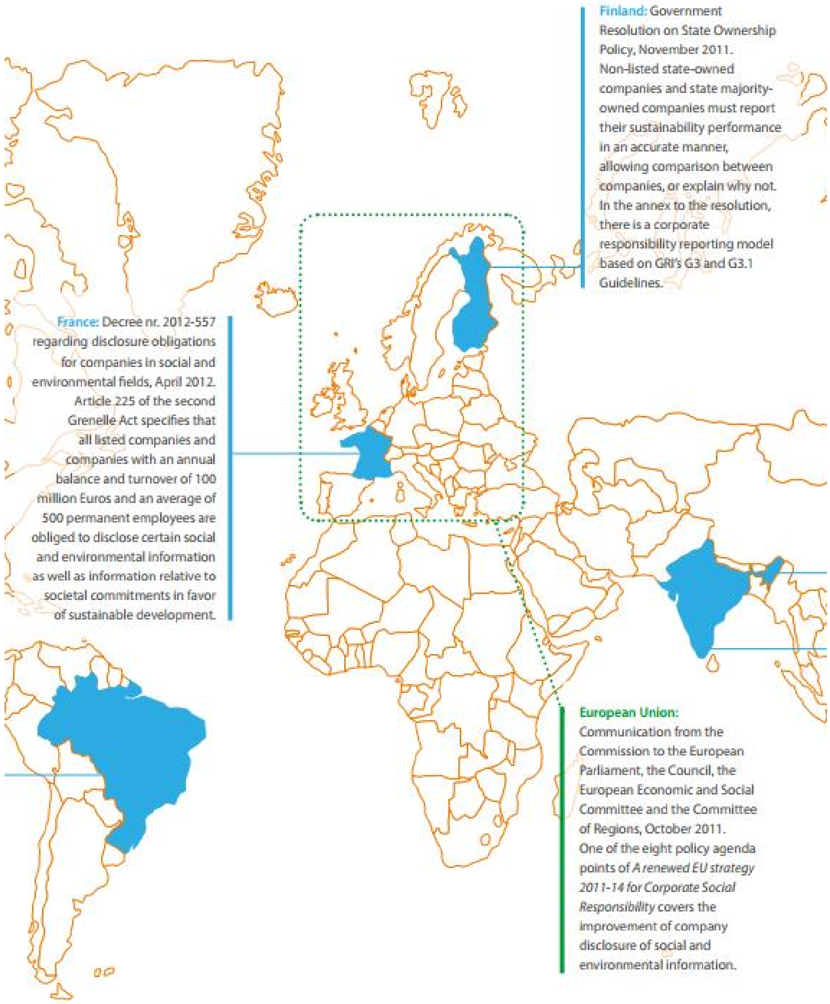


Figure 2.1: Taken, in part from policy updates 2011/12 (Global Reporting Initiative, 2013c, p. 25)

A third factor considered is the trend toward integrated reporting where sustainability reporting is not viewed as an autonomous kind of reporting but rather as an integrated part of the financial reporting. "*A small but growing corps of companies now view integrated reporting as a means of encouraging* "integrated thinking," *where environmental, social and financial impacts of business decisions are considered in concert — and, ideally, in a way where each one optimizes the others*" (EY and GreenBiz, 2014, p. 29). Furthermore, as a fourth derivation of the research question, there are IT-based basic principles which state that reporting should be created from one source, often named as the "*single point of truth*" (see also section 3.6.5), excluding the use of dedicated sustainability software systems.

Bringing together the issues outlined above, the hypothesis was made that the only practicable way to implement sustainability reporting is to use the BI which is well established in most companies, assuming that sustainability reporting will be formed as part of the obligatory financial statements of each company.

As described in Table 1, the research objective is divided into theory-based research questions, process based research questions, and case study-based questions.

Research objective: How to support companies willing to implement sustainability reporting with BI?
1) Theory-based research questions
1a) Which are the triggers and requirements for the realization of BI reporting projects (from a IT implementation perspective)?
1b) Which are the triggers and requirements for the realization of sustainability projects (from a conceptual / content-based perspective)?
1c) What do these triggers and requirements (1a and 1b) have in common and what are the differences?
2) Process-based research questions
2a) Which approaches for the IT implementation of sustainability-reporting with BI are currently developed?
2b) What does a sustainability -reporting implementation look like?
3) Case study-based research questions
3a) What challenges does this implementation approach outline?
3b) To what extent can sustainability reporting be implemented with this reporting process using QlikTech?

Table 1: Research questions

In summary, this thesis provides a new approach, one of the first in literature, outlining the steps needed to integrate sustainability reporting using BI technology. Furthermore, it can be assumed that the importance of this topic will increase due to the tendencies described in the foregoing section. It can be said that "*a sustainability reporting process can be seen as a road trip in which many choices need to be made before arriving at the final destination. Although the trip will be different for every organization, the final destination should be the same for all, i.e. a well-balanced, complete and accurate report*" (KPMG, 2014b, p. 8).

2.4 Methodological Classification of This Work and Research Process

Derived from the description of scientific theory frameworks described in section 2.1, the presented work is aligned with applied or practical science with an overlap on social research. The approach is deductive meaning that a theory is set - that sustainability reporting can be implemented using BI – which is then proven by the findings, the developed SureBI. Referring to the special requirements of knowledge in information systems, the presented approach is design-oriented, i.e. it describes "how to do something" (Gregor and Jones, 2007, p. 313). The presented work uses the paradigm of applied science and concrete design research. Also, it can be said that the thesis is located in the field of business engineering. Business engineering is the study of theories of design where model- and method components from business studies including change management, system engineering and technology watch are integrated (Töpfer and Winter, 2008, p. 31).

Regarding the research techniques proposed by Wilde and Hess (2007, p. 282), the presented work uses reference modelling, where the presented implementation method (SureBI, see chapter 8) is developed inductively based on existing theories and models.

The described characteristics of applied science require a special research process since the research findings have to bear theoretic foundation as well as practical relevance. The research process used for this thesis is presented in Figure 2.2 and described in the following.

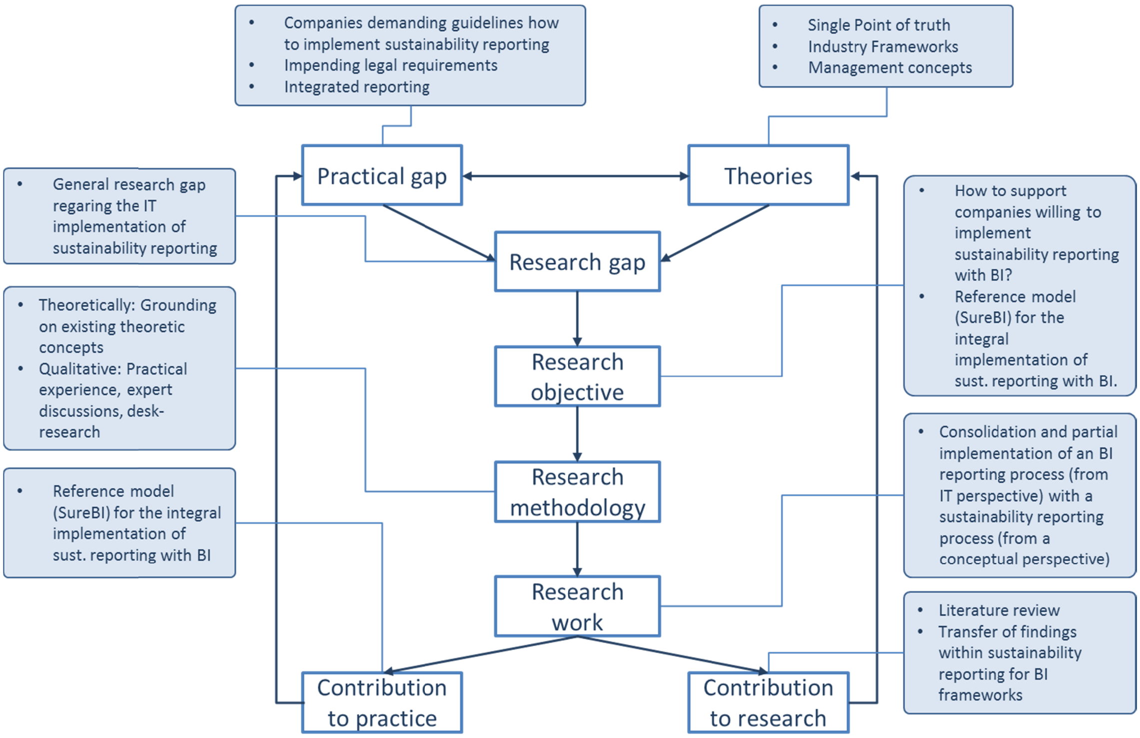


Figure 2.2: Research process of this thesis, based on Brenner and Hilbert (2014)

The initial steps of the research process include the practical requirements, which are then further developed using theories from both IT and sustainability. The practical gap and the theories then form the research gap. Derived from the research gap, the research objective including the research questions, are described in section 2.3. For the research methodology (defined in the foregoing within this section) and the research work, there are several methodologies used to form the main contribution to the thesis - the novel SureBI. First, literature is used to define the BI background (see chapter 3) and sustainability background (see chapter 5). The issue of the role taken by consultancy companies regarding BI and sustainability implementation processes is explored and the outcome of this, combined with practical experience, is used to form the novel reporting process for BI reporting projects (see chapter 5) as well as the conceptual sustainability reporting process (see chapter 7). The novel SureBI is developed including the IT implementation perspective from chapter 5 and the content perspective from chapter 7 and is evaluated using theoretical criteria (qualitative criteria) as well as the implementation of crucial process steps using a BI solution. These research methods, assigned to each chapter, are further described in Figure 2.3.

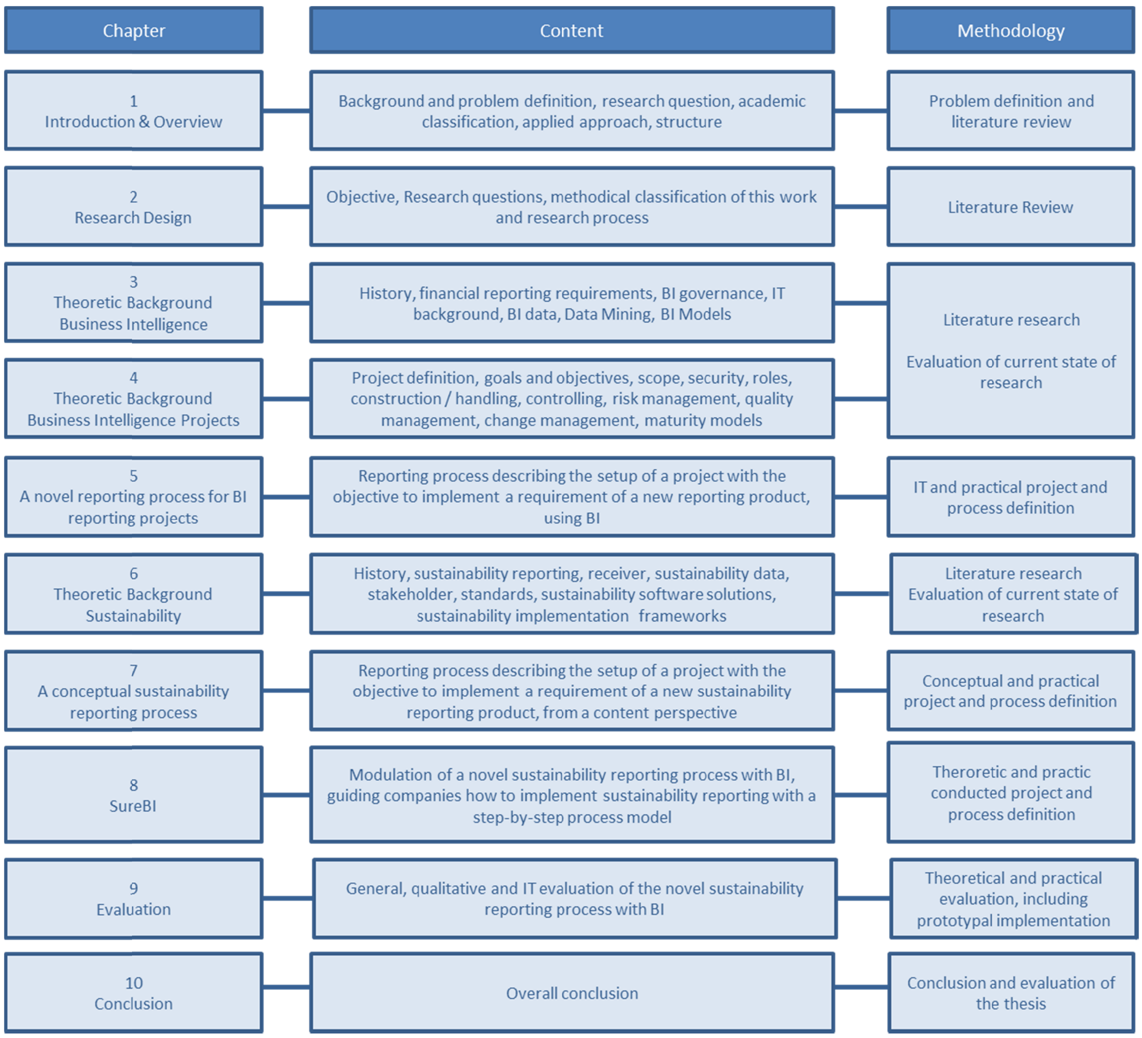


Figure 2.3: Structure and methods of thesis

Summing up, the initial situation is the practical requirement, which is then further developed by developing artifacts and ends with SureBI, the integration model for practice.

The presented work strives to further develop information management in the context of sustainability reporting with the objective to deliver an academic as well as practical contribution.

2.5 Conclusion

Ensuing from the scientific theory framework, described in section 2.1, and the derivation of special requirements for researchers in the field of information systems, described in section 2.2 the research objective and the research questions were presented in section 2.3. The methodical classification, described in section 2.4 outlined, that the thesis presented is aligned to applied sciences, using a deductive, design-oriented approach. The research technique, described within this chapter, can be best described as reference modelling based on the deductive development grounded in existing theories and models. Furthermore, the research process with which the thesis is developed is described in 2.4. Beginning with a practical requirement, SureBI's objective is to deliver an academic as well as a practical contribution.

3 Business Intelligence

This section describes the topic of Business Intelligence (BI) from the historical development through the business-related driver of BI, the reporting functionality. The reporting itself is analyzed, various reporting standards are described, and the specialty of financial indicators is carved out. Furthermore, the topic of BI governance, as a subsidiary function of IT Governance, for the identification of data quality is described. This is followed by an analysis of the technical features of BI and a detailed description of the identified BI basic principles. This section serves as foundation for the conceptual and technical BI aspects.

3.1 History and Definition

IBM researcher Hans Peter Luhn first used the term 'business intelligence' in 1952. He defined intelligence as "*the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal*" (Luhn, 1958, p. 314). The conceptual framework of BI has thus been in use for over 60 years. Today, BI has come to be defined as "*the ability to extract actionable insight from data available to the organization, both internal and external, for the purpose of supporting decision making and improving corporate performance*" (Canes, 2009, p. 46). In other words, BI software is "*a collection of decision support technologies for the enterprise aimed at enabling knowledge workers such as executives, managers, and analysts to make better and faster decisions*" (Chaudhuri *et al.*, 2011). BI refers to a set of tools and techniques that helps the decision making process and, more importantly, it helps corporate management to define and support their business strategy (Rizzi, 2009, p. 287). "*The goal is to enable data-based decisions aimed at gaining competitive advantage, improving operative performance, responding more quickly to changes, increasing profitability and, in general, creating added value for the company*" (Rizzi, 2009, p. 287).

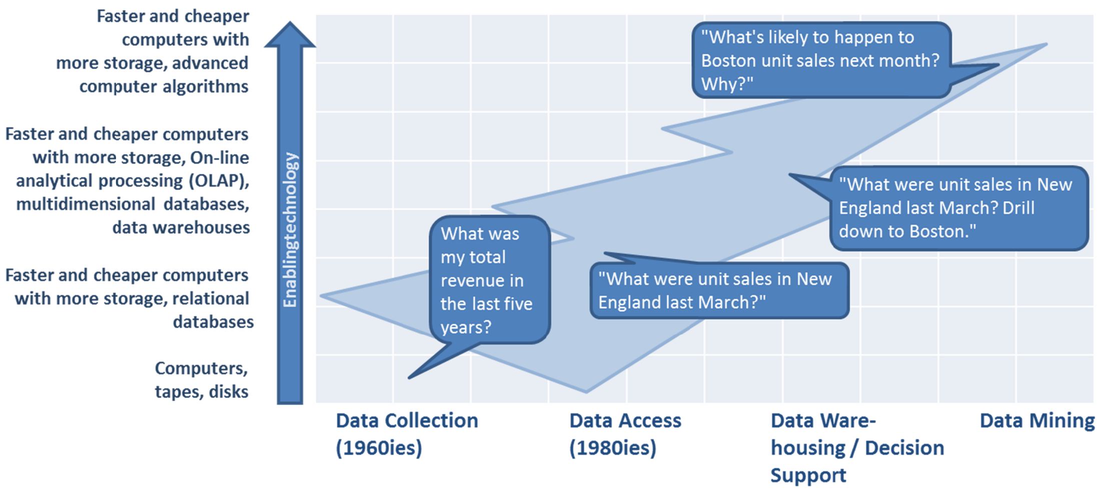


Figure 3.1: Data mining (Alexander, 1997)

As shown in Figure 3.1, BI systems have developed over recent decades. BI no longer merely refers to data processing using IT systems. With the increasing speed of modern server solutions and new software solutions, complex analytical applications can now be developed.

3.2 Reporting

A report is a "*document containing information organized in a narrative, graphic, or tabular form, prepared on ad hoc, periodic, recurring, regular, or as required basis. Reports may refer to specific periods, events, occurrences, or subjects, and may be communicated or presented in oral or written form*" (Business Dictionary, 2014f, p. 1). The call for a written report regarding a corporation's financial achievements and failures, the financial reporting, started after the industrial revolution when companies began to seek capital from external stakeholders. Although the investors were considered an integral part of the company, they were not included in managerial functions (Anandarajan *et al.*, 2003, p. 11). With the increased involvement of investors, internal and external reports were generated to disclose the performance of a company. Figure 3.2 illustrates the two different kinds of output which BI systems are generating - financial reporting and managerial reporting. Figure 3.2 also shows that these reports are fed by two distinct sources, the sub-ledgers and the general ledger.

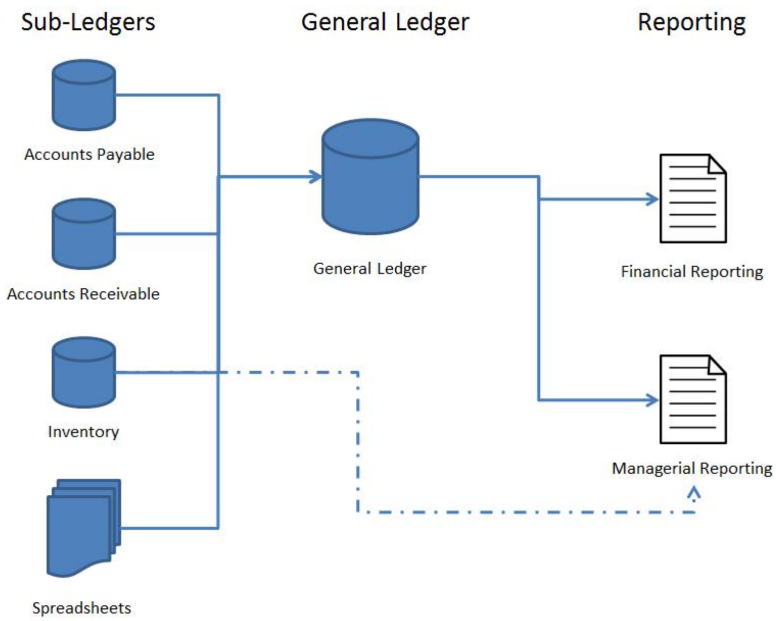


Figure 3.2: Modern Accounting System (Anandarajan *et al.*, 2003, p. 57)

The general ledger can be defined as *the central repository for all financial activity* (Anandarajan *et al.*, 2003) while the sub-ledgers contain the detailed information *related to specific processes within enterprises* (Anandarajan *et al.*, 2003). These can include, as seen in Figure 3.2, the Accounts Payable, Accounts Receivable and Inventory.

The financial reporting output, as shown in Figure 3.2, covers the balance sheet and the income statement, which describe the financial activities of a company. The objective of financial reporting is to measure the financial performance and is utilized by management, investors and other stakeholders (Anandarajan *et al.*, 2003, p. 57) (see also section 4.4). Financial reporting is created from the general ledger or from consolidation tools (see also section 3.2.3) if there is more than one general ledger.

Managerial Reporting, on the other hand, is utilized for internal use only. The term describes the reporting for managers and employees mostly in planning and operations and it is often used for forecasting and controlling. As this kind of reporting needs a more precise view of the company's position, it typically comprises data from both the general ledger and sub-ledger applications (Anandarajan *et al.*, 2003, pp. 57–58).

Figure 3.3 outlines a further breakdown of the reporting concept whereby different phases of the report generation process are shown, triggered by the demand for information and ending with the final use of the information. These various phases are components of reporting in the strictest sense, in the classical meaning and in the broadest sense.

This thesis refers to the whole reporting process, according to the foregoing definition to reporting in the broadest sense.

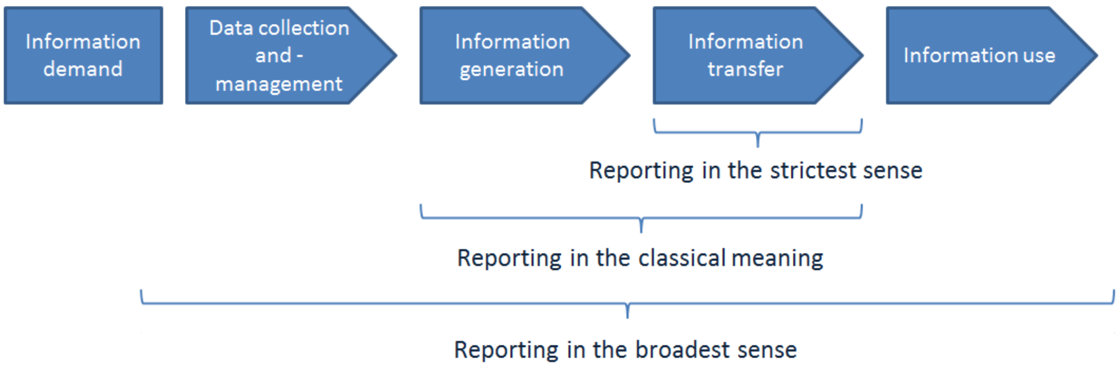


Figure 3.3: Possible reporting phases, based on (Taschner, 2013, p. 39)

Regarding the content and the structure, there are three different kinds of reports mentioned in standard business literature today (Taschner, 2013, pp. 61–66; Schäfer-Kunz, 2013; Horváth, 2011). Standard reports are defined by extensive line item illustration, in which the receiver has to identify and choose relevant information himself. Contrary to this, the deficiency report directs the receiver's attention to facts which require individual decisions. Deficiency reports are only developed in case of existing deficiencies. Demand reports are only developed if demanded by an end user and it often serves the purpose of providing additional analysis of issues. A further classification possibility (Kemper *et al.*, 2010, p. 126) is the breakdown to periodic reporting (standard reporting), variable scheduled reporting (early warning system) and ad-hoc reporting, which are only developed on demand.

Regarding the technical aspects, a BI system can be classified into macro- and micro-levels. The macro-level describes overall activities, in particular the controlling and steering structures (including governance), while the micro-level describes the actual development, reengineering and maintenance processes (Kemper *et al.*, 2010, p. 165).

3.2.1 Reporting Definitions

Objects in case of reporting can include, for example, clients of a company or its products. Every object possesses attributes, as a product has attributes like product group or product type. In reporting, value factors are assigned to attributes, like e.g., turnover to product group. Aggregation is the subsumption of individual (associated) information, e.g. the subsumption of multiple cost centers (Taschner, 2013, p. 98). Consolidation is the subsumption of dependent companies under unitary administration (Kemper *et al.*, 2010, p. 138). Consolidation can also mean subsumption of data from various source systems (see also Figure 3.2). The period cycle describes the period between two consecutive publishing of a periodic standard report. In contrast the reporting period describes the period, the report covers[2].

3.2.2 Reporting Standards

Regarding the content and the structure of reports (mainly in the case of financial reporting), there are several standards, developed over the last several decades, focusing on the quality and the content of reports. These standards are fixed and compliance with them is mandatory. The standards focusing on the handling and presentation of the report data

[2] e.g. 01.01.2012-31.12.2012, see also Taschner (2013, pp. 215–221).

are termed as generally accepted accounting principles (GAAP)[3]. There are national specifications for these principles in many countries[4].

Some examples of these principles are the:

- Principle of accuracy and true and fair representation which means that data in a report must be verifiable from receipts and documents.
- Principle of distinctiveness and clarity which obligates companies to choose a clear structure which is comprehensible to the end user as well as any third party users.
- Principle of completeness means that all transactions have to be integrated into the annual balance sheet.

Besides the described GAAP standards, there are several local reporting standards such as HGB in Germany or IAS/IFRS in the United States. These (and other) reporting standards will be used during the evaluation of the sustainability reporting process (see chapter 9).

3.2.3 Financial KPIs

Financial KPIs (Key Performance Indicators) are "*Key business statistics such as number of new orders, cash collection efficiency, and return on investment (ROI), which measure a firm's performance in critical areas. KPIs show the progress (or lack of it) toward realizing the firm's objectives or strategic plans by monitoring activities which (if not properly performed) would likely cause severe losses or outright failure*" (Business Dictionary, 2014e).

[3] Especially in case of management reporting, there are similar principles like relevance and traceability. See also Taschner (2013).
[4] E.g. in Germany these standards are called „ Grundsätze ordnungsmäßiger Buchführung".

In principle, KPIs can be classified using the following criteria (Vollmuth and Zwettler, 2008, pp. 9–10): *Absolute key figures* can be derived directly from company data (e.g. sales revenue). *Ratio key figures* are calculated by setting absolute data in relation to other key figures (e.g. equity ratio = (equity / total capital) * 100)[5]. Furthermore, KPIs can be classified as an *index*, where data of a company is related to average figures derived from a sector or sectors.

A further differentiation is the classification of data within a given dimension. A dimension describes the breakdown of a KPI according to company division, such as by country, as described in Figure 3.4.

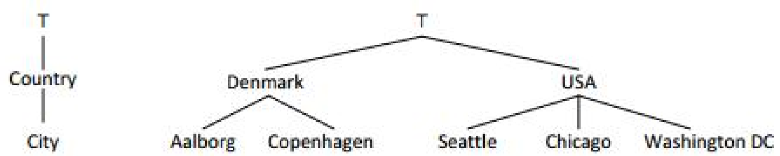


Figure 3.4: Schema and Instance for the Location Dimension (Aalst *et al.*, 2013, p. 7)

Dimensions have to be considered at the beginning of the planning process of a new key figure, in order to deliver the reporting according to the desired area (e.g. country). The technical requirements regarding BI dimensioning will be described in section 3.6.3.

3.3 Reporting Functions

As described in the foregoing chapters, reporting is a main function of the controlling department. In addition to reporting, there are several supporting operations, derived from the basic structures of reporting.

[5] Ratio key figures can be further clustered in Structuring key figure and Relation key figure, see Vollmuth and Zwettler (2008, p. 11).

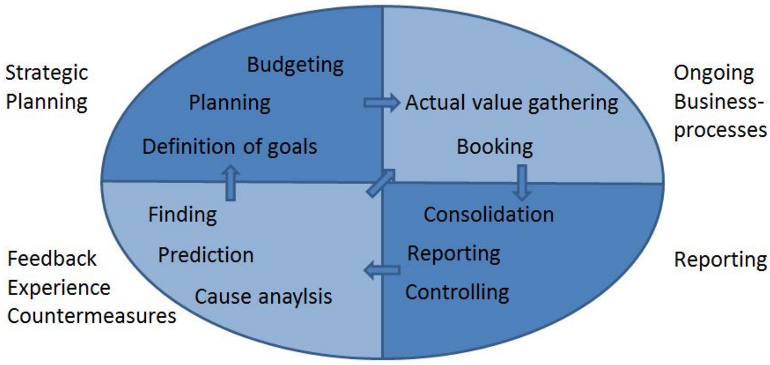


Figure 3.5: Controlling closed loop (Gansor *et al.*, 2010, p. 45)

Figure 3.5 illustrates that in addition to the controlling of data, there are additional tasks needed to transform the reporting data into useful information.

3.3.1 Planning

One of these operations is planning. Planning can be categorized into execution planning, functional planning and strategic planning (SAP, 2007, p. 3). *Execution planning* is a short-term planning function (such as product or capacity planning). *Functional planning* is medium-term (e.g. sales or demand planning) and *strategic planning* is long-term planning approach (e.g. strategic concept or long-term investments).

A further differentiation, which can be made, regarding planning, is the differentiation in top-down and bottom-up planning. In case of top-down planning for example, the management presets sales volumes, which then are split into individual product-groups or sales-areas. An example for the bottom-up planning is that plan data for individual product-groups is defined by the local sales teams and then aggregated to obtain an overall figure (SAP, 2007, p. 4).

In principle, planning tries to determine values and amounts for specific areas (e.g. product area) for the future as well as to control other variables within the company (e.g. planning of the number of sales employees based on planned product sales).

3.3.2 Analysis

In order to give importance to figures (e.g. product sales) to the management, these figures have to be analyzed by identifying trends or patterns within the data. One systematic approach designed to ensure that companies "*benefit from all the data they have collacted and stored*" includes the following steps (Dobbs *et al.*, 2002):

1. Extract the data they have from its different and varied sources;
2. Transform it into a consistent format;
3. Load it into a repository e.g. a data warehouse; and
4. Find a way to analyze the data so as to give decision makers at all levels and in different units the support they need to make better business decisions more quickly than their competitors (typically this entails using business intelligence software, ranging from advanced reporting suites to statistical packages.)

Figure 3.6 describes a similar approach, but splits the conceptual phase (upper part no.2 and no. 4) and the technical development (lower part no.3 and no.5):

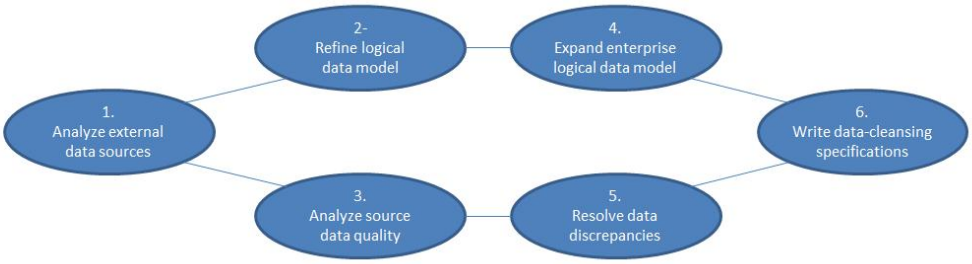


Figure 3.6: Data Analysis Activities (Moss and Atre, 2006, p. 142)

This approach illustrates the interaction of conceptual work and IT implementation.

Analysis of large amounts of data is often referred to as data mining, a field which has recently experienced a major technical evolution (Kemper *et al.*, 2010, p. 114). In traditional BI systems, the end-user was further involved in the analysis process. The user had to select the data base and pass it to a statistics expert who had to identify the adequate method of data analysis to utilize. Then, the statistician had to give it to an IT-expert to analyze the data base again and then pass it back to the statistics expert to develop an aggregation for the end-user. These sub-steps nowadays are simplified by modern BI-Solutions.

There are several methods for data mining with the ones mentioned most often in business literature described (Kemper *et al.*, 2010, pp. 115–116): Description is the delineation of interesting - but not immediate relevant to the action. Deviation analysis surveys atypical or inaccurate values[6]. Association, for example, is used by online mail-order firms, to suggest clients other products based on a shopping cart analysis of the client's purchases. The named methods serve mostly for the analysis of structured data (see also 3.6.3) but there are more and more possibilities (such as text mining) which can be utilize to analyze semi-structured data such as email content (see also section 3.6.6).

Companies as well as consulting firms developed several models to illustrate data mining processes and to describe them step by step. To give a few examples, there is the Cross Industry Standard for Data Mining (CRISP-DM) (Wikipedia, 2014a) as well as SEMMA (Sample, Modify, Model and Assess) (Wikipedia, 2014b) Standard which was developed by the SAS Institute.

[6] E.g. misuse of credit cards can be identified by extraordinary high amounts or atypical payment locations, Kemper *et al.* (2010, p. 116).

3.4 BI Governance

In a study of business practices at Deloitte (Deloitte, 2014, p. 3), a leading consulting firm, the most common question asked by the business user is "*Where did that number in the report come from?*". This task is named data lineage.

Besides the technical pre-conditions to verify the data origin (see section 3.6), there is a framework referred to as BI Governance. "*The usual definition of governance is 'the manner of directing and controlling the actions and affairs of an entity'. 'Governance' stems from the word 'gubernare', being the Latin word for 'steer'*" (Visser *et al.*, 2009, p. 110). BI Governance is derived from IT governance, "*the framework of rules and practices by which a board of directors ensures accountability, fairness, and transparency in a company's relationship with its all stakeholders (financiers, customers, management, employees, government, and the community*" (Business Dictionary, 2014c, p. 1).

In practice, BI governance is often described as a prioritization of BI requests, for example, according to ROI, budget or capacity (Gutierrez, 2011, p. 2).

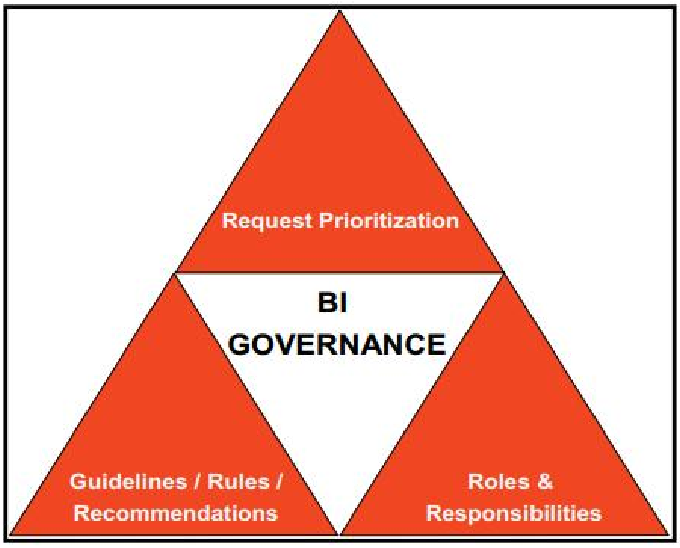


Figure 3.7: The three dimensions of BI Governance (Gutierrez, 2011, p. 2)

Figure 3.7 demonstrates the interaction of the various definitions, used in the context of BI governance, the determination of roles & responsibilities, the development and provision of guidelines/rules/recommendations and the prioritization of requests.

The guidelines for the design and application of the BI architecture can be aligned with basic rules (e.g. corporate governance or IT governance), but also with the company objectives (e.g. company, IT, or BI strategies). The importance of the alignment of roles as major part of the BI governance will be described in section 4.4.

3.5 BI Platform Models

BI Platform models aim to give an overview of the different phases within a BI system. They intend to structure each phase and then assign the technical principles to each phase. Figure 3.8 demonstrates a very common BI platform model.

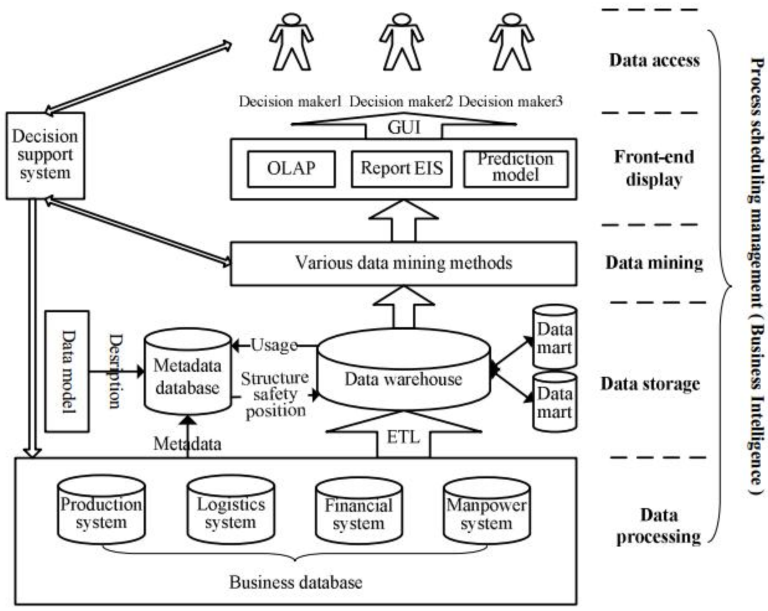


Figure 3.8: The ERP and BI integrated architecture (Zhou, 2012, p. 270)

These models attempt to illustrate the process beginning with the ERP systems to the data access by the reporting users. Each technical principle is described in section 3.6.

Figure 3.9 shows the similarities between the earliest and most recent BI frameworks. It was developed to outline the phases which will be considered when developing the BI reporting process. The similarity is that they all begin with data collection and end at the point of the delivery of the data to the customer. Only the wording and level of detail differ.

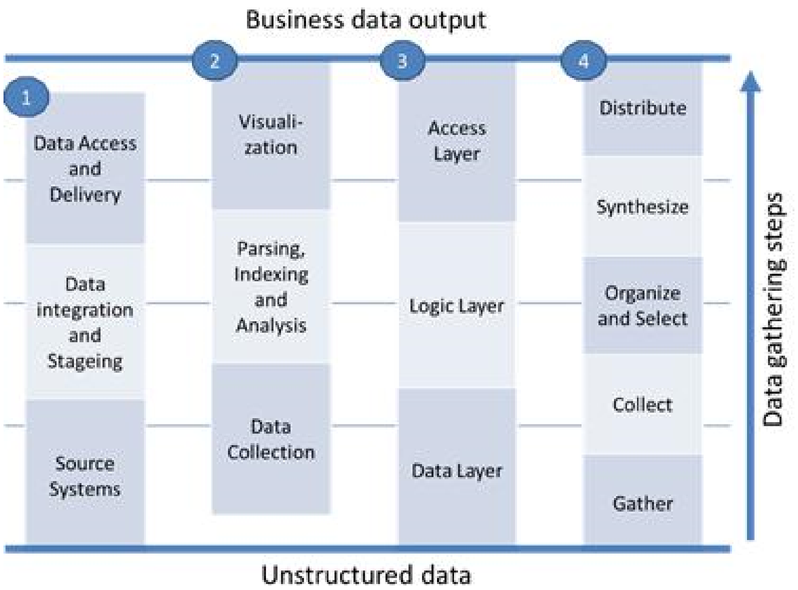


Figure 3.9: Evolution of four BI framework approaches (Alxneit *et al.*, 2011, p. 3)[7]

Another approach in illustrating the different phases is the concentration on Business Performance Management (BPM). BPM can be regarded as a managerial approach which aggregates available information pertinent to the business as a whole in order to inform the management and to help them to make better decisions. It is also referred to as corporate performance management (CPM) (Business Dictionary, 2014b). Figure 3.10 illustrates a BPM technology framework. There are many similarities such as the ETL phase, but BPM concentrates more on the conceptual information generation.

[7] No 1 based on Brian Swarbrick (2007, pp. 22–23)
No 2 based on Chung *et al.* (2005, p. 64)
No 3 based on Baars and Kemper (2008, pp. 137–142)
No 4 based on Gonzales (2004, pp. 24–51)

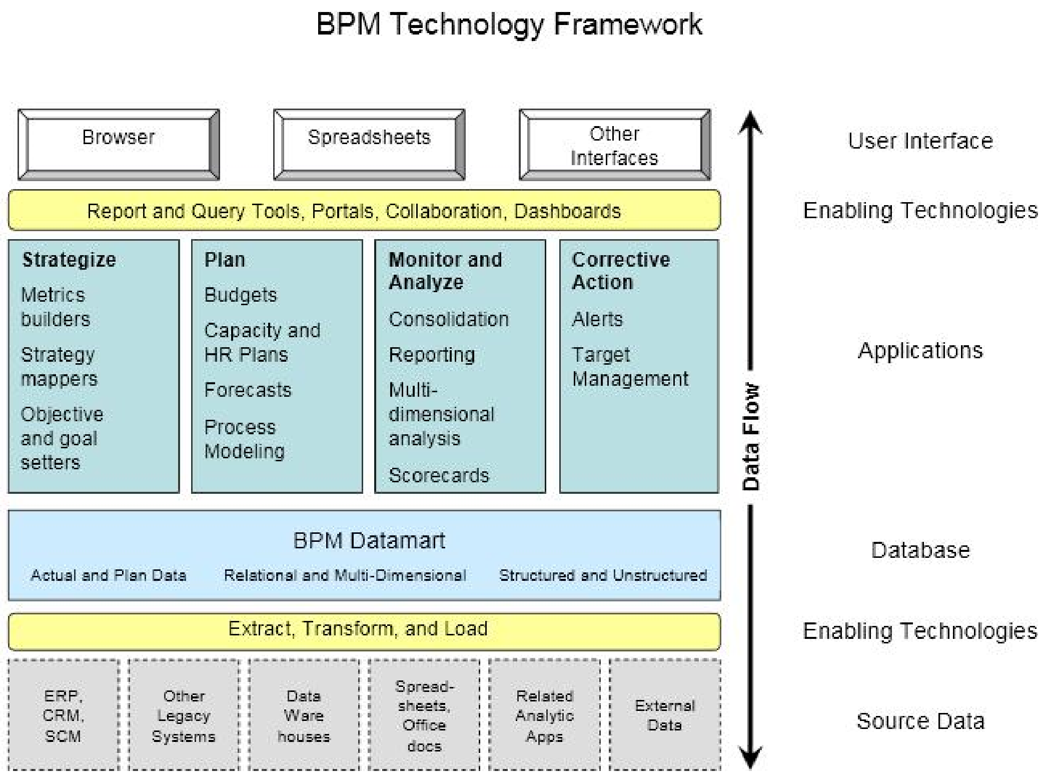


Figure 3.10: BPM Technology Architecture (Business Performance Management, 2011, p. 10)

3.6 Basic Principles of BI

As described in section 3.5 there is a similar BI architecture (see also Figure 3.9), which is implemented completely or at least partially by the major BI supplier (see also Figure 3.23). Besides this architecture, most BI solutions have basic principles that have been developed over recent decades. These are described in the subsections that follow. Figure 3.11 outlines the phases, typical BI-systems consist of and key terms important in this context. The following sub-chapters describe the most important principles of BI-Systems, which are all part of one phase, described in Figure 3.11.

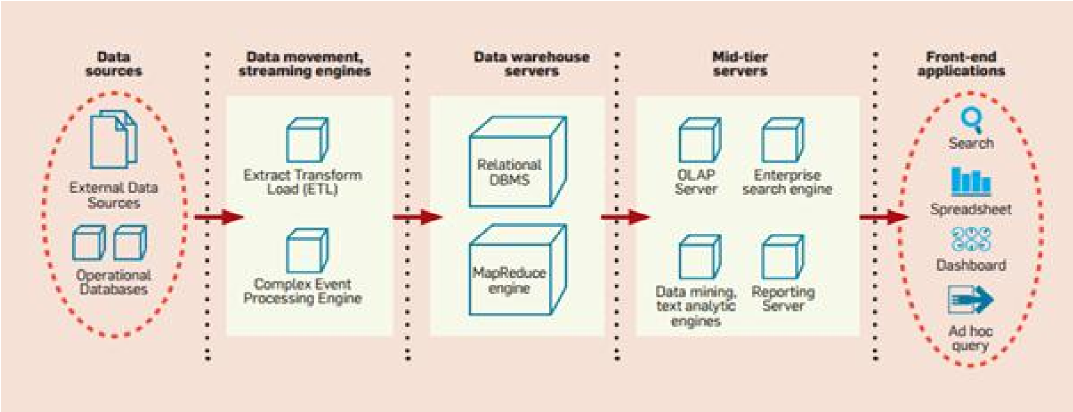


Figure 3.11: General architecture of a BI software systems (Chaudhuri *et al.*, 2011, p. 90)

3.6.1 System Structure

To ensure the stability of big BI systems[8], these systems are oftentimes divided into several systems. The development stage is an image of the production stage (however, not with real transactions and master data). Here, among other processes, new queries are developed and new system updates[9] are installed. These then have to be approved by a second person and are automatically transported to the second stage, the test stage[10]. In the test stage, there is still no real data (as developer and external like consultants are involved in the development and testing), however this data is generated to represent a real-life model (e.g. the real queries are included and real data-sources are connected) to enable detailed tests on the development. After completing these tests and after a further approval, these changes are then transported to the production system.

[8] Referring e.g. to the BI systems of multinational companies processing millions of datasets daily.
[9] in case of SAP these are called system transactions.
[10] in case of SAP e.g. with the SAP Change and Transport System (CTS).

3.6.2 Online Analytical Processing (OLAP)

"*OLAP designates a category of applications and technologies that allow the collection, storage, manipulation and reproduction of multidimensional data, with the goal of multidimensional analysis*" (Anandarajan *et al.*, 2003, p. 96).

In the OLAP process data which is to be analyzed is loaded into a data warehouse (see also 3.6.8) whereby the data can be analyzed while avoiding coming into contact with transactional data (data generated from source systems) which can cause poor performance in the source systems as well as within the analysis. In contrast, online transaction processing (OLTP) involves data from transactional systems which are processed in real-time. In the case of OLTP, it is possible to change data in transactional systems, whereas OLAP-Systems permit read-only access. Another difference is that in the case of OLTP a very detailed view on data is provided contrasted by OLAP systems where the data is normally highly aggregated (SAP, 2006, p. 11).

3.6.3 Data

Data is "*information in raw or unorganized form (such as alphabets, numbers, or symbols) that refer to, or represent, conditions, ideas, or objects*" (Business Dictionary, 2014d). Data can be classified into structured, semi-structured and unstructured information. "*Structured data is understood to be data that is assigned to dedicated fields and that can thereby be directly processed with computing equipment*" (Baars and Kemper, 2008, p. 132). An example of structured data is sales per product.

No standard definition for unstructured data exists in literature. One definition is that, "*unstructured content is information contained in non-database sources*" (Griffin, p. 53), for example email, blogs or scanned documents. The opposite view is that "*a more accurate term for many of* *these data types might be semi-structured data because, with the exception of text documents, the formats of these documents generally conform to a standard that offers the option of meta data*" (Blumberg and Atre, 2003, p. 1). In this thesis, the definition that "*the term semi-structured data is used for all data that does not fit neatly into relational or flat files, which is called structured data*" (Negash, 2004, p. 180), is used. Figure 3.12 illustrates some examples for semi-structured information.

▪ Business processes	▪ Letters	▪ Phone conversations	▪ User group files
▪ Chats	▪ Marketing material	▪ Presentations	▪ Video files
▪ E-mails	▪ Memos	▪ Reports	▪ Web pages
▪ Graphics	▪ Movies	▪ Research	▪ White papers
▪ Image files	▪ News items	▪ Spreadsheet files	▪ Word processing text

Figure 3.12: Some Examples of Semi-Structured Data (Negash, 2004, p. 180)

Generally, it can be said that "*BI applications usually revolve around the analysis of structured data*" (Baars and Kemper, 2008, p. 132). However, as described in Figure 3.12, there is an abundance of unstructured and semi-structured data which BI system have to convert into structured data in order to be able to analyze, comparare and report on it. The classification of semi-structured data and the implementation within BI systems will be further elaborated on in the following sections. Besides the classification into structured and semi-structured data, a key principle of this thesis is the differentiation between quantitative and qualitative information. Quantitative data is data which can be represented in an exact and numerical manner, for example, sales figures. Qualitative data is data which is not exact and is more difficult to measure - for example, employee satisfaction. This example of qualitative data can only be determined roughly by employee attitude surveys or by reaching conclusions based on changes in the number of sickness days utilized by an employee. A further possibility to organize data is applying metadata. Metadata can include document IDs, description, classifications or length (Inmon, 2002, p. 270). A definition for metadata is that it can include information about the original data and that it "*can be stored* *easily in a relational database management system (RDBMS)*" (Blumberg and Atre, 2003, p. 1). It can also be described as data about data and it helps to describe the correlation between data (Kemper *et al.*, 2010, p. 26).

The format data exists in provides another possibility in which to classify it (Anandarajan *et al.*, 2003, p. 96). Historically, most BI systems process textual content and numerical values. Currently, there are new sources like video, audio and others which are described in section 3.6.6. Another classification between master data and transaction data is described in the section 3.6.5. In the next section, data quality is further described.

3.6.4 Data Quality

Data quality can be defined as the "applicability of data for the usage referring to set intentions of use" (Müller and Lenz, 2013, p. 38). The analysis of data quality mainly concerns the sub-systems connected to the BI system (see for example Gluchowski *et al.*, 2008, p. 264). Within the ETL process, however, failures could also lead to poor data quality, which is described in the following.

Generally poor data quality can lead to disastrous impacts on the data analysis (Müller and Lenz, 2013, p. 40). This is also often stated as "Garbage in – Garbage out" (see for example Müller and Lenz, 2013, p. 40). According to Gluchowski et al. (2008, p. 314), the fatal impacts resulting from data-quality dependent wrong decisions have to be prevented, since they can lead to a loss of trust from the users and to problems of acceptance of the whole BI environment. Furthermore, additional costs can arise such as in the case of multiple delivery of the same advertising brochures.

The origin for data quality issues can be from various entities. These possibilities, structured according to sources, is described in Figure 3.13.

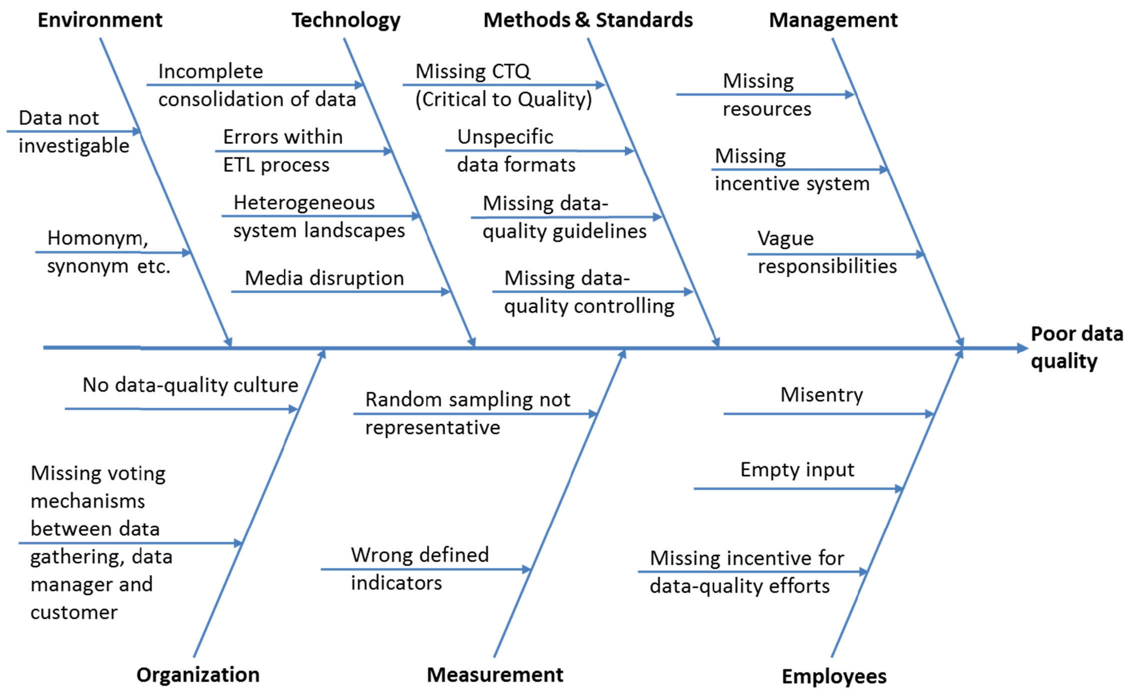


Figure 3.13: Potential reasons for poor data quality (Gluchowski *et al.*, 2008, p. 316)

Furthermore, data quality can be distinguished by the kind of incident. Table x outlines various quality challenges which BI users have to face:

Quality challenge	Example
Consistency / Key Integrity	Key uniqueness, referential integrity
Completeness	Missing information
Accuracy	Compared to reality
Validity	E.g. validity regarding business rules
Uniqueness / Interpretability	Homogeneity, clarity, comprehensibility
Reliability	Correctness, consistency, trustworthiness
Usefulness	Completeness, precision, timeliness, redundancy free, relevancy

Table 2: Overview of data quality criteria (based on Frisendal, 2012, p. 87; Müller and Lenz, 2013, pp. 38–39; Batini and Scannapieca, 2006, pp. 20–34)

To cope with the risks of poor data quality within a BI project, there are various process approaches. Gluchowski et al. (2008, p. 314) distinguish these into three process steps. First, data profiling which is the analysis of data quality, followed by data cleansing which is, in the case of BI systems, an ex-post cleansing. It is then concluded by data monitoring which is the continuous monitoring of data quality.

3.6.5 Single Point of Truth

The term "*Single Point of Truth*" is often described when talking about BI's basic requirements. It refers to a unique source where data is stored.

Data in this case refers mainly to master data and includes data such as customers, suppliers or products. In comparison, transaction data such as invoices or sales orders, which is delivered by other systems including electronic point of sale systems cannot be organized as a unique source. In the case of the electronic point of sale system, for example, this is because it often contains thousands of data sets per second. The difference between master data and transaction data can also be described by its frequency of change. Master data usually changes infrequently (like the postal address of employees), while transaction data usually changes frequently (such as in the receipt of goods).

That means, that master data, which is used to give a specific order to the database has to be collected within one database and one data warehouse. With a data warehouse, organized as described above, the data (transaction data) from other systems (e.g. HR-systems, CO-systems) can be uploaded to this database. Generally, Master Data Management (MDM) is a very relevant topic, because building a BI-System technically starts with organizing master data. In the case of a large company, it would be impossible to manage data, for example, customer addresses, utilizing various systems.

Müller and Lenz (2013, p. 21), furthermore, describe the risk of departments defining their own dimensions and KPIs. They refer to the fact that the data truth (or single point of truth) can't be ensured since a comparability between these KPIs or dimensions isn't possible in this case.

Summing up, there should be one system where actual and revisable master data and comparable structure data, like KPIs and dimensions, is processed and organized. Single Point of Truth can also refer to data in general. Annual reporting, for example, has to be generated from one source to make data reproducible and thereby revisable.

3.6.6 Data Sources

One possibility to classify data sources is the differentiation in internal and external sources. Internal systems can include, for example, customer relationship management (CRM) or human resources (HR) databases. External sources can include the market research data of a market research agency, with which analyses are made.

A further differentiation is the kind of IT source system. SAP distinguishes these into (SAP, 2015a):

- Relational sources (e.g. IBM DB2, Teradata)
- Multidimensional sources (e.g. Hyperion)
- SAP-sources (e.g. SAP CRM)
- File (e.g. CSV)
- XML
- Legacy applications (e.g. Oracle Financials)

In the last few years, these sources were extended by many new systems. Figure 3.14 provides an overview over these new sources.

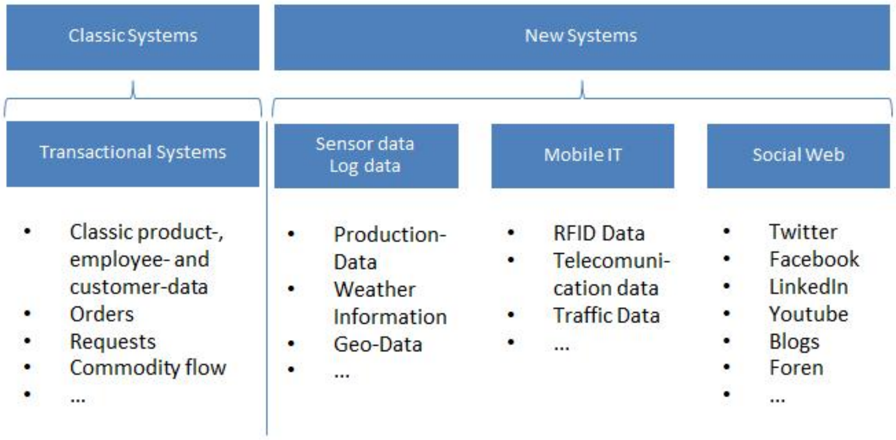
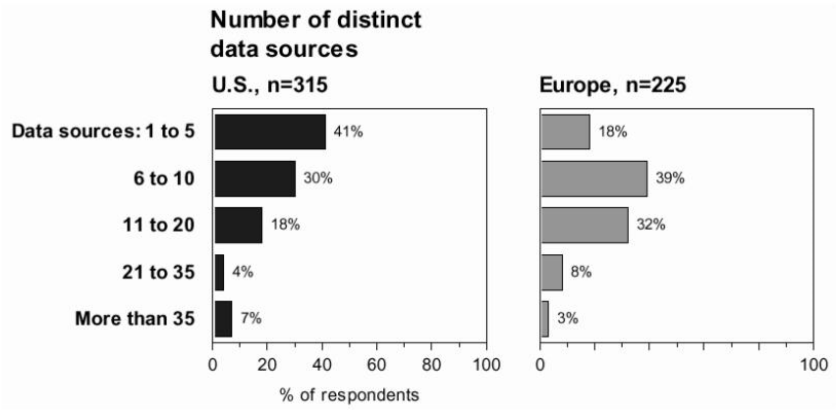


Figure 3.14: Data sources for big data (Gadatsch, 2013, p. 24)

Complexity of modern BI systems is increased by the number of data sources a company wants has to connect to the BI to report the demanded indicators. A study of the Gartner group (see Figure 3.15), 32% of interviewed companies in Europe connect to 11 to 20 data sources. Summing up it can be said that the majority (59% in US and 82% in Europe) report based on more than 5 data sources.



Source: Gartner group multiclient study

Figure 3.15: Organizations have multiple data sources that they want to use BI against (Elliott, 2004, p. 11)

In literature there are many process models for the data source selection. There are common process descriptions (Moss and Atre, 2006, p. 138) to detailed workflow descriptions (Figure 3.16):

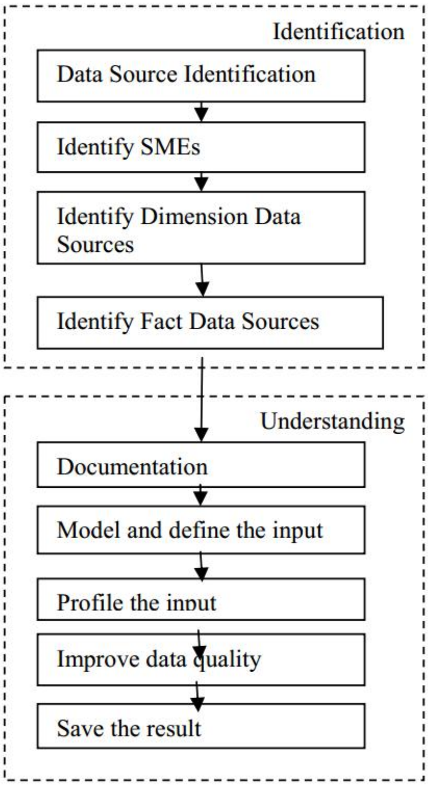


Figure 3.16: Managing Data Sources Workflow (Idris and Ahmad, 2011, p. 4)

Figure 3.16 also refers to the important elements (for BI governance, see 3.4) including the documentation of the process.

3.6.7 Extract Transform Load (ETL)

ETL "*refers to a collection of tools that plays a crucial role in helping discover and correct data quality issues and efficiently load large volumes of data into the warehouse*" (Chaudhuri *et al.*, 2011, p. 96). In other words, ETL is the process of the identifying the required data, bringing it to the database, transforming it (e.g. currency calculations), and loading it into database tables.

Most established BI providers include ETL tools in their BI landscapes, but there are also special ETL tools which can be used to load data from different sources.

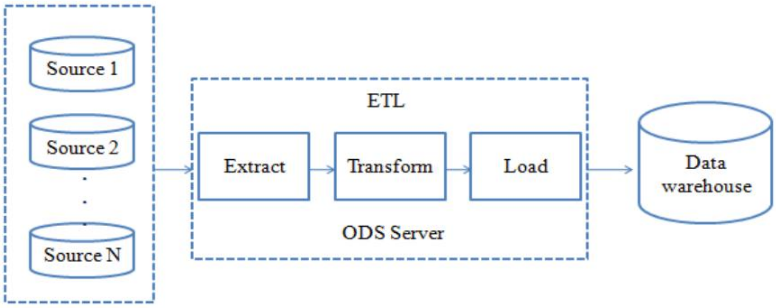


Figure 3.17: Traditional ETL approach (Wang *et al.*, 2012, p. 282)

Figure 3.17 shows the path of the data from various sources, through the ETL process, through loading, ending in the data warehouse.

According to Moss and Atre (2006, pp. 216–217) there are three kinds of data load mechanisms during the ETL process. The initial load which describes the first load of actual data into the data warehouse. Subsequently, historical data is loaded, where *static*, already archived data is loaded. After these two load-processes have been conducted – and also during continuing operation – new data is loaded regularly (e.g. monthly, weekly or daily) through the incremental load.

Persistent Staging Area (PSA)

The Persistent Staging Area is in SAP BW, a database-table which correlates to the transfer-structure of the interface to the source system (mostly SAP R/3 systems). In this table, data from data loads is achieved. The PSA can also be called temporary storage. In the case of problems arising regarding the data-loads from the source systems, data doesn't has to be reloaded again, but, rather, it can be loaded from the PSA.

3.6.8 Data Warehouse

"*A Data Warehouse (DW) is a company-wide system for the integration of crucial data for controlling a company and it serves as Single Point of Truth*" (Gansor *et al.*, 2010, p. 28). Another definition states that a data warehouse is defined as "*the data over which BI tasks are performed is typically loaded into a repository called the data warehouse that is managed by one or more data warehouse servers*" (Chaudhuri *et al.*, 2011, p. 90). In other words, a data warehouse is a unique place where all data (which is described in section 3.6.5) needed by a Business Intelligence system, is stored. As more and more sources are connected to a data warehouse (see Figure 3.14), it is common that not only one data warehouse is utilized, but several. This breakup could be regarding company divisions or by separating data based on actual and historical data (see also Figure 3.18). This is also called as partitioning, which "*means the splitting of data into small units*" (Inmon, 2002, p. 66).

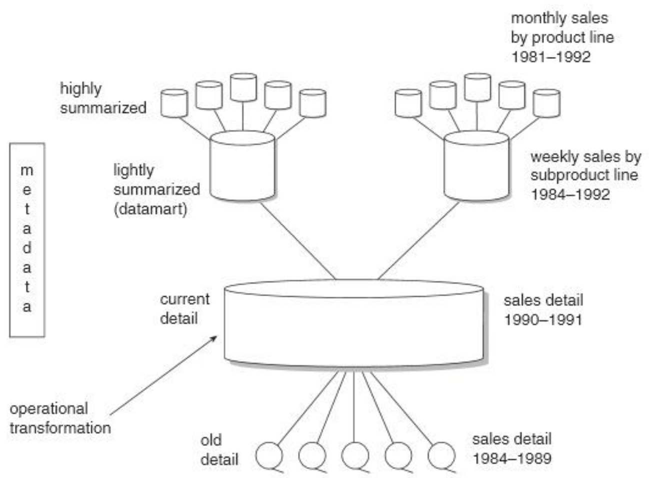


Figure 3.18: The structure of the data warehouse (Inmon, 2002, p. 58)

3.6.9 Historiography

For the purpose of comprehensibility, the term historiography has to be excluded from the terms archiving and data backup. Archiving describes the fact that data has to be rebuilt in case of a functional requirement (e.g. legal proceedings). Backup describes the backup of data banks, for recovery in case of technical problems (Kemper *et al.*, 2010, p. 71).

The characteristic of a data warehouse is that integrated data is stored permanently and is therefore available for future reporting. To limit the growth of data, in this case, historiography is essential. For this, data of a certain age can be stored in compressed form (Kemper *et al.*, 2010, p. 21). The challenge regarding historiography in the case of a BI system is that not only old data sets can be aggregated, such as product groups but also general assignments which have changed over the years, which have to be historicized, too[11]. Beside the historiography, most BI systems certainly apply archiving and data backup.

3.6.10 Multidimensional Data

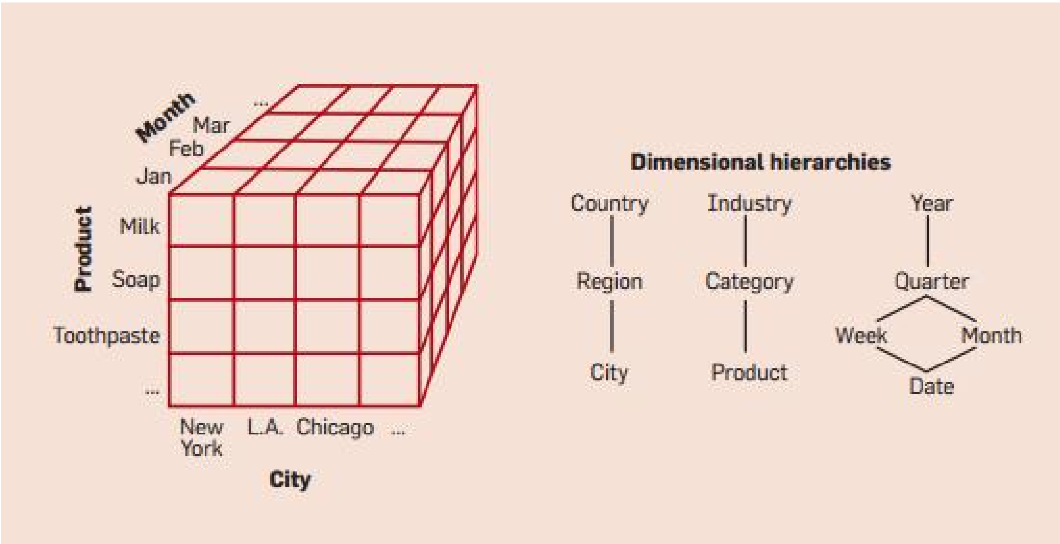


Figure 3.19: Multidimensional data (Chaudhuri *et al.*, 2011, p. 92)

A BI system has to be organized due to the large amount of data it holds. The term multidimensional data (shown in Figure 3.19) describes how data is organized on a

[11] A description of the possibilities of historiography can be seen e.g. at Kemper *et al.* (2010, p. 71).

database level. In this example, a product has several dimensions of data, such as the city where it is sold and monthly sales.

3.6.11 Star Schema

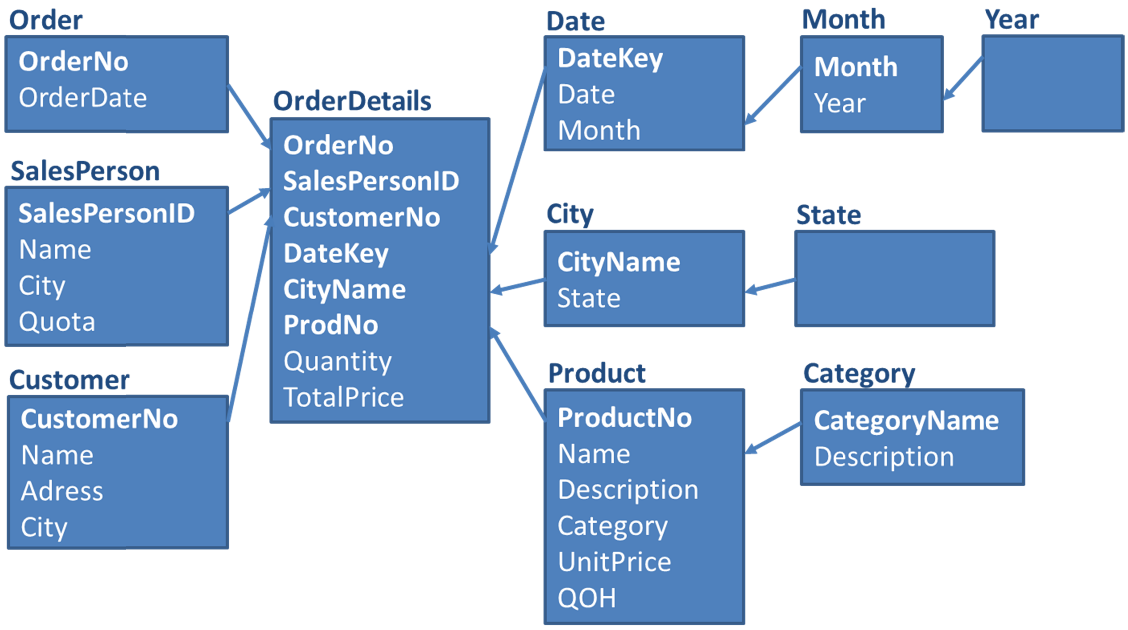


Figure 3.20: Star schema (Chaudhuri *et al.*, 2011, p. 93)

To organize multidimensional data technically, a so-called star schema (based on its resemblance to a star) is used to define the tables in the database (Figure 3.20). In the illustration the main table to access is OrderDetails. In this table, there are a number of IDs (identifiers), such as OrderNo or SalesPersonID, describing the values quantity and total price. The identifier (e.g. OrderNo) is linked to another database table (in this case Order), and is used to normalize the main table (OrderDetails). Normalization in databases describes guidelines and principles designed to transfer databases into redundancy-free or nearly redundancy-free structures (see also Kemper *et al.*, 2010, p. 63). Therefore, if a reporting tool is reporting OrderDetails in the first step, only the IDs are loaded, not the details (OrderDate). These details can be accessed by sending a request to the database, using the ID (OrderNo to acquire the OrderDate).

Most BI systems have included this schema in their database processing software. By using such a schema, data can be acquired more rapidly, because detailed data that is needed infrequently is not always accessed. Some BI providers have extended this system. For example, SAP has implemented a star schema with dimension tables that do not contain the Master Data information. This information is instead stored in so-called master data tables using surrogate ID tables and organized into 'info cubes'. Figure 3.21 illustrates the SAP star schema using the IDs and tables outlined in Figure 3.20.

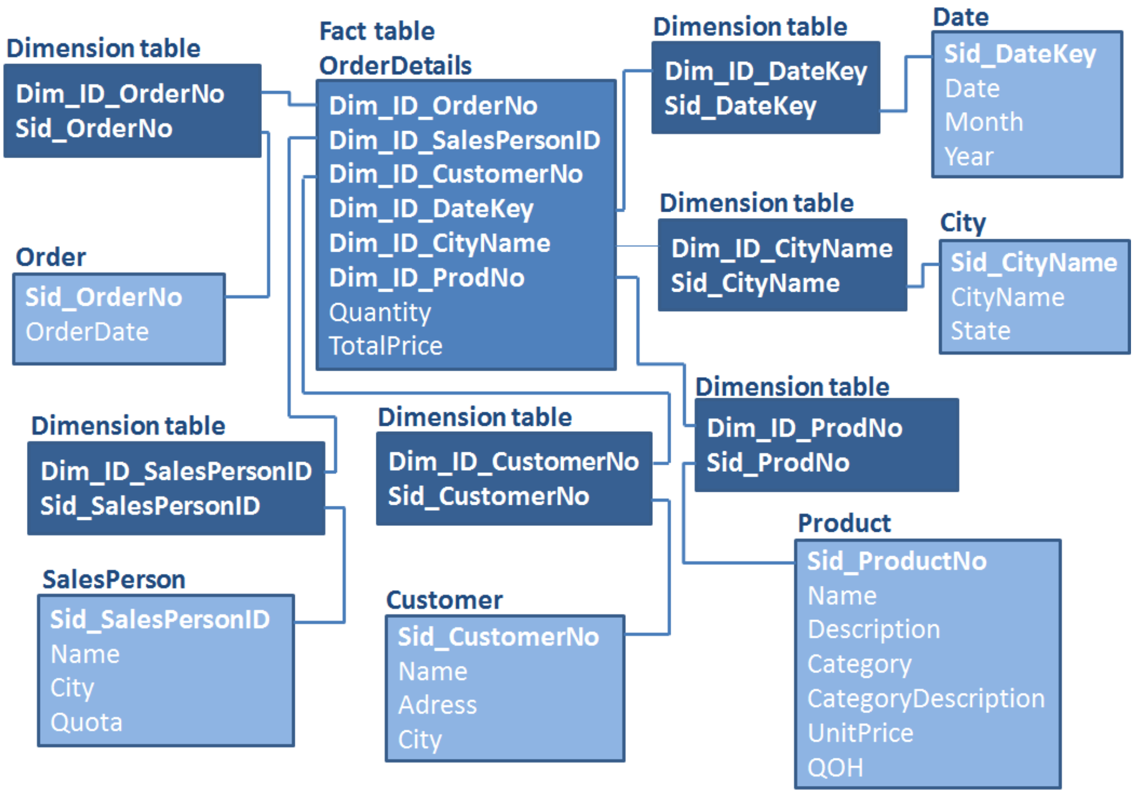


Figure 3.21: Extended SAP Star schema based on Figure 3.20 (own diagram)

3.7 BI Software Provider

There are many BI solutions available and in addition to business analytics solutions available, there are various supporting tools, as displayed in Figure 3.22

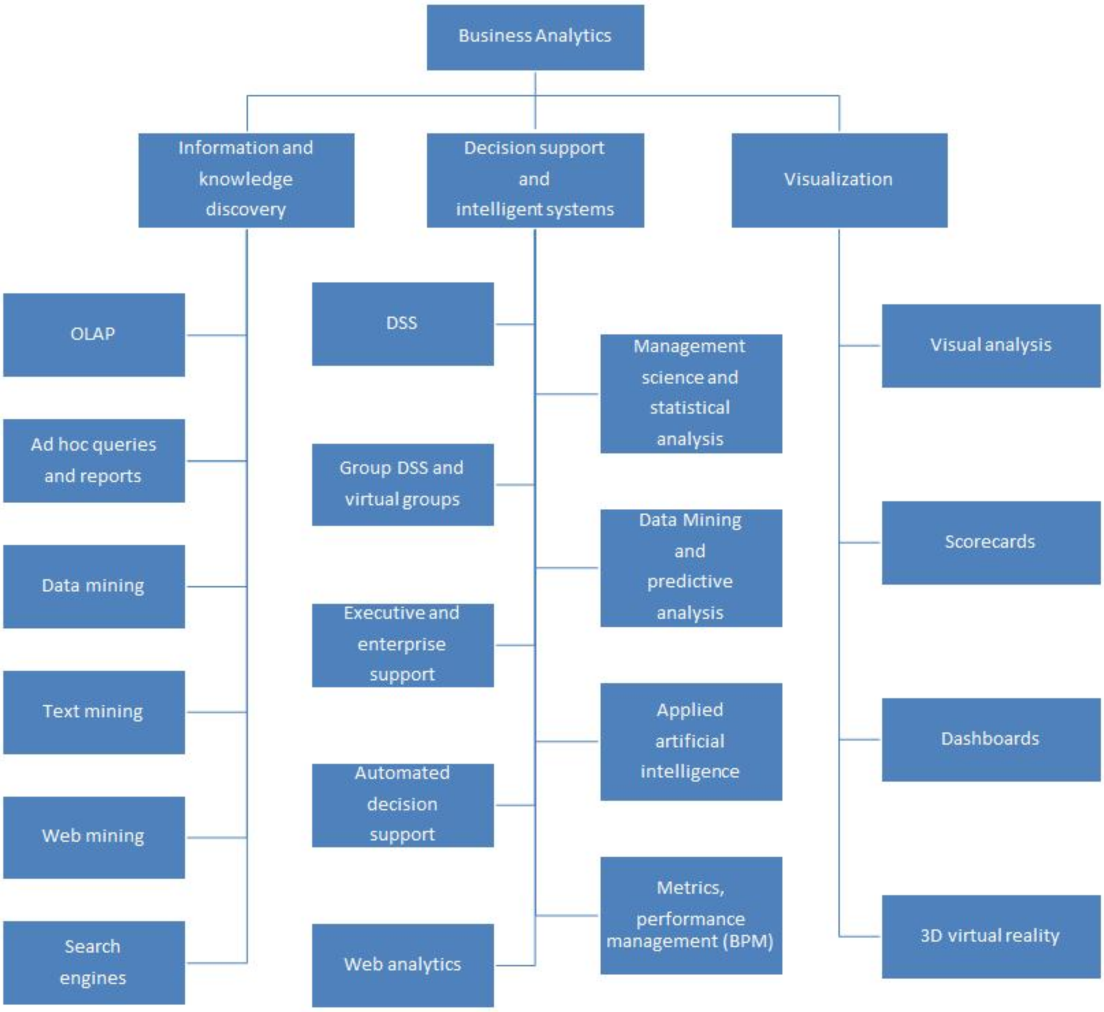


Figure 3.22: Categories of Business Analytics (Turban, 2008, p. 88)

Gartner provides an overview for the integrated BI solutions available and a comparison to other BI-solutions[12] (Gartner, 2014). Figure 3.23, from 2013, outlines such an overview.

[12] Regarding completeness of vision and ability to execute.

Gartner not only outlines the main players providing BI-products, but also gives an overview of their ability to execute (e.g. a comparison of their marketability) and their completeness of vision (e.g. a comparison of their functionalities).

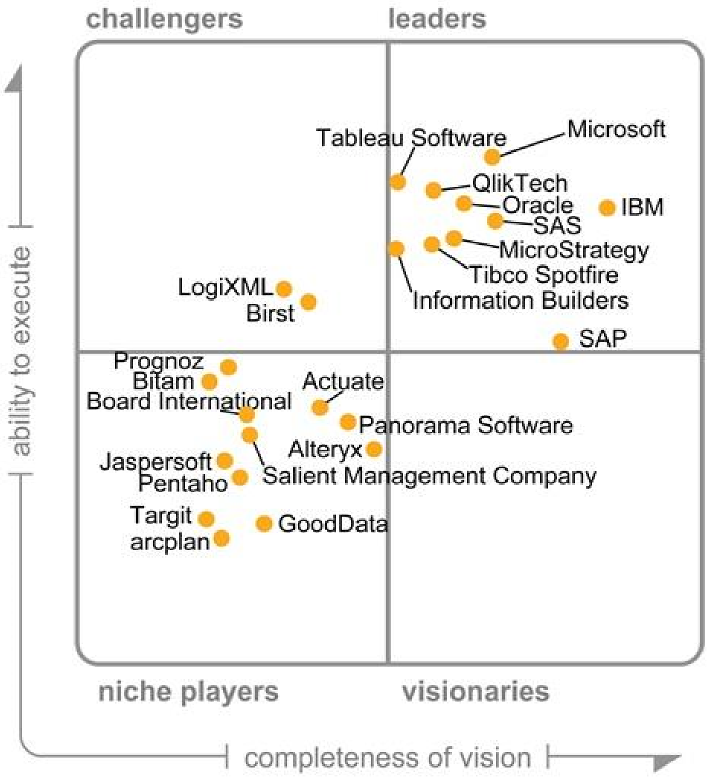


Figure 3.23: Gartner Magic Quadrant 2013 (Gartner, 2013)

In the next section, the BI solution from QlikTech is introduced since the IT evaluation (see 9.4) is done using this BI tool.

3.7.1 QlikTech

QlikTech is a company founded in 1993 in Sweden, with subsidiaries now in existence worldwide. The BI Solution QlikTech by Qlikview is very popular (see Figure 3.23). The solution is characterized by a very easy to use application. From the analysts view of Gartner, QlikView's strengths "*lie in its user-driven approach to BI, its ease of use, its intuitive interface and how 'likeable' the product is to use*" (Computerweekly, 2014). Many data sources can be connected to their database. The data is loaded into their data warehouse by using a script language and can be modified during the loading process (QlikTech calls that the ETL process). An integrated authorization concept distributes the generated reports and dashboards to the end-user. The QlikView product family consists of a desktop version (the version for the development of documents), the clients for the end-user, the server solution for the spreading of documents as well as the publisher for document management. Because of its position in the BI market, as well as the flexible demo version, in section 9.3 QlikTech is applied to make the development of the BI process more comprehensible. Since the BI solution is based on the basic principles of BI (see 3.6), the presented implementation in section 9.3 can be conducted with other BI solutions and only the solution specific implementation, like ETL approaches, may differ.

3.8 Outlook

With the increasing requirements for modern reporting solutions (see Figure 3.1), there are many initiatives designed to improve the IT systems in order to make them able to handle and report on the increasing amount of data. These initiatives are described in the following.

3.8.1 Near Real-time BI

Looking at the BI solution of a real-life domestic retailer, electronic point of sale data can be loaded within the ETL process overnight. However, if this retailer acts globally, there are no night-time breaks, namely there are no times when BI data might not being accessed. This continuous use paralyzes ETL processes and data access. The solution is the near real-time access of BI data. Additionally, in this retail example, marketing departments can also control specific marketing activities (for example, the announcement of marketing activities in email newsletters) in real-time.

There are many examples of this need for real-time BI. "*Consider an airline that tracks its most profitable customers. If a high-value customer has a lengthy delay for a flight, alerting the ground staff proactively can help the airline ensure that the customer is potentially rerouted. Such near real-time decisions can increase customer loyalty and revenue*" (Chaudhuri *et al.*, 2011, p. 95). In summary, these new requirements suggest highly technical BI implementations.

A further step in this dynamic is Operational Intelligence (Gleich, 2011, pp. 207–208), which analyses information during runtime, e.g. from social media.

3.8.2 In-memory Technology

In-memory technology aims to counteract the requirements for persistent storing of databases. In this case, data is no longer stored persistently inside database tables, but instead is stored non-persistently within the random access memory. Tables are only generated following a specific database request. This leads to a remarkable acceleration of requests and generation of reports.

Because this technique is still emerging, many companies remain without in-memory technology. Implementing it is not only expensive (e.g. the IT costs for the new hardware), but the efforts for changing the database tables to the new concepts also result in a high monetary as well as time investment. An example of this new approach is the software from SAP called SAP HANA (SAP, 2013a).

3.9 Conclusion

Based on the literature research and the longevity of the project experience (see section 1.4) it can be said that BI systems are widely defined. Even modern BI systems reach their limits due to the requirements to process more and more large quantities of data (big data) in less time. Also, the appearance of new data sources (see section 3.6.6) raises the complexity, but delivers at the same time the evidence that besides the financial indicators, the integration of non-financial indicators is possible. This is further researched in chapter 6. The challenge regarding most of the BI implementations, however, is that they have grown and developed over decades, are never or rarely cleaned, and new functionalities have been added which influence the performance of the BI systems. Therefore BI cleaning projects would be necessary as well as the implementation of a defined BI reporting process. The requirements regarding a BI project are shown in the next chapter in order to develop the general BI implementation process in chapter 5.

4 STRUCTURE OF A BI REPORTING PROJECT

This chapter describes the structure and the characteristics of a BI reporting project with the aim to develop a concrete process for a BI reporting project in Chapter 5.

It starts with the different definitions of a BI project and the definition of a BI project as it relates to the context of this work. Subsequently the possible customers of BI reporting are described, and a transition to potential stakeholders of a BI project is made. Furthermore, the possibilities to identify and to prioritize the stakeholders are described with a short insight of the authorization concept. After the definition, identification and prioritization of the stakeholders, the possibilities of how to set up the topic's organization and possible controlling measures during a project are shown. Concluding the topic, various BI Maturity Models are illustrated as a possible method to evaluate the maturity of the company, followed by the description of BI implementation frameworks.

4.1 BI Project Definition

A project can be defined as a temporary endeavor undertaken to create a unique product, service, or result (IEEE Computer Society, 2011, p. 5). A BI project can have various dimensions starting with a complete rebuild and establishment of a BI solution within a company, to ongoing projects soliciting new requirements from the business units with eventual implementation by IT and other business units.

A BI project in the context of this thesis can also be named as BI-operation: The BI-operation ensures that developed BI solutions can be applied satisfactorily for the user. That means that the system is available within the requested performance (range of functions) and analyses, reports and data can be used correctly and timely as planned (Gansor *et al.*, 2010, p. 126).

Gansor et al. (2010, p. 112) define a typical BI project as an implementation of for example a sales-reporting, closure of the information-delta (the data enhancement), and improvement of data-quality. This process can also be defined as the data administration process (Gansor *et al.*, 2010, pp. 234–235). In contrast, a BI strategy project can be defined as the development of a BI strategy, conception of strategic frameworks, architecture/technology and organization (either together or in parts), and superior development of a project portfolio (Gansor *et al.*, 2010, p. 112).

As described in the previous sections, a KPI requirement from a business unit involves various stakeholders, from business units to the IT-department. Therefore, before starting a BI-project of this dimension, various pre-conditions will be described in this section and possible approaches will be explored.

Petrini and Pozzebon (2009, p. 183) differentiate between a managerial and a technical approach. The managerial approach sees BI as a process which creates an information environment to get strategic information for the business. The technical approach focuses on the set of tools and the processing of the data.

A further differentiation is the classification of projects due to their potential triggers (Gansor *et al.*, 2010):

- Day-to-day business alignment

  BI projects and activities are aligned primarily to operational requirements.

- Operational purchase objective alignment

  BI projects and activities are subordinated to purchase objectives.

- Day-to-day IT alignment

  BI-approach, whereby tool-selection etc. are aligned to the operational needs of IT operation and IT development.

- Reporting department alignment

  The reporting department decides when and how a BI-project is implemented.

There are several factors relating to the process of project management in a successful IT project including the process of initiating, planning, executing, controlling and the project conclusion (Daojin Fan, 2010, p. 489). Figure 4.1 not only outlines these phases but also the costs and the amount of manpower necessary for each phase.

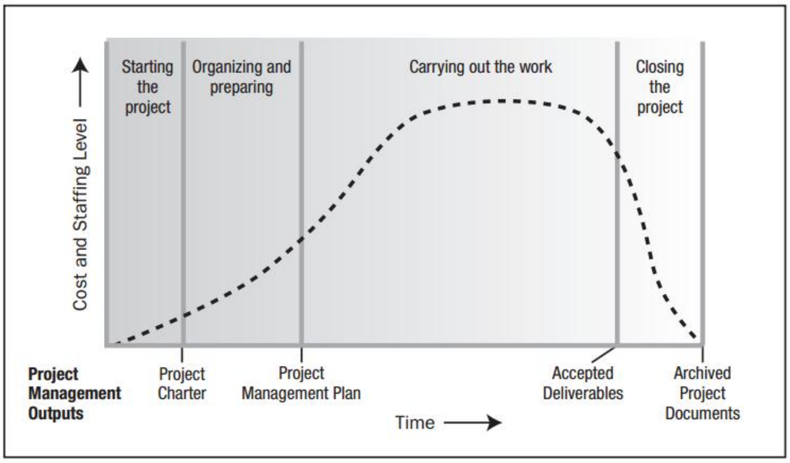


Figure 4.1: Typical Cost and Staffing Levels Across the Project Life Cycle (IEEE Computer Society, 2011, p. 16)

However, it cannot be gathered from this that resources only have to be provided for the implementation phase. Specially IT-projects have to be planned very carefully because of the interface between IT and the business departments as "*IT often complains about to high efforts, the business user are unsatisfied with the generated content or the performance of the BI system and the management regrets the insufficient achievement of business objectives aligned to the BI approach*" (Gansor *et al.*, 2010, p. 13).

Elliott (2004, p. 32) describes a BI success model, where the exit of BI applications is based on several modules. The first module, organizational readiness specifies that a successful BI project is based on the company's vision and strategy, a well-defined organizational and corporate culture and on skill development. Furthermore, the company should be technically ready, that means that the technical infrastructure should be defined and that data is of a high quality level. The BI application should not be developed before these basic requirements are fulfilled. Elliott concludes the model with the measurable results module which means that every result is verified, e.g. with an ROI analysis.

4.2 BI Reporting Requirements

The requirements for reporting (see also section 3.2) can be classified based on where the information demands originate. Information demands are typically generated from two different sources (Gansor *et al.*, 2010, pp. 97–98):

1. Demand-oriented (whereby the decision-maker and user are interviewed to determine what information they need today or in the future)[13]
2. Supply-oriented (based on the operational systems it is determined what data can be implemented into the BI system)

Both approaches have disadvantages. In the first case, the business department demands reports which the IT department cannot produce. In the second case, the IT department is overstrained as they oftentimes are not involved in the business processes and therefore not knowing the requirements from the business users. It can be deduced that the ideal approach combines the two approaches above.

Regarding Moss and Atre (2006, p. 85), BI projects are data intensive and not function intensive. Moss and Atre state out that 80% of the effort should be applied to data and 20% to functionality. Furthermore, the scope should be measured due to the number of data elements which have to be extracted, transformed and cleansed from the source systems. As new presentation applications emerge, including dashboards or analytical tools, these percentages have to be critically examined.

[13] Based on the project experience, this is the most common case, that the business departments define the reporting requirements.

4.3 Clients

Clients of BI Projects are typically (except, for example, in cases involving regulatory requirements) internal to the company. Figure 4.2 outlines the characteristics of fragmentation whereby individual BI products (e.g. reports or dashboards) are produced for multiple departments and that these departments have to collaborate in the development process.

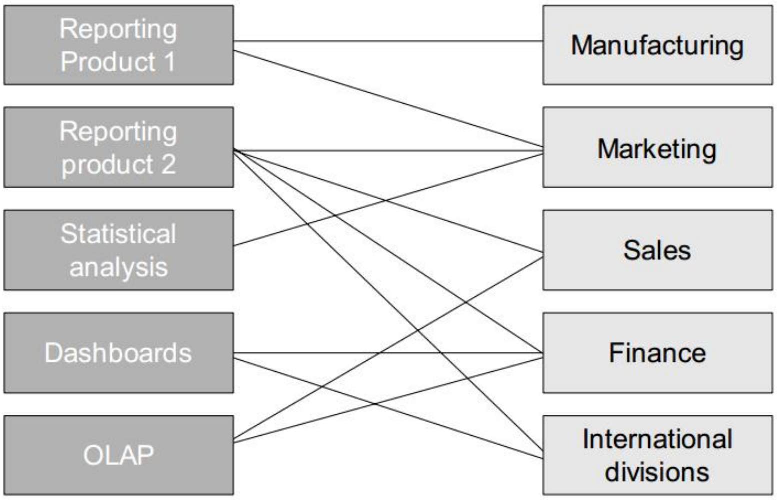


Figure 4.2: Most organizations today have fragmented BI implementations, with many departments using multiple, overlapping products (Elliott, 2004, p. 9)

4.4 Stakeholder and Project Roles

A stakeholder is "*a person, group or organization that has interest or concern in an organization. Stakeholders can affect or be affected by the organization's actions, objectives and policies*" (Business Dictionary, 2014g). The term was significantly characterized by Edward Freeman within his book "Strategic Management: A stakeholder approach" which was published in 1984 for the first time (Freeman, 1984). According to Freeman, stakeholders determine the economic success or failure of a company. The Stakeholder-Value-Concept was developed as a counter-concept which states that corporate activities are only geared to the concerns of the owner (Beiersdorf, 2012, p. 99). Generally a stakeholder is an involved person in a project, in this case a BI project and can be internal or external. Daojin (2010, p. 488) states that in IT projects, a stakeholder can be defined very easily as the customers who pay for the project and the users who are the receivers of the product or service[14]. This general proposition will be further developed in this thesis, especially in respect to sustainability reporting.

In the context of BI projects, a classification in internal and external project roles can be made. An internal role covers the salaried employees working for the company while the external project members are temporarily working on the project and are not salaried employed. A further classification can be made into the core team and extended team. The core team members are fully involved in the BI project, whereas the extended team members also have responsibilities on the BI project, but it is not their main priority (Moss and Atre, 2006, pp. 20–25).

As described in the previous section, there are different project roles needed for conducting a successful BI project. Table 3 describes the possible project roles and their impact and demands on the BI projects. Furthermore, a classification of core and extended and in internal and external stakeholders is made.

[14] In this case it can be referred to as reporting.

Project role	**Description**	**Impact and needs**	**Internal / External**	**Core / Extended team**
Management Team[15]	**Leading circles in the company**	**Demand for actual and revisable data and reports**	**I**	**C**
Department	**E.g. Controlling employees**	**Additional demand for new KPIs**	**I**	**C**
IT operations	**Employees, responsible for operation and maintenance of the BI-Server solutions**	**Information about changes in the BI-system threatening the dependability**	**I**	**C**
IT development	**e.g. employees of the BI IT, responsible for the data processing**	**Demand for information provision from special departments to implement modifications.**	**I**	**C**
IT purchase	**Employees from the IT department, responsible for the purchase and the negotiation of licenses of BI solutions**	**Demand for information provision from special departments and IT departments**	**I**	**C**
Database administrator (DBA)	**Employees from the IT department, responsible for the administration of the database**	**Performance and feasibility**	**I**	**C**
External operators	**E.g. external providers, hosting the BI solution**		**E**	**C/E**

15 "*The attention paid by top managers is essential to the success of the project, because it influences other project participators' ideas whether to support or refuse the project*" (Daojin Fan, 2010, p. 488).

Consultants	**e.g. to support and replace employees from special departments or IT departments**	**Increased information demand**	**E**	**C/E**
Software producer	**Producer of the BI solution**	**Responsible for the continuous improvement of problems and for support**	**E**	**C/E**
Supplier	**e.g. the Enterprise Resource Planning (ERP) system, when they have to deliver new goods**	**Current data**	**E**	**C/E**
Customer	**e.g. like supplier**	**Current data**	**E**	**C/E**
Regulatory requirement	**e.g. price precepts by the Federal Network Agency**	**Revisable data and reports**	**E**	**E**

Table 3: Overview of typical Stakeholder in BI Projects (based on Gansor *et al.*, 2010; Turban, 2008; Inmon, 2002, p. 323; Taschner, 2013, pp. 225–235; Moss and Atre, 2006, pp. 20–25)[16]

To cover all stakeholders and to classify them in order to define their part in the project, a stakeholder analysis has to be done at the beginning of a project. "*Stakeholder analysis is a technique of systematically gathering and analyzing quantitative and qualitative information to determine whose interests should be taken into account throughout the project. It identifies the interests, expectations, and influence of the stakeholders and relates them to the purpose of the project*" (IEEE Computer Society, 2011, p. 248). One possibility to classify the stakeholder is to align them according to the matrix shown in Figure 4.3. In this case, the stakeholders are evaluated for their power and their interest in the project. The resulting arrangement delivers guidelines on

[16] The overview can be further expanded, but serves as good overview of the most important stakeholders.

whether to keep the stakeholder satisfied, to manage them closely, to keep them informed or only monitor them.

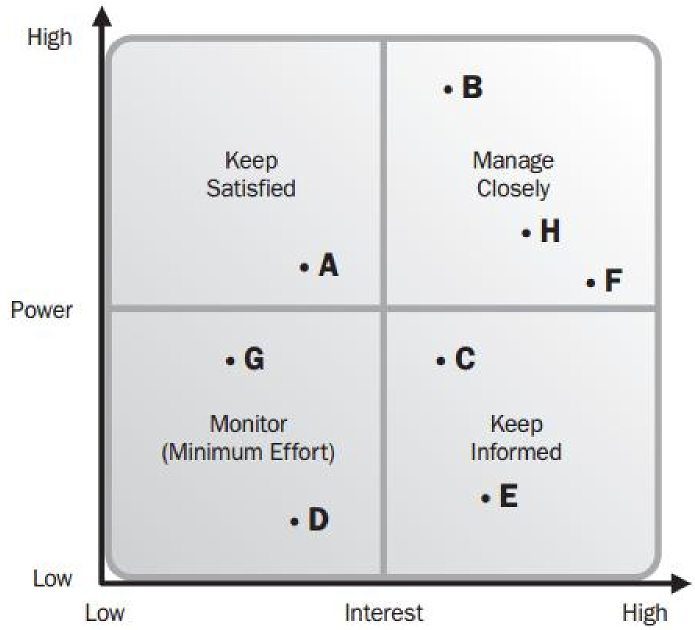


Figure 4.3: Example Power/Interest Grid with Stakeholders (IEEE Computer Society, 2011, p. 249)[17]

After defining the stakeholder GRID, the RACI (Responsible, Accountable, Consulted, and Informed) method (Hei and Linden, 2010, p. 20) can be used to define the extent of responsibilities of the roles within each role in the project[18]. To accomplish this, a matrix is designed where the x-axis covers the roles of the project and where the y-axis covers the tasks.

Then, for every task and every role, the assignment is made whether the role is:

- Responsible (R) - The project lead
- Accountable (A) - Role responsible for project costs

[17] A-H representing the placement of generic stakeholders.
[18] There are further developments to structure the roles more in detail, e.g. Supportive (S), a supporting role; Verify (V), a person verifying the results; Sign-Off (S), a person who affirm the result of role V; Omitted (O), a person who is explicitly not involved.

- Consulted (C) - Those whose responsibility is offering information

- Informed (I) - The person or people which must be kept informed regarding the project's progress

	Manager	BI-Specialist	Database Specialist	Controller
Task 1	**R / A**	**I**	**C**	**I**
Task 2	**A**	**R**	**C**	**I**
Task 3	**I**	**A**		**R**
Task 4	**R / A**		**I**	**I**

Table 4: Exemplary RACI Matrix

Table 4 outlines an assignment of the RACI method using fictitious tasks, as it can be used during the assignment of project members.

BI stakeholder and project roles may differ based on the BI organization defined by companies (see also 4.6). Therefore, Figure 4.4 gives an overview of the various interfaces and the resultant possibilities to cooperate between business and IT departments. As described in Figure 4.4, these differ based on the tasks a user has to perform the topic and is, therefore, conducted correspondingly by a BI-User from the business department leading to BI professionals from the IT department.

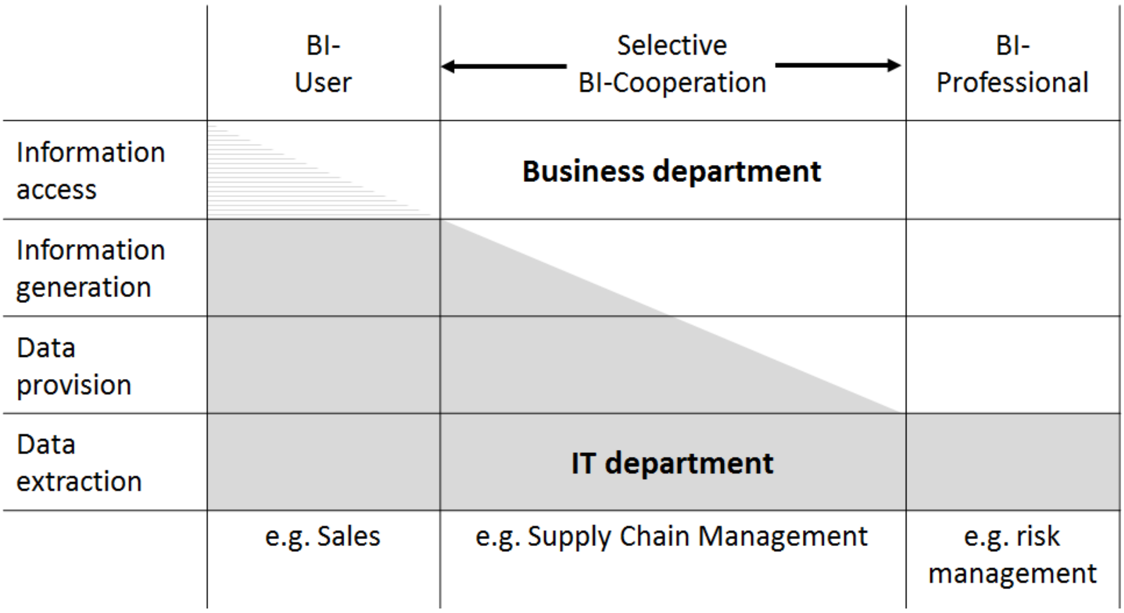


Figure 4.4: Alternative cooperation variants business department and IT department (Kemper *et al.*, 2010, p. 194)

4.5 Authorization Concept

The authorization concept of modern BI applications can be regarded from two points of view. On the one hand, the visibility of data can be restricted. That means that only the assigned users have the right to view certain data or to make certain analysis.

On the other hand, the application itself contains an authorization concept. That means, for example, that system developers are only allowed to access certain data or certain systems (see also section 3.6.1).

The reason for this is that BI systems consolidate the most relevant company data (e.g. sales figures or plan data), which are under a special security level.

4.6 BI Competency Center (BICC)

Besides the approaches to identify the stakeholder in a BI project, there is an approach to incorporate a team structure on an organizational level. The BICC can be regarded as business department which is incorporating the tasks, roles, responsibilities across various company departments. In an empirical study, 3/4 of the companies interviewed already had (or were planning) a BICC within their company in 2007 (Kemper *et al.*, 2010, p. 192). Figure 4.5 describes an "*informal*" BICC. As described within this figure, not only staff from the IT department (e.g. Data warehouse or ETL experts), but also the master power user from the business units have to be incorporated in the BICC.

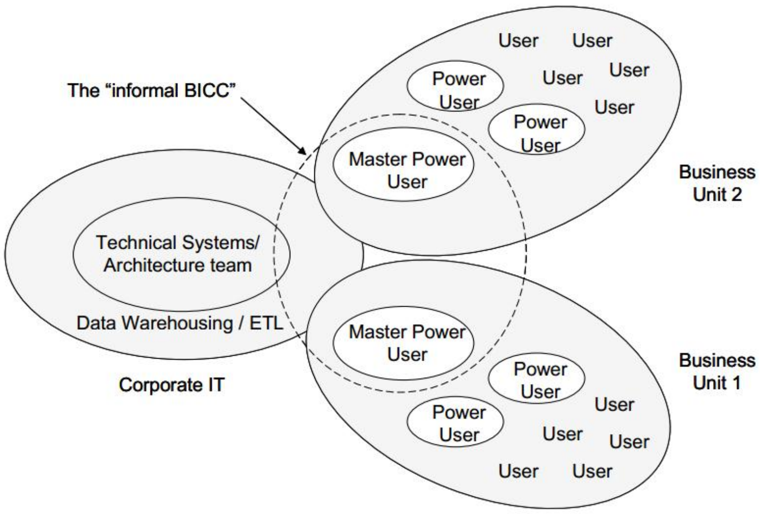


Figure 4.5: Current situation — an "informal" BI competency center (Elliott, 2004, p. 26).

This is based on the understanding, that BI itself contains IT and non-IT requirements which cannot be solved only by the IT department or only by the business units. Elliott further states that employees who are incorporated in the BICC have to hold three types of overlapping skills:

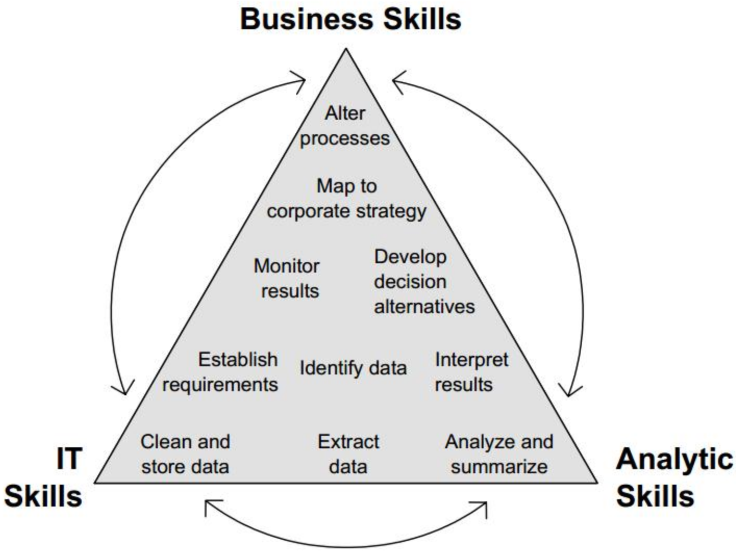


Figure 4.6: BI competency center employees need three types of overlapping skills (Elliott, 2004, p. 29)

4.7 Project Control

Modern BI implementations can face various problems. As shown in Figure 4.7, 60% of the interviewed BI users criticized data-quality (as described in section 3.6.3) and 56% are facing performance problems. Also, many users criticize the complexity of merging data and the complexity of BI-systems in general.

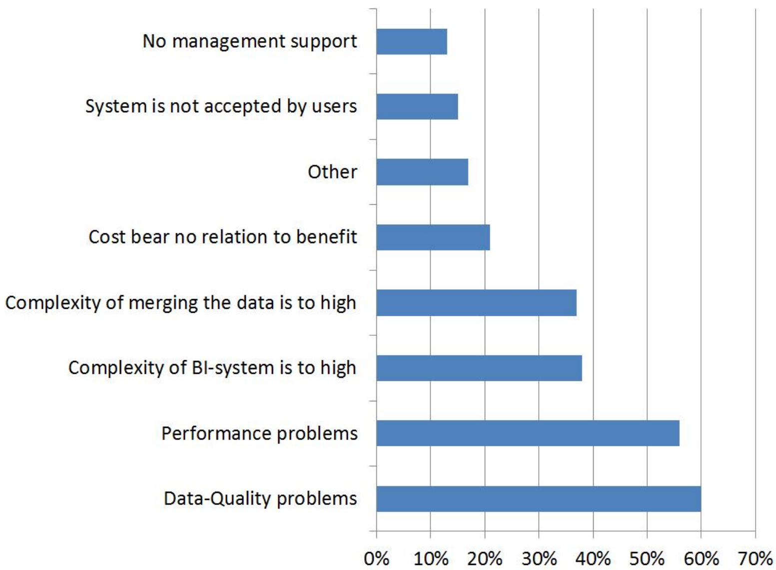


Figure 4.7: Issues in the BI adaption (Gansor *et al.*, 2010, p. 36)

The problems users face regarding BI-systems have to be addressed during BI projects. Regarding the performance, there are several examples of how to accelerate a BI system without modifying the hardware[19]. To address these problems (or, even better, to avoid these problems) it is important to fundamentally define the project success criteria. Success criteria can be classified as qualitative and quantitative (Gansor *et al.*, 2010, p. 13). Quantitative success criteria can be IT performance, emerging costs or the usage of the system while qualitative success criteria can be data quality, reliability of the BI system or service quality. These success criteria have to be reflected in the planned project costs and the manpower estimations. There are then a variety of tools which can be utilized to help to support the decision making process[20]. The output of this process can include a quality management plan, quality metrics and quality checklists, which are developed within the sustainability reporting process (IEEE Computer Society, 2011, p. 192) (see also chapter 7)[21].

Last, but not least, project controllers have to be aware that "*lack of timely and effective communication is an important factor leading to failure*" (Daojin Fan, 2010, p. 489).

4.8 BI Maturity Models

The first approach to measure the maturity of a model was raised by Watts Humphrey in 1986 in his concept called the Capability Maturity Model (CMM) (Chuah and Wong, 2012, p. 5). Basically, this model consists of five maturity levels including 1: initial, 2: repeatable, 3: defined, 4: managed, 5: optimizing (the final stage remains open as new developments

[19] This could be done by optimizing the data-loads for example or sometimes it is also a lack of updates for the BI-system.
[20] For example a cost-benefit analysis can help to make accurate and appropriate decisions.
[21] Furthermore, a very detailed overview over the controlling requirements regarding BI projects can be found at (Kemper *et al.*, 2010, p. 187).

arise). These models have been further developed in other fields of system models resulting in numerous maturity models for BI systems.

One approach, a benchmarking tool, illustrated in Figure 3.23 measures the level of completeness of vision and ability to execute by comparing various BI providers. Another example is the maturity model of the TDWI (2013) which is based on the five maturity levels of the CMM. There are also maturity models concentrating more on the technical aspects of BI systems and which are developed by BI providers such as the Hewlett Packard (2012) Business Intelligence Maturity Model.

Figure 4.8 outlines a summarizing approach to address every key aspect of a BI system within a BI maturity model. It integrates the Data Warehouse, information quality and the knowledge process to help companies to classify their own level of maturity.

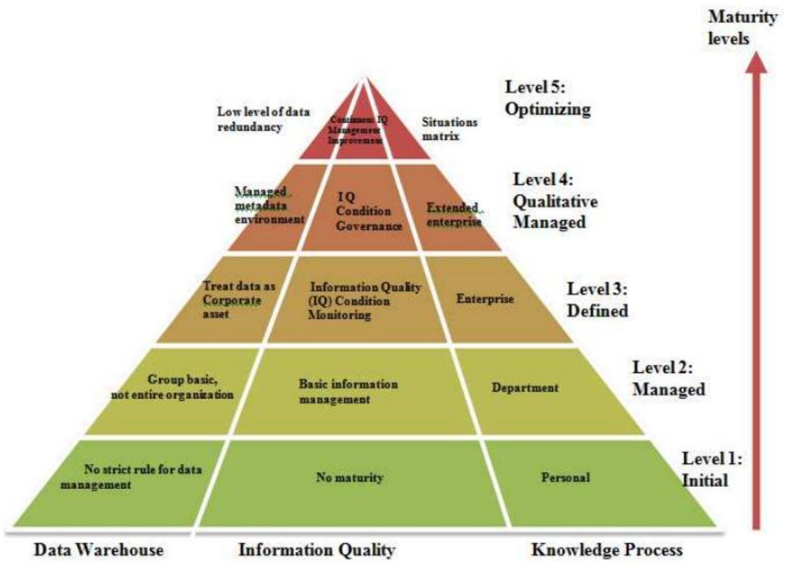


Figure 4.8: BI Maturity Model (Chuah, 2010, p. 305)

Summing up, there are an abundance of maturity models for BI systems which aim to help companies measure their level of maturity and to implement methods to further improve their current level.

4.9 Implementation Frameworks

One possibility to describe and name the process steps of an implementation is to rely on an overall IT project process description. This project cycle gives a framework and defines phases like the planning stage, implementation stage, presentation stage and stabilization stage. Furthermore, there are a number of models which describe the implementation of BI and also many describing the implementation of new KPIs in existing BI landscapes. The differences and similarities are described in the following.

First, Figure 4.9 illustrates a complete framework focusing on the technical implementation aspects.

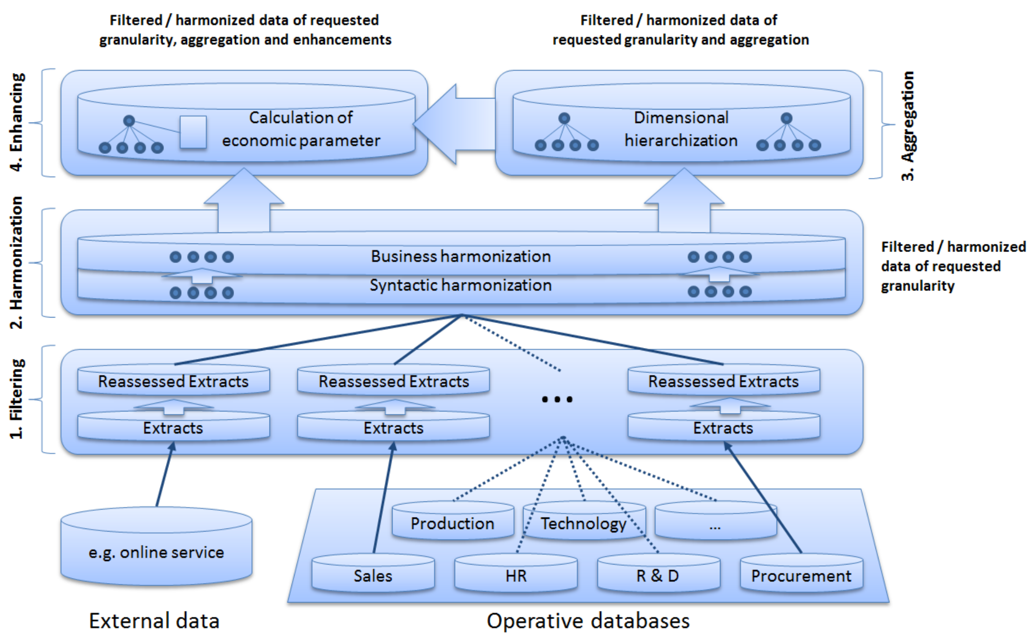


Figure 4.9: BI Transformation layer (Kemper *et al.*, 2010, p. 38)

The transformation layer, described in Figure 4.9 can be described as follows. The first transformation layer is filtering. That means that data from source systems are extracted and revised from syntactic and semantic deficiencies. Afterwards, the data is loaded into the staging areas of the Data Warehouse. The second transformation layer describes the harmonization of data whereby data is edited so it can be integrated for business purposes (e.g. currency calculations). The third transformation layer describes the aggregation of data. At this juncture, data is aggregated on a level needed for reporting (for example, in cases where sales figures are not needed on a document level). In the fourth transformation layer, data is enhanced. At this level, business KPIs are calculated and integrated into the data pool.

Another approach, described in Figure 4.10, specifies the non-technical BI implementation.

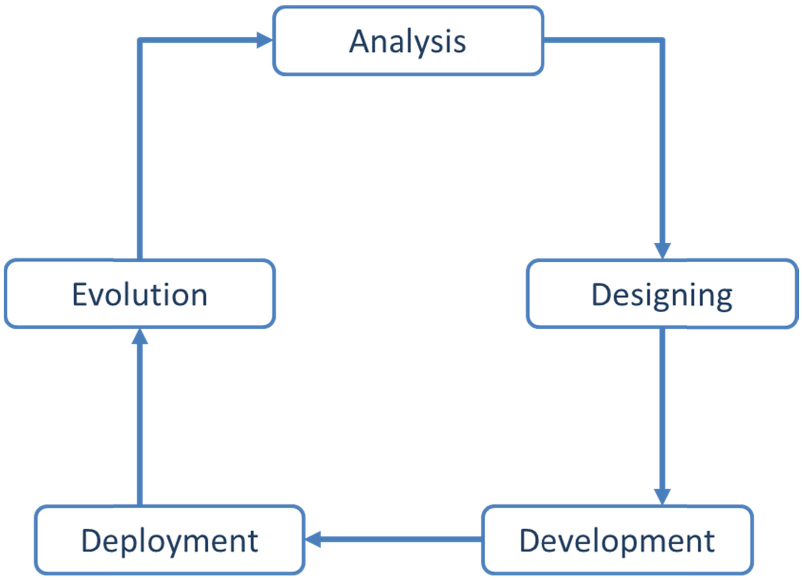


Figure 4.10: BI Implementation process (Gangadharan and Swami, 2004, p. 141)

Gangadharan describes the BI implementation as an ongoing closed loop. The process starts with the analysis which includes defining costs and advantages which the proposed implementation should deliver. The analysis phase should deliver a high level design of the used components. The subsequent design phase should then define the requirements, expectations and the adequate IT development by using prototyping. The development phase then first describes the handling of meta-data and the ETL process, referring to the requirements for data cleansing and data transformation. After testing these functions, the solution is then deployed in the so-called deployment phase. Additionally, Gangadharan adds an extra evolution phase, which should measures the success of the embedded solution. This evolution phase should then transfer the results to the analysis phase for future projects. Gangadharan indeed describes a closed loop process, but the phases are described insufficiently.

Yet another approach describing the BI implementation from a business view is described in Figure 4.11.

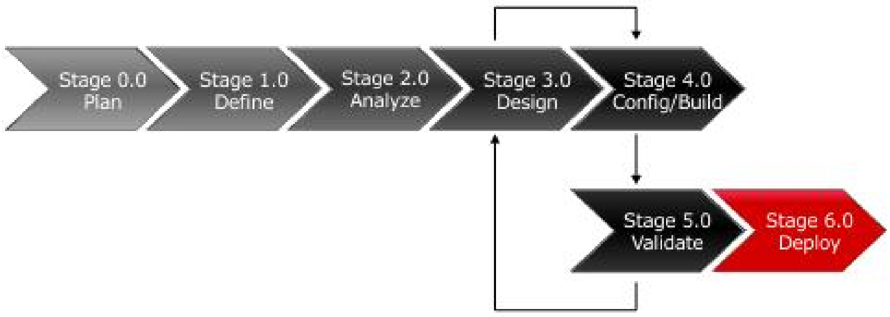


Figure 4.11: BI implementation process (idhasoft, 2013, p. 1)

Compared to the approach from Gangadharan, the implementation process is extended by a planning and a subsequent define phase. The planning phase includes the confirmation of scope, the identification of the stakeholder and the development of a project plan. During the design phase (which is performed through workshops, for example) information is collected and a business requirement document is developed.

Also unlike Gangadharan's approach, IDHSoft concentrates more on the architecture and the modified data-model and already includes the prototype mock-up. In the subsequent phases (configure, validate and deploy), the phases to build the report (or dashboard) is showed similarly to the approach from Gangadharan. Compared to the model from Gangadharan, however, this model isn't built as a closed loop. Only the phases design, config/build and validate can be repeated, where the results from the validation phase does not feed the planning phase again but rather the design phase.

A further framework is described in Figure 4.12. It describes similar project phases but illustrates both the functional project design and the technical implementation.

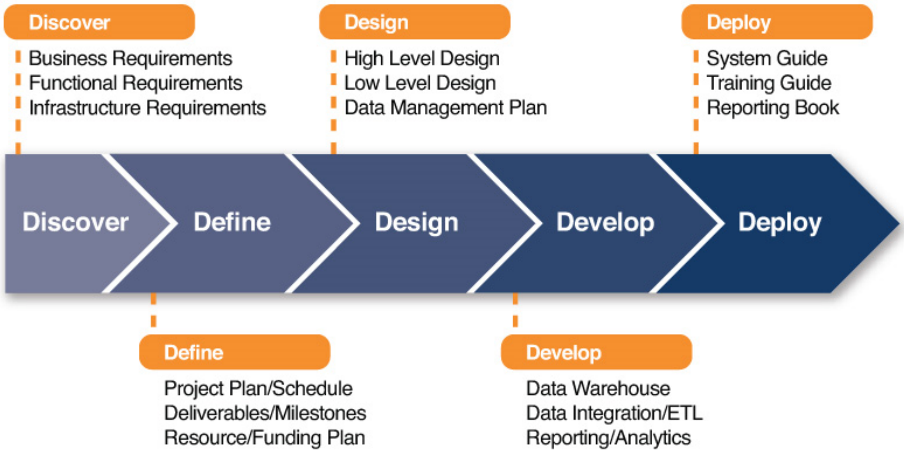


Figure 4.12: BI Framework (IOLAP, 2014, p. 1)

A further very detailed approach is described in the Business Intelligence Roadmap (Moss and Atre, 2006). This approach amplifies the foregoing models with a process model for the following phases:

1. Business Case Assessment
2. Enterprise Infrastructure Evaluation[22]
3. Project Planning
4. Project requirement definition
5. Data Analysis
6. Application Prototyping
7. Meta Data Repository Analysis

[22] Here the technical infrastructure as well as the non-technical infrastructure is described.

8. Database Design
9. Extract / Transform Load
10. Meta Data Repository Design
11. Extract / Transform / Load Development
12. Application Development
13. Data Mining
14. Meta Data Repository Development
15. Implementation
16. Release Evaluation.

This model is the most detailed (Compared to Gangadharan and Swami, 2004, p. 141; idhasoft, 2013, p. 1; IOLAP, 2014, p. 1), but it refers primarily to situations requiring a complete rebuild of the BI system. Another detailed process model concentrates on the enrichment process of new KPIs (Gansor *et al.*, 2010, p. 235). The process model describes the enrichment of new data into the BI system, originating with the start-event "data not available". Additionally, the process model describes the involvement of the business department, BICC (see also section 4.6) and IT.

Furthermore there are models which do not illustrate the whole BI implementation process, but only important aspects (for example the data mining process (Wang and Wang, 2008, p. 625) or the design and implementation of an ETL approach (Wang *et al.*, 2012) WANG. In this section, these models are not considered, but are instead used for the development of SureBI (See chapter 8).

4.10 Conclusion

Summing up, there are a number of different BI project definitions. The corresponding definition for this context can be also called operational BI, or in other words a project with the objective to implement a new report within BI. It is a complex topic itself, due to lacking organizational involvement of the BI topic, as well as the variety of stakeholders (which are oftentimes not fully identified and addressed). Also, the possibility of controlling to influence a BI reporting project is only possible if the project is planned thoroughly, which, in reality, is often disregarded due to the high complexity of systems. This section is the basis for the generic BI reporting process which is developed in the next section.

5 A Novel Reporting Process for BI Reporting Projects

"*IT often complains about high efforts, the business users are unsatisfied with the generated content or the performance of the BI system, and the management regrets the insufficient achievement of business objectives aligned to the BI approach*" (Gansor *et al.*, 2010, p. 13).

Due to these operating limitations, in this chapter a BI implementation process is developed, describing both the technical and non-technical aspects.

From the technical (IT) perspective as well as from the business perspective, there are a great deal of established BI implementation models (see also section 4.9). Many of them attend to the complete rebuild of a BI system while others focus on the implementation of single KPIs. To establish comparableness with the sustainability reporting process, in this section the process on how to implement a new report is described. The developed process model is grounded in the implementation models from literature, consultancy process models, and many years of project experience in the field of business intelligence. In section 5.1 a project in this context is illustrated. Section 5.2 describes how the process steps are developed and the further sections describe each process step including tasks, outcomes and deliverables.

The resulting developed process forms the basis for SureBI in chapter 8.

5.1 Definition of BI Reporting Project in this Context

To outline a reporting process for a BI reporting project, the project definition from section 4.1 is used, defining a project with a definite beginning and end. Start event of a BI project in this context is defined as a demanded reporting product[23]. Therefore, it can be further deduced that a project in this context can be regarded as a complex operational BI project (as defined in section 4.1) in comparison to data-loading initiatives[24].

The triggering event for the demand of a BI project (see also demand oriented vs. supply oriented in section 5.3.2) is not considered; the project starts with the demand of the reporting project.

As a pre-condition on the technical side, it is assumed that a BI system is running (see also section 3.6) that it is built-on the basic principles of BI (See for example the Solutions ranked by the Gartner Group, Figure 3.23), several source databases are connected to the Data Warehouse and that the project should be executed by using the reporting solutions (in case of SAP the BEX suite), the BI provider delivers. That means that the reporting process does not contain a software selection process.

5.2 Definition of Reporting Process in this Context

The reporting process aims to guide the reader through the process of implementing a BI reporting product wherein a process is developed illustrating each step of the implementation. The implementation process illustrates an ideal process, however, in reality, many BI projects are not planned in such a profundity and therefore often fail[25].

[23] That could be among others an annual report, management-report or a management dashboard.
[24] E.g. in case of missing KPIs for one report.
[25] Many BI architects e.g. concentrate too much on the technical implications of a BI project and don't consider the business implications while planning the project; see also Gonzales (2004, pp. 1–2).

The reporting process consists of process steps, which are consolidating subject areas (e.g. one topic or one area of responsibility) which are derived from literature, consultancy input and project experience. The order is deduced from the required input and delivering output of each process step and from there the execution order (linear / parallel) is derived. The process steps serve as the regulatory concept for the reporting process. The definition of the process steps and the order is described in section 5.3. Each process step is structured in sub-process steps, describing again a formal subarea (again, one topic or one area of responsibility). Each sub-process contains a start event and an end event (and deliverables) where the order of the sub-processes is defined. Additionally, it is in the step, constraints such as approval or loops are defined and it is indicated if the sub-processes can be executed simultaneously. Furthermore, for each sub-process, the tasks necessary to accomplish the end event are described including organizational assignments, methods, guidelines, cross references to this thesis and links to further readings. Summing up, the reporting process describes a structured approach for accomplishing a BI reporting project.

5.3 Definition of Process Steps

The process steps, including their sequence, are derived from BI literature, frameworks from BI consultancies, and project experience but also from standard project management literature. The project approach described in this chapter combines the technical BI implementation view with a standard business perspective, the adaption of business requirements with BI software. In this section, the process steps are defined, describing the reason for each process step, the derivation of its sequence and whether the process step can be executed simultaneously to other process steps. Following the definition for a project in the context of this thesis (see section 5.1) and typical project management literature (IEEE Computer Society, 2011), a project typically starts with the plan phase (this trail is also followed by idhasoft, 2013; Moss and Atre, 2006; Ying Shi, 2010, p. 69). This phase outlines what should be achieved, how it is transformed, by whom both is conducted and which risks have to be avoided. This phase defines the full range of requirements for conducting a BI project within a small team and ending with the project kick-off, which reflects the formal start of the project with all of the project stakeholders.

In practice companies oftentimes calculate a business case prior to the project phase. For reasons of clarity and comprehensibility, the needed steps for the justification of a project are included in the planning phase. After having planned the project in general including the project team and the scope of the project, literature establishes the next phase, the analyze phase (As described in Gangadharan and Swami, 2004, p. 141; idhasoft, 2013, p. 1; Gansor *et al.*, 2010; Moss and Atre, 2006), as next step for conducting a BI project. In this phase, the requirements for the BI product (see section 5.1) are further developed, the needed data is analyzed by the involved stakeholder, and a first rudimental prototype can be developed. This phase concludes with the definition and establishment of the requirements from the business users to the IT department who are then responsible to process it. The project specifications developed in the foregoing phase are then used in the design phase (Moss and Atre, 2006, pp. 191–257; Gangadharan and Swami, 2004, p. 141; idhasoft, 2013; IOLAP, 2014). In this phase the BI system is configured on the technical side and the reporting functionality is designed both on a conceptual level and within the BI system. The subsequent development (As described in idhasoft, 2013; Gangadharan and Swami, 2004, p. 141) phase illustrates the actual realization of the reporting product. As described in section 5.1, this process illustrates an ideal reporting process and therefore this phase is placed after the more thorough planning, analysis and design phase. A contrary approach, often used in software development, is rapid prototyping, where the above-mentioned phases are conducted in a parallel rather than sequential fashion. Since a BI product has to be developed both from a business perspective (e.g. calculation metrics, what KPIs the report should contain, how these KPIs have to be opposed) and a technical perspective (which data has to be loaded, how are new data sources connected, how is the database configured), a separate project phase called the validate phase has to be conducted after the develop phase (Moss and Atre, 2006, pp. 268–273; idhasoft, 2013; Anandarajan *et al.*, 2003, p. 192). This phase not only considers whether the KPIs are calculated correctly, but also the usability of the reporting product and technical BI topics such as if the data loading processes are running automatically. As BI users face serial problems regarding their reporting applications (see also Figure 4.7), this phase is detached from the develop phase to ensure the desired solution at the end of the project. The result of this process step can be the return to the develop phase to correct the defects resulting from the validation phase. After the confirmation that the developed reporting product can be published to the target group, the project phase deploy (As described in Gangadharan and Swami, 2004, p. 141; idhasoft, 2013; Gansor *et al.*, 2010; Moss and Atre, 2006) is defined. This phase describes the release of the reporting product to the receiver who was defined at the beginning of the project. This can also be named as the formal end of the project, referring to the project definition in section 5.1. After the completion of the project, the reporting product commences operations that mean that both the IT department and the business department are responsible for the stabilization and optimization. Though these steps are subsequent to the original project, references for the handling of the following operational phase and the inclusion of lessons learned for prospective future projects are described within this phase.

Figure 5.1 illustrates these identified process steps as well as the section where each process step is described in detail.

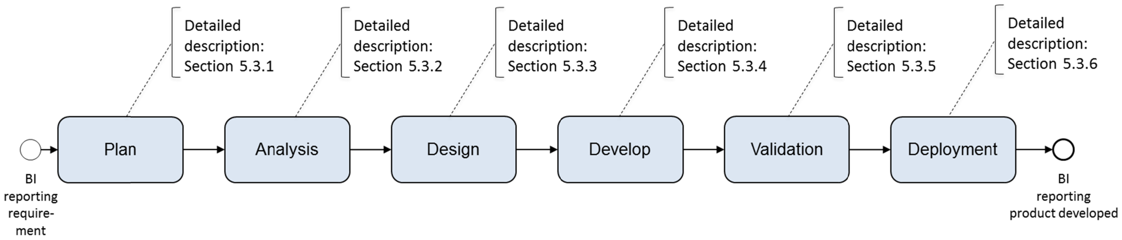


Figure 5.1: BI Reporting Process - Process Steps

5.3.1 Plan

In his article, "Implementing Business Intelligence Standards", Elliot (2004, p. 9), suggests that BI fragmentation is increasing. This phenomenon leads to the following results: various BI providers (with different service offerings) increase in complexity and various business departments have different reporting demands[26]. This leads to, among other factors, higher procurement costs, higher training costs, longer project implementations and higher information inconsistency (Elliott, 2004, p. 10). Furthermore, Kemper states, that there is an erroneous trend regarding the efficacy of BI implementations (Kemper *et al.*, 2010, p. 171). He states that a strategic balance between BI profitableness and BI efficacy should exist. For that reason, and as described in the foregoing sections, the decision of developing a business case for the project should be considered prior to the planning process step. A BI business case should then contain the following topics (Moss and Atre, 2006, p. 48):

- Objectives of the proposed BI application
- Business problem or business opportunity
- Explanation of how the BI application will satisfy that need

[26] For example one report needs data from sales and finance, the other report data from manufacturing and marketing.

- Delimitation of what the solution will not offer
- Cost-benefit analysis results
- Risk assessment

These topics are then outlined in one document and passed to the project sponsor for approval and are then described within the planning phase.

The first event of the project in this context is the request for a new reporting product as described in section 5.1. As the first process step, the given requirement is examined meaning that the general problem or user requirement is defined in broad terms and the stakeholders are identified (this step is similar defined by Anandarajan *et al.*, 2003, p. 191; idhasoft, 2013). Within this process step, the requirements including defining the receiver(s), determining the needed data, and choosing the most appropriate form of presentation are undertaken. The stakeholder definition in this case serves for the following process steps to gain input for further investigations. Typical stakeholder can be the reporting clients (see also section 4.3.) and further receiver of the report as well as business departments of the own company dealing with the needed data. Anandarajan (2003, p. 191) extends this process step by claiming that during this sub-process step, an initial feasibility study can be made which can help lead to a start or stop decision on the project. Although Moss and Atre (2006) describe the installation of a new BI system; the described steps can be used for a project realization in this context. He extends the definition of the project requirements by considering the definition of data and functionality – including queries – which are followed by a technical and non-technical infrastructure assessment. This approach is also described by idhasoft (2013) and IOLAP (2014)[27].

[27] IOLAP stratifies for business requirements, functional requirements and infrastructure requirements.

Derived from these approaches, the first step "reporting requirements and stakeholder identification" is followed by "technical and non-technical infrastructure assessment". The technical infrastructure assessment report aims to describe the BI hardware landscape as well as its connections on a very detailed level. It illustrates the names of the systems as well as the content these systems provide. Mostly this information already exists in the company (often referred to as BI architecture) and it only has to be supplemented with additional project information. This report can also include information about new tools and hardware which will be required to be purchased due to the project requirements. The non-technical infrastructure assessment report describes the non-technical requirements. Deliverables for this sub-process step would be incorporated into the non-technical infrastructure report which includes, among other items, the use of a development methodology, roles and responsibilities (of the BI product) and the project's security provisions (Kemper *et al.*, 2010, p. 54). Moss and Atre (2006, p. 99) enhance the establishment of project requirements with the determination of the quality of the source files and databases "*to make an educated guess about the effort needed for data cleansing*", which can be made after the infrastructure assessment. That means that, in this step, the data source quality should be investigated to deliver an assessment of further costs for data quality expected in the next process steps.

After having defined the project requirements and the technical and non-technical infrastructure, the defining of the project team can take place. In other words, after defining what the project should deliver as output, the critical decision of who is best equipped to achieve this can be made.

Gansor et al. (2010) differentiate the project teams into the main project team and the extended project team. The main project team members are defined as actual acting persons in the project. Gansor et al. suggest limiting this group to a maximum of 5 to 7 members. In contrast, the extended project team members are specialists responsible for delivering information. They can be recruited from other business areas and other company divisions. Moss and Atre (2006, p. 22) name the following roles for the core project team:

- Application lead developer
- BI infrastructure architect
- Business representative
- Data administrator
- Data mining expert
- Data quality analyst
- Database administrator
- ETL lead developer
- Meta data administrator
- Project manager
- Subject matter expert

This list of primary roles may have to be extended[28] or reduced[29] if necessary and reviewed if the selected resources are available during the project. Afterwards, every role has to be

[28] For example with the project stakeholders described in section 4.4.
[29] Depending on the project, and as Moss and Atre mostly refer to a complete build-up of a BI system, some of these project roles may not be needed for a project in this context.

assigned to a project role. Therefore the RACI Method (described in section 4.4) can be used.

After having defined the project members and their roles within the project, a determination of the cost estimate can be done (this is also described in Moss and Atre, 2006, pp. 98–99). This is best done after the assignment of employees to the specific project roles due to the variable costs of human resources. It is in this cost estimate that the specific costs generated by the project are listed. A good overview of typical cost drivers in BI projects is illustrated in the following Figure 5.2.

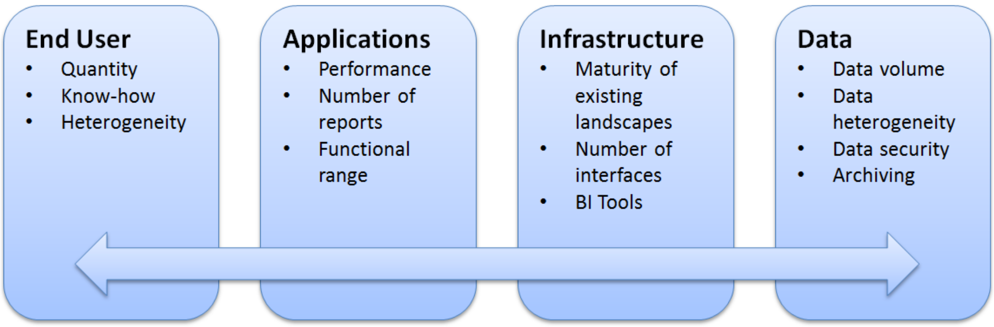


Figure 5.2: Structure of typical cost driver of BI systems (Gansor *et al.*, 2010, p. 255)

After having defined the planned costs of the BI project, these costs should be analyzed relative to the anticipated return on investment (ROI) the planned project is expected to accomplish (see also Moss and Atre, 2006, pp. 37–39; Elliott, 2004, p. 16). Elliott (2004, p. 10) describes the complexity of defining the ROI of BI projects (see also Boyer *et al.*, 2010, p. 29). One method to define the ROI is to consider similar, introduced BI projects and to derive the anticipated ROI to the ROI achieved from these projects. Another possibility is to benchmark the company's BI landscape to other companies in the same (or similar) sectors. External companies and consultancies can often provide these services.

To ensure the most ideal process model, the possible risks which can occur during the course of the project have to be analyzed. Since these process steps include the analysis of both the technical infrastructure, as well as the project team, this process step is set after the technical infrastructure and before the project team definition.

According to Solms and Solms (2009, p. 87) a risk's potential for occurring and potential impact if it does occurs must be researched. A standard approach regarding risk management is first identifying possible risks, then analyze the risks, identify possibilities to cope with the risks and concluding with the ongoing controlling and monitoring of the risk during the project (see for example Müller and Lenz, 2013, p. 157).

To support the process of identifying possible risks, a classification of the source of possible risks in a project, in people and in technology (see for example Gansor *et al.*, 2010, p. 95) can be made. Table 5 outlines some exemplary risks which can occur during a project.

Project	
Project scope	Can the requirement be implemented within the project scope?
Project content	The project content understandable to all project members?
Business sponsor	Do we have the support of the project sponsor in case of delays?
Scheduling	Can the project be conducted within the planned time schedule?
Parallel development	In practice, BI project are only implemented successfully if other required, preceding projects are successfully implemented. One example of this is the implementation of specific source systems.
Budget	Can the project be executed within the planned budget?

Changing business requirements	Will other business requirements change during the course of the project?
Project management	Do we have appropriate project management know-how?
People	
Team	Do we have enough project-related, expert know-how ? In case of doubt, external service providers should be utilized.
Availability	Are the project members available during the course of the project including in case of delays?
Motivation	Is the project team motivated or is there resistance?
Technology	
Isolated applications	Are there any isolated applications (e.g. spreadsheet analytics) which have to be included?
Technology / BI system	Is the BI system well-engineered and available during the course of the project?
Data quality	Are there any data quality issues known or issues which can occur during the course of the project?

Table 5: Possible risks during the course of a BI project (based on Gansor *et al.*, 2010, p. 94; Moss and Atre, 2006, p. 86; Gartner, 2015; Kemper *et al.*, 2010, pp. 174–175)

The list of risks described in Table 5 will be extended, based on the requirements of the project.

After the identification of possible risks, these risks are analyzed and evaluated. Moos and Atre (2006, pp. 40–45), recommends the development of a risk matrix (Figure 5.3). A risk matrix contains the various variables[30] on the y-axis. These variables are then categorized by their risk level on the x-axis (Moss and Atre, 2006, p. 40):

- Green: Low risk meaning that the project should continue
- Yellow: Medium risk, which means that the project can continue with caution, but has to be closely monitored
- Red: High risk, which decrees that the project has to be stopped and the variable has to be reevaluated before proceeding further.

Level of risk			
Variable	Green (low)	Yellow (medium)	Red (high)
Technology	Experienced with mature technology	Minimal experience with technology	New technology, little experience
Complexity	Simple, minimal workflow impact	Moderate, some workflow impact	Mission critical, will require extensive reengineering
Integration	Stand-alone, no integration	Limited integration required	Extensive integration required
Organization	Solid internal support	Supportive to a large extend	Little internal support
Project team	Business experience, business-driven, talented, great attitude	Some business experience, business-driven, talented, fair attitude	No business experience, only technology-driven, limited talent, bad attitude
Financial investment	Possible ROI within a very short time	Possible ROI within a moderate time frame	Possible ROI after a few years

Figure 5.3: Basic Risk Assessment Matrix (Moss and Atre, 2006, p. 41)

30 Regarding Moss and Atre (2006, p. 40) the development should bear to the six major variables: technology, complexity, integration, organization, project team und financial investment.

After finishing the risk assessment, the developed content is written down in a document designed to convince the project sponsor of the feasibility and significance of the project[31]. Occasionally, the outcome of the risk assessment can implicate a need for re-assignment of the project roles or a further elaboration of the infrastructure assessments.

After the identification and the analysis of the risks, strategies should be set on how to cope with the possible risks. Solms and Solms (2009, p. 88), therefore, outline three specific strategies:

- Reduce the potential impact or the risk
- Reduce the probability or frequency of the risk
- A combination of both of the above

In the case of the identification of lacking BI know-how, an external service provider can be contracted, for example, to reduce this risk. As described before, the risk assessment concludes with the definition of the ongoing controlling and monitoring during the course of the project.

After completion of the risk assessment Moss and Atre (2006, pp. 98–99) recommend the definition of Critical Success Factors (CSF). This is also described by Anandarajan (2003) and placed after the project team definition and the allocation of resources to the project (Anandarajan *et al.*, 2003, p. 192). According to Anandarajan et al. (2003, p. 192), the CSF should include factors relating to hardware, software, data, people and procedures. As a real-life example, a limited availability of employees from the BI-Team could be named as CSF.

[31] Elliott (2004, p. 43) describes the importance of an active executive sponsorship und the monitoring and communicating of the implementation plan.

At the end of this phase, the output of the planning phase can be developed as well as the establishment of the project charter and the project plan. In theory, these two documents can be developed independently as no input from one another is needed (this is also described in Moss and Atre, 2006, p. 98). In the following, the project charter is described followed by the project plan.

The project charter "*represents the agreement between the IT staff and the business sponsor about the definition, scope, constraints and schedule of the BI project*" (Moss and Atre, 2006, p. 100). The project management institute states that at this point, expert judgment can be used to define the project charter (IEEE Computer Society, 2011). Figure 5.4 illustrates a template for the project charter. The in-frame / out-of-frame sections can be used to clarify project conditions. In this context stakeholders (but also activities, analysis etc.) can be named as an agreement not to expend project time on them (another example of a project charter can be seen at Ruf and Fittkau, 2008, p. 105).

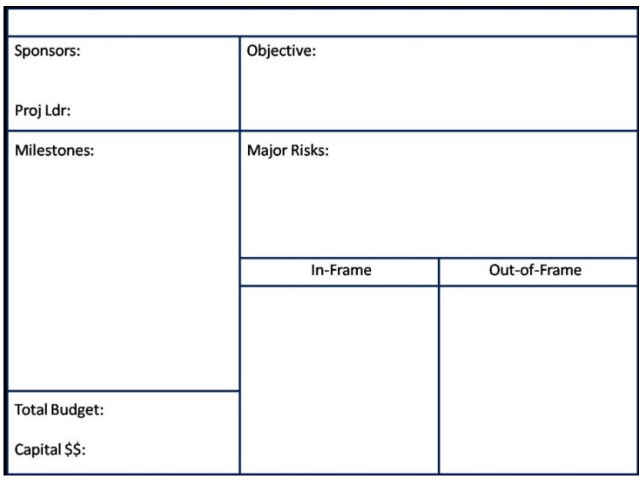


Figure 5.4: Project charter example (Project Management Guru, 2014)

In the planning phase at the beginning of the project, often a high-level project plan is developed with the more precise, drilled down versions being developed during later stages of the project by the project teams. The high-level project plan aims to illustrate the timing of the project. It reflects (oftentimes via a Gantt-chart) the detailed task estimates, task dependencies and resource dependencies. Moss and Atre highlight the activities of project planning (Moss and Atre, 2006, p. 90):

- Create a work breakdown structure listing activities, tasks and subtasks.
- Estimate the effort hours for these activities, tasks, and subtasks (Moss and Atre, 2006, p. 92 states out three possibilities of estimation: historical, intuitive and formulaic)
- Assign resources to the activities, tasks and subtasks
- Determine the task dependencies
- Determine the resource dependencies
- Determine the critical path based on the dependencies
- Create the detailed project plan

IDHSoft (2013) further states out that the project plan should contain also the deliverables and milestones for each phase.

As soon as the two documents are approved by the business sponsor[32], the project can start beginning with the initial kick-off meeting. Regarding Moss and Atre (2006, p. 421), the kick-off meeting should include also the assignment of the project responsibilities, the discussion of the project charter and a discussion of the project plan.

[32] An example of a project assignment form can be seen at Ruf and Fittkau (2008, p. 107).

5.3.2 Analysis

The analysis of the reporting product, defined in section 5.1, takes place after the planning phase of the project. The objective of this process step is to define the specifications of the reporting product so it can be designed and developed in the next phases. Gangadharan and Swami (Gangadharan and Swami, 2004, p. 141) state the objective of the analyze phase is to develop a high level design including the needed components and the sources of relevant information to achieve the desired reporting product[33]. The focus is on the planned content dissociating the planning of the report in the previous process. Furthermore, in contrast to the planning process phase, all project members are already involved in this process step.

Two options for analysis can be chosen which are derived from the possible directions of the information demand (Gansor *et al.*, 2010, pp. 97–98): Demand oriented, which means that the business department determines the functionalities the reporting product should contain and supply oriented which describes the setup of the reporting product based on the data available in the IT- systems. The process steps of the analysis phase are guided by the direction of the definition of the reporting contents by the business department towards the technical implementation on database level. Therefore the process steps are defined (as previously described in section 5.3.1) by individual work packages which can be streamlined by topic or area of responsibility.

Deduced from this approach, the first step is the clarification of the definition of reporting requirements. A proposed method to gather information about the reporting product is to conduct requirements workshops (idhasoft, 2013) or conduct interviews (Moss and Atre,

[33] However Gangadharan includes a cost-benefit-analysis in the planning phase, which is already treated in the Planning phase.

2006, pp. 117–118 additionally offers interviewing tips and how to conduct the interviews). At the end of the analysis of the reporting requirements, a business requirements document should be delivered (see also idhasoft, 2013; Moss and Atre, 2006 names it application requirements document).

Based on the order – beginning with the requirements from the business user – the reporting requirements are further defined. Moss and Atre (2006, p. 115) start with the definition of desired subject areas, e.g. product, costumer, order etc.. Additionally, the KPIs can be derived from the subject areas (Gangadharan and Swami, 2004, p. 140 suggests to define a set of KPIs within this phase). Furthermore, the reporting functionalities (like e.g. drilldown), including the calculation and the requirements for historiography (see section 3.6.9) are defined. Based on the outcomes from these steps, the origin of the desired KPIs is analyzed. Therefore, the data and meta-data (for both see section 3.6.3) required for providing the defined KPIs is defined including both existing data and non-existing data. Moss and Atre (2006, p. 120) suggests developing a high-level logical data model where, based on the overview of required data, the data cleansing requirements can be defined. Moss and Atre (2006, p. 115) recommends classification of the required data into critical, important and insignificant and define thresholds like "monthly sales total: dirty data threshold = 2 percent". The business requirements document furthermore could contain preliminary service level agreements (SLAs), describing among others the availability of the system, response time, data cleanliness and the ongoing support (Moss and Atre, 2006, pp. 120–121).

While the further definition of the reporting requirements is usually conducted by project members from the business departments (having the knowledge about the business requirements for the reporting product), a further sub-process step, data analysis (this sub-process step is also defined by idhasoft, 2013; Moss and Atre, 2006, pp. 125–147), which focuses on the technical origin of the data and therefore is conducted by project members with BI knowledge. This sub-process step includes the determination of data sources needed to deliver the required data and the examination of data and data vacancies (idhasoft, 2013). However, before examining the data, the data sources have to be defined. Therefore the data sources can be classified according to already connected sources, new sources, and internal/external sources. The data resulting from the sources can further be analyzed for the data source quality and data discrepancies. The data quality assessment can be categorized by the criteria illustrated in Figure 5.5.

Quality challenge	Description	Example
Consistency	Conflicts between terminology, definitions, representations, data values etc. across divisions, departments and IT systems	Different opinions on what "Cost Price" is
Completeness	Missing information	Product category only available on less than 50 % of the products sold
Accuracy	Incorrect information when compared to reality	Product weight registered as 10.5 when it should be 11.2
Validity	Information is in violation of expected and/or specified ranges or business rules	Salary is three times higher than the average for that type of employee in that department
Uniqueness	Duplicates exist. Can be either "same-same" or (worse) same identification but different content	Reuse of an old UPC for a new product (even though the old product is still found in the data warehouse)

Figure 5.5: Data quality criteria (Frisendal, 2012, p. 87)

The output of this sub-process step could then be a data-cleansing specification document containing methods of dealing with data discrepancies based on the data cleansing requirements defined in the sub-process reporting requirements.

The findings from the further definition of the reporting requirements and the data analysis might lead to higher complexity than projected during the planning phase. As a result of this and of having acquired a better understanding of the needed effort of implementing the data during the last sub-process steps, a further process step referred to as prioritization is recommended (idhasoft, 2013). This sub-process step is optional but can be used in cases where only part of the reporting requirements can be implemented. To prioritize KPIs for example, the KPI outlines can be developed (as described in section 5.3.3) and can be classified by "*needed for controlling*" and essential "*for checking purposes*" (Vollmuth and Zwettler, 2008, p. 27). These KPIs can then be evaluated using a matrix (see also section 4.4) by the project team. The same approach can also be used to prioritize the reporting requirements or analysis possibilities. In this context it also has to be considered that the technical effort by external service providers can be incorporated to meet the time frames allotted. A further possibility is the MoSCoW method (Coley Consulting, 2014), where KPIs, reporting requirements or analysis possibilities can be classified according to "*must*", "*should*", "*couldn't*" and "*won't*".

Referring to the high-level design of the output from the analysis phase (Gangadharan and Swami, 2004, p. 141) a prototype can be developed as the final sub-process step of the analysis phase. The objectives of the prototype are to defining the overall project concept at this stage, review the implementation process and the business user's view as well as the disclosure of possible errors and risks.

A prototype in this context should contain exemplary KPIs, exemplary queries, possible analysis capabilities arranged in the reporting format defined in the process steps "plan" and "analyze". The prototype is shown to the project sponsor and the project team as the last task within this process step.

5.3.3 Design

With the help of the developed business requirements document and with further results from the prototype presentation, at this point the design of the reporting product takes place. The objective of this phase is to design the requirements as detailed as possible to be able to implement them during the development phase. The process steps can be subdivided into conceptual design regarding the presentation layer (idhasoft, 2013) and technical design regarding the IT implementation. It is recommended to conduct the conceptual design prior to the technical design as the conceptual design may contribute new requirements for the technical implementation design. Kemper et al. differentiate the conceptual design stage into the "*development model*" (2010, p. 198) and the "*service model*" (2010, p. 202). The development model contains the development of a project data model, the definition of the information-system-design, the definition of the communication- and cooperation-system-design and the development, testing and consolidation of the prototype (idhasoft, 2013 also describes the development of a prototype mock-up for this phase). In the project data model, the relevant KPIs and the corresponding internal and external data as well as the resulting values are defined (this is also defined in idhasoft, 2013). For this part, a KPI outline[34] can be developed. Therefore, for every KPI, the following data is determined:

[34] KPI outlines are often used in consulting companies to structure the requirements.

- Name: name of KPI
- Description: short description of KPI
- Unit: unit of KPI, e.g. currency
- Periodicity: e.g. monthly
- Reporting dimensions: e.g. country, product-group
- Receiver of KPI: e.g. accounting
- Calculation: which figures are used and how the KPI is calculated.

The "*service model*" (2010, pp. 202–205), described by Kemper, includes the technical operation (the management of the technical infrastructure), the functional operation (including the administration of the data warehouse and the report production), the support (as the central contact for service requests) and controlling (organizing new reporting requirements) phases. Additionally, the conceptual design phase should include the general structure of the reporting product, the arrangement of the KPIs and the required reporting functionalities. Summarizing, the conceptual design process step should deliver the content and can be presented as a design mock-up as described above.

The technical design phase is derived from Moss and Atre (2006, pp. 191–279) describing first the design of the database followed by the design of the ETL process towards the design of the meta data repository. During the first process step, the design of the target database and the developed reporting requirements are used to design the BI target database. Therefore, based on the basic principles seen in 3.6.10 and 3.6.11, a relational data model is developed as shown in Figure 5.6 which describes the allocation of energy consumption to fictitious products in two factory locations by assigning database keys (e.g. #PR as key for the product name) to the database tables as well as their connections. This design is then used to physically build the BI target database. This step should be executed very accurately and succinctly as "*weak points in the design phase of the data model, lead to serious consequences for the whole BI development process*" (Kemper *et al.*, 2010, p. 200).

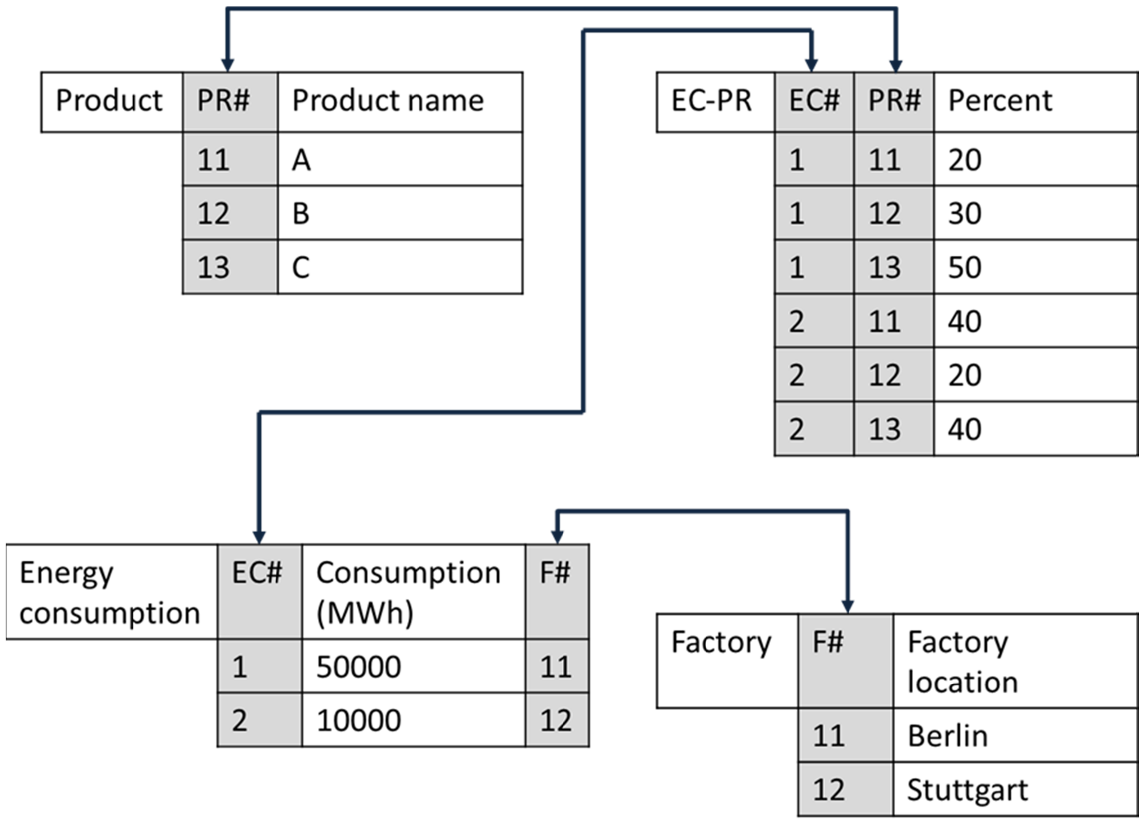


Figure 5.6: A relational model (own illustration based on Kemper *et al.*, 2010, p. 65)

The next step in designing a new report product is the development of the ETL process (see also section 3.6.7). Bustamante Martínez et al. (2012) describe three forms of modeling the ETL process: conceptual, logical and physical. The conceptual modeling includes a basic modeling with the help of an ETL process flow diagram as shown in Figure 5.7.

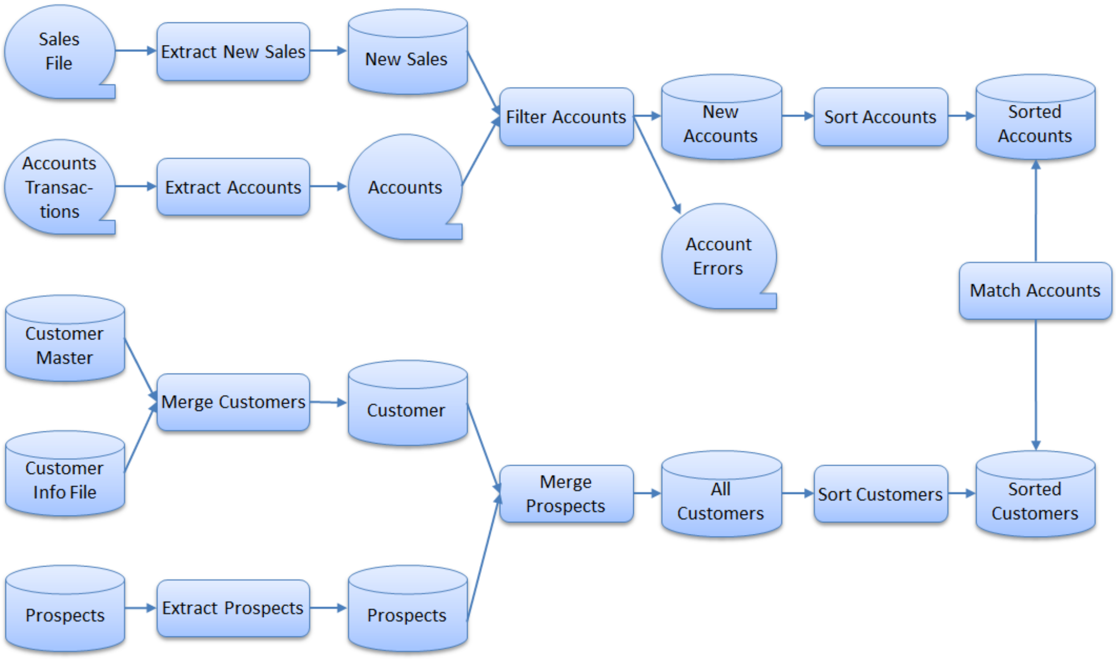


Figure 5.7: ETL Process Flow Diagram (Moss and Atre, 2006, p. 227)

Logic modeling includes original tables, dimensions (see also 3.6.10), attributes and operations whereas the physical ETL modeling additionally includes restrictions and indexes on a more precise level. The modeling of the ETL process can also be aligned to the phases outlined in Figure 4.9: Filtering, Harmonization, Aggregation and Enhancing.

In summary, the predefined reporting requirements are used for defining the data sources and the data sources are then connected to the BI system (if not already connected). When the data sources are connected and the data is extracted, they are passed on to the transformation process. This phase adjusts inconsistent data values and primary keys and combines different data formats (see also section 3.6.3). Accordingly, the load process is started where consistent data is loaded into the data warehouse.

The design of the ETL process also includes the definition of the automated loading processes, which are designed to automatically load the data into the data warehouse based on certain time specifications (e.g. every night at 2 a.m.).

Moss and Atre (2006, p. 227) concludes the design process with the meta data repository design. Regarding the proposed implementation process for a BI project in this context, the next process step covers only one part of the named meta data repository design, the clarification of the meta data repository. Here, the defined reporting requirements from the analyze and the functional design phases have to be reviewed and missing meta data has to be identified and loaded into the repository.

Finally, Kemper (2010, p. 205) and Gangadharan and Swami (2004, p. 141) conclude the described process steps with the prototypical development to test the model at this point. In the context of this thesis, as the last process-step, the prototype resulting from the analyze phase (see also 5.3.2) is extended and presented to the project team.

5.3.4 Develop

The objective of the development phase is the implementation of the reporting product planned up to this point. Based on the results from the design phase, the process steps can be subdivided into the tasks necessary to implement the front-end (presentation layer) and the tasks required to implement the needed data in the back-end. These steps can be conducted independently assuming that the design of the report was planned sufficiently during the design phase. As the first step, the target database has to be developed (IOLAP, 2014) to provide the data structure required for the ETL-process.

Therefore, the requirements resulting from the data model, developed in the design phase, are used to create new database tables or reuse existing ones. After having implemented the new data structure, the ETL process can subsequently be developed (this is also illustrated by IOLAP, 2014). The ETL flow diagram, developed in the design phase, serves as input. Based on the defined diagram, the ETL process is implemented. Regarding the source data that is connected through the ETL process, Moss and Atre (2006, p. 261) prescribe that the following conditions must be fulfilled:

- Cleansing: Clean
- Summarization: Condensed
- Derivation: New
- Aggregation: Complete
- Integration: Standardized

Moss and Atre (2006, p. 276) subdivide the load processes into the initial load, historical load and incremental load (see also 3.6.7). As described, the initial load is done once involving first loading actual data into the data warehouse. Then, already archived data is loaded in a process called the historical load which is then followed by the setup of the incremental load. This portion of the process is based on a defined sequence (e.g. monthly, weekly or daily) and involves loading only new data into the data warehouse. Typically, these data loads are transported automatically based on the named sequence. These data load procedures also have to be implemented within this process step. Moss and Atre (2006, p. 276) additionally recommends defining an ETL test plan which "*should state the purpose for each test and show a schedule for running the tests in a predefined sequence*". Regarding the system structure (described in 3.6.1), at the end of this process step is the implemented ETL process within the development stage. Anandarajan (2003, p. 192) states "*this phase typically includes user involvement and the generation and loading of test data to test the system's functionality and user interfaces*".

Simultaneously with the development of the ETL process, the authorization concept can be implemented. Therefore, the roles defined in the foregoing phases are implemented and the dedicated users are assigned.

As described in the beginning of this section, the next process step, the development of the presentation-layer (idhasoft, 2013) can be conducted parallel with the development of the target database and the ETL process. The purpose of this process step is the development of the front-end of the planned reporting product, that is, for example, a report or a dashboard. Therefore, the mockup from the design phase is used to implement the structure, arrange the KPIs and construct the analysis possibilities. Moss and Atre (2006, pp. 276:297) iterate the requirement for an application test plan, including the objective of the test, the schedule, test cases, input criteria and the expected output.

In this step, based on the reporting requirements, it has to be decided if special data mining requirements exist which have to be implemented. Kemper et al. (2010, p. 114) describe the hypothesis as first step, followed by the selection of the data basis, selection of statistical methods, analysis of the data basis and the summarizing of the results. Turban (2008, p. 156) additionally highlights the importance of the consolidation of business understanding and data understanding before the data preparation. The data mining task is included in this process development, but not described more profoundly here (a very detailed process description is also available at Mora *et al.*, 2012).

The concluding process step is the development of a quality assurance (QA) test plan. To do this, the application test plan and the ETL test plan are combined and testing personnel are identified and assigned to the schedule. On the IT side, the developed target database, the ETL process and the developed report is transported to the test stage (as described in section 3.6.1).

5.3.5 Validation

After the development of the planned BI product, an accurate validation phase has to be conducted. Anandarajan et al. (2003, p. 192) state that testing should not only be conducted regarding "*technical accuracy (e.g. calculations) but also for usability, interfaces with other systems, satisfaction of functional requirements, and performance metrics*". These test forms can be conducted through every process step described in the following paragraphs.

Start requirement for the evaluation of the BI product is the QA test document from the development phase with the defining of the objective, test cases, input criteria, the schedule and the expected output (see section 5.3.4).

The order of the sub-process steps within this process step can be adjusted to the development order of the BI product (see section 5.3.4). Therefore, the first sub-process step is the testing of the ETL process. Moss and Atre (2006, p. 279) describe the test of the ETL process as the next step as a time consuming step, but annotates that "*without a defined ETL process, no BI solution is in use*". This implicates the following tests:

- Are the data sources connected correctly?
- Is the data transformed as defined within the reporting requirements?
- Is the data loaded correctly to the target database?
- Is the ETL process running automatically?

Moss and Atre (2006, pp. 269–273) then recommend the unit test meaning the initial, historical and incremental load, the integration or regression test which tests the entire ETL process flow, the performance test including a stress test, the quality test which can be conducted with the operational staff, and the acceptance test where the business user tests the result. After the ETL process is tested and the results are documented, the Meta data repository is tested. For this, Moss and Atre (2006, p. 331) suggest a unit test. Since the data of the Meta data repository is based on and dependent upon the ETL process, this step cannot be conducted before the ETL process is tested.

Also, the front-end application (e.g. report or dashboard) cannot be tested before a consistent ETL and Meta data repository is tested, however, specific functionality (such as a drill-down in reports or selection functions in dashboards) can be tested beforehand. It is essential that the business user should be involved in the validation of the results, specifically whether or not KPIs are calculated correctly (Moss and Atre, 2006, p. 295). Idhasoft (2013) complements this sub-process with user acceptance tests which can be conducted by the future user of the reports. Here, the business users are interviewed to determine the feasibility of the implementation of the reporting (or dashboard) functionalities.

The results of each test may require revisiting certain parts of the development phase and ultimately a rerun of certain tests (Anandarajan *et al.*, 2003, p. 192). The end event of this process step is reached when the quality requirements, defined in section 5.3.3, are fulfilled.

5.3.6 Deployment

The final process step, deploy, describes the introduction of the completed reporting product and illustrates the tasks necessary to achieve this final result. The process step starts after the go-live approval at the end of the develop phase, at the point which the data quality defined in the foregoing process steps has been achieved. Kemper et al. (2010, p. 198) describe that "t*he concluding prototype is transferred as BI application system to the operational use, if it is assessed as stable and appropriate after multiple circles*".

The first sub-process step, the technical deployment describes the transportation of the tested environment to the production stage. In this stage, a schedule has to be defined which describes which part has to be transported in which order. After having defined that requirement, the ETL, the data repository, requests and the report are moved to production (idhasoft, 2013). It is recommended to test the security structure within this process step to make sure that data security isn't breached (idhasoft, 2013).

After the provision of the technical infrastructure, the next sub-process steps describe the implementation of user trainings (Moss and Atre, 2006, p. 295; idhasoft, 2013) and defines the user support by stating "*the success of BI project primarily lies on the quality of end user training and support*" (Gangadharan and Swami, 2004, p. 141).

The sub-process step conduct user trainings includes defining training content, scheduling of the trainings, and the execution of the trainings. It is further recommended to develop a quick reference guide and to provide it to the end user (idhasoft, 2013).

The next sub-process step describes the definition and implementation of user support. The user support aims to help the business user in case the program is not functioning correctly or that they don't know how to use them.

Kemper et al. (2010, p. 202) subdivide this phase into technical operation, functional operation and support. The technical operation includes the management of the technical infrastructure, network and the database. The functional operation includes the administration of the data warehouse (here also security management (Moss and Atre, 2006, p. 340), data backup and recovery (Moss and Atre, 2006, p. 345), monitoring of the utilization of resources (Moss and Atre, 2006, p. 347) and growth management (Moss and Atre, 2006, p. 349)) as well as the production of reports. The support is comprised of problem solving within the BI application as well as the handling of requests.

After the technical deployment, the user trainings and the establishment of the user support, the project is deployed and the users are informed that the reporting product can be used.

After this, the project closing phase takes place. According to Tiemeyer (2011, p. 287), the project approval and project transfer typically contain a project closing session with the project sponsor where the project leader asks for the project approval. At this point, the project can be transferred for ongoing operation by the responsible departments. Figure 5.8 outlines the typical tasks during the project closing.

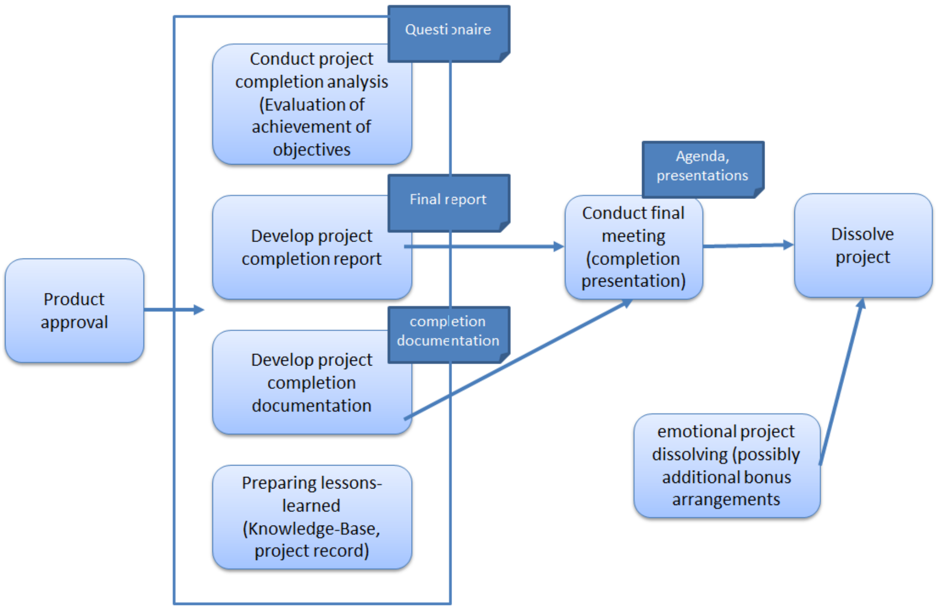


Figure 5.8: Project conclusion tasks (Tiemeyer, 2011, p. 287)

Finally, the information gathered during the project should be documented for future evolution purposes as "*measuring the success of the application, extending the application across the enterprise and increasing cross-functional information sharing are the goals of evolution*" (Gangadharan and Swami, 2004, p. 141).

5.4 Conclusion

Literature and consultants provide a great deal of information about processes for implementation of new BI systems. As described in the foregoing sections (and within the context of sustainability reporting), BI projects are rarely conducted from the ground up, but have to fit in existing BI systems.

The developed process illustrates a generic, ideal process for the implementation of a new report within existing BI landscapes. Compared to the processes from literature and consultancies, however, it represents a novelty, as these current processes either focus only on parts of the BI process (e.g. the ETL process Wang *et al.*, 2012), the complete rebuild of a BI system (see for example Moss and Atre, 2006) or only outline a superficial view on the implementation without further explications of the needed tasks (see for example idhasoft, 2013). Furthermore, the process does not only include the IT steps needed to generate the report, but also includes general project management tasks.

The novel reporting process for BI projects, furthermore, is the basis for SureBI developed in chapter 8.

6 Sustainability / Corporate Social Responsibility (CSR)

Ninety-five percent of the 250 largest companies in the world ('G250'companies) now report on their corporate responsibility (CR) activities with two-thirds of non-reporting companies being based in the US (KPMG, 2014a, p. 1). Between 2004 and 2006, more than half of Germany's 60 largest companies published their own individual sustainability reports and all German stock exchange-('DAX'-)listed corporations published relevant information on their social responsibility initiatives at least in their annual business reports (Mögele and Tropp, 2010, p. 164).

Figure 6.1 gives a brief account of some of the topics addressed by CSR reports. These topics are further described in the following sections.

Dimensions	Aspects	Explanation
External environment	Social responsibility and new opportunities	Contributing to solving or reducing social problems
	Community relations	Extent of openness and support to people around the organisation and to (local or national) government, stakeholder groups, action groups, churches, educational institutes, health care institutes, and others
	Consumer relations	Extent of openness towards consumers; recognition of rights of consumers: safety, information, free choice, and to be listened
	Supplier relations	Extent of openness towards suppliers; recognition of rights of suppliers: information, participation in design
	Natural environment (e.g. pollution and packaging) and future generations	Execution of legal requirements, research into current and future technical and environmental developments, environmental issues regarding packaging (recycling). Respect for biodiversity and needs of future generations
	Shareholders relations	Extent of openness regarding social effects of the activities of the organisation (especially with regard to investment decisions)
Internal environment	Physical environment	Safety, health, ergonomic aspects, structure and culture
	Working conditions	Demands in relation to recruitment, selection, promotion, part-time work, working on Sundays, medical aspects, retirement aspects
	Minorities/diversity	Extent to which attention is given to minorities, diversity, multiculturalism
	Organisational structure and management style	Empowerment, involvement
	Communication and transparency	Top down and bottom up communication, use of information technology, review of information flows: relevance, timeliness, detail, accuracy
	Industrial relations	Extent to which communication takes place about expectations, needs, values and norms in society
	Education and training	Needs of employees, current and future knowledge and skills, review of training budget, personal development, quality assurance of training process, evaluation of training results
Holistic	Ethics awareness	Attention within development and training and communication for ethical subjects and aspects in relation to work and the business; involvement of employees in developing codes of behaviour, values, ethical codes, and the way employees are addressed to those aspects; stimulation of broad ethical discussion with all parties

Figure 6.1: Aspects of CSR (Castka *et al.*, 2004, p. 217)

6.1 History

Sustainability is one of the major requirements big companies are responsible to address. In 2011, findings from the KPMG International Survey of Corporate Responsibility Reporting show that such reporting is now undertaken by 95 percent of Fortune Global 250 companies (KPMG, 2014a, p. 1).

Social responsibility was defined by Howard Bowen (called by Archie Carroll the 'Father of Corporate Responsibility') in 1953 when he stated, "*It refers to the obligations of businessmen to pursue those policies, to make those decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society*" (Eccles and Krzus, 2010, p. 123).

In the 1970s, attempts were made to establish a framework that would make the supply chain more transparent to stakeholders, notably local communities and policymakers (Loew *et al.*, 2004, p. 74). This establishment process began with the UN Conference on the Environment in Stockholm in 1972 and the publication of 'The Limits to Growth' by the Club of Rome project. These initiatives were conducted in response to the increased presence of multinational companies and their ability to regulate commodity prices by their globalized operations. Because of this rising dominance of multinationals, a new economic order that was more fair and uniform was demanded. This had strong implications on the reporting requirements of companies. Schneider and Schmidtpeter (2012, pp. 501–502) describe that until the end of the 20th century, protection of creditors and shareholder and monetary evolution of a company were the main focus. By identifying new stakeholder, demand for improving the social responsibility of a company (and the reporting of these actions) including acting credibly on the societal and ecological impacts of their corporate decisions was increased. This is illustrated by the statement: "*Companies are increasingly being asked to provide more and better information on how they identify and manage social, ethical and environmental risks, and to explain how these risks affect short- and long-term value*" (WBCSD, 2015, p. 11).

Figure 6.2 additionally provides an overview of the historical development of the terms CSR and sustainability as well as the development of the environmental and sustainability debates.

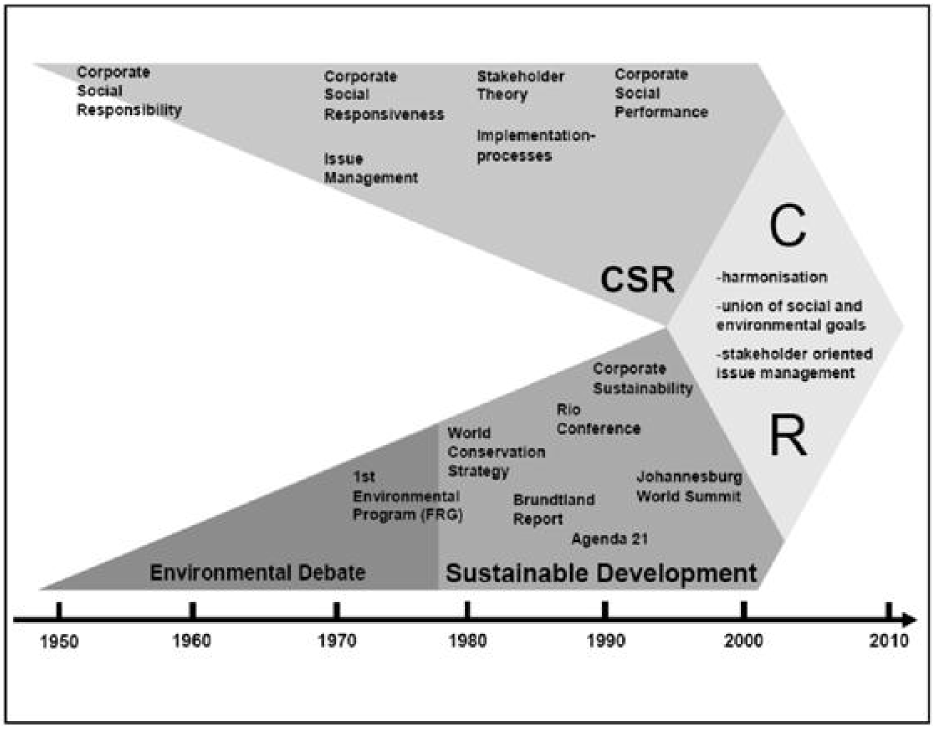


Figure 6.2: History of CSR (Loew *et al.*, 2004, p. 74)

In today's current business environment, buying, producing, and investing is being conducted globally. Although this degree of globalization provides vast benefits for multinationals, such as lower production costs in low-wage countries, many such companies are not taking the responsibility for improving employment conditions in these nations. For example, while "*Daimler-Benz cars are delivered by 1500 suppliers worldwide*" (Räbiger, 2013, p. 1), their sustainability report indicates that they did trainings for only approximately 100 of these suppliers (Daimler, 2011).

Another good example for the globalization of the production process where responsible CSR measures were not taken is that of Mattel, "*which was fined $2.3 million in 2007 by the US Consumer Product Safety Commission because of the discovery of lead in the paints used for its toys and forced to carry out widespread product recalls*" (Kavilanz, 2009, p. 1). One of Mattel's many suppliers in China was found to be operating outside existing laws regarding the amount of lead in toys, incurring financial and reputational costs on the US producer. This example is indicative that any company that uses purchased parts for its products is more susceptible to difficulties in controlling its manufacturing processes.

However, there are also positive examples. For example, Daimler Benz changed its printers worldwide in a so-called 'Green IT' initiative and announced cost savings of millions of dollars annually: "*Green IT substantially improves the environmental performance of all of our company's units. According to our calculations, it was possible to reduce electricity consumption by more than 62,000 megawatt-hours in 2011 alone, thanks to the measures initiated since the project was launched. CO2 emissions were reduced by over 37,500 tons and costs by more than €6.2 million*" (Daimler, 2011). Some companies also modify their printers to only print documents when the employee holds his or her company badge to a special terminal on the machine thereby minimizing 'accidental' prints and saving money not to mention paper, electricity, and toner.

6.2 Definition of Sustainability / CSR

"*The term CSR is a brilliant one; it means something, but not always the same thing to everybody. To some it conveys the idea of legal responsibility or liability; to others it means socially responsible behavior in an ethical sense; to still others, the meaning transmitted is that of 'responsible for,' is a casual node; many simply equate it was a charitable contribution*" (Schneider, 2012, p. 18).

CSR can also be referred to as 'corporate responsibility' or simply 'sustainability'. Whichever term is used, they all seek to describe the ethics of a company and its social responsibilities with respect to its employees, clients, shareholders, and the external environment. The European Commission defines CSR as "*the responsibility of enterprises for their impacts on society*" (European Commission, 2011). However, with this definition, there is some uncertainty whether the word 'enterprise' also covers non-governmental organizations (NGOs) and public-sector organizations. The European Commission further states the goals of collaboration between companies and their stakeholders:

- To maximize the creation of shared value for their owners/shareholders, other stakeholders, and society at large; and
- To identify, prevent, and mitigate their possible adverse impacts.

Given the diversity of CSR definitions, deriving a short definition of CSR that covers all industries and stakeholder needs is almost impossible. Consequently, the International Organization for Standardization (ISO) developed ISO 26000:2010 "*to guide what CSR means and how to use it*" (ISO, 2013b). "*Because ISO 26000:2010 provides guidance rather than mandatory requirements, it cannot be certified unlike other well-known ISO standards. Instead, it helps clarify what CSR is, allows businesses to translate their organizational principles into effective actions, and shares best practices globally. It is aimed at all types of organizations regardless of their activity, size, or location*" (ISO, 2013a, p. 1).

The definition, which is the most adequate for the context of this research is triple bottom line (3BL) reporting, developed by Elkington (1998), which is defined as "*an expanded spectrum of values and criteria for measuring organizational (and societal) success: economic, ecological, and social*" (Wikipedia, 2014b) and to emphasize on the reporting part of CSR.

Because of the missing awareness of this term and because of the notion mainly used in economy in the following the concept of "sustainability" is used.

6.3 Motivation for Reporting on Sustainability Data

Companies are often accused of reporting sustainability indicators only to improve their public reputation and therefore to "*degrade morality to a business factor*" (Schmeisser *et al.*, 2009, p. 112). Schmeisser et all. (2009, p. 112) respond by saying that morality, in the case of businesses, has another significance than in normal life. He states "*economic moral stands under the influence of efficiency need and return constraints of global markets*".

In principle, the motivation for the reporting of sustainability can be distinguished into pull- and push factors. In case of pull-factors, companies anticipate external requirements, as for example to improve their ability to compete, for internal and external controlling, or to advance innovation. In case of push-factors the company reacts to external factors, such as, for example, to re-establish their reputation (Bader, 2010, p. 39). Besides the voluntary reporting of sustainability (see also section 6.4) there is a trend in legislation whereby more and more countries are deciding to integrate obligatory sustainability information into their annual reporting[35].

6.4 Legal Requirements and Trends

The initial foundation of the sustainability discussion in the EU was laid in 2000 in Lisbon by declaring an EU strategy. There, the objective was defined to be "*the most competitive and dynamically, knowledge based economic area with more and better workplaces to achieve a better social solidarity*" (see also European Union, 2006; Bader, 2010, p. 25). This premise held steadfast until 2010 when an additional session was held by the UN Global Compact with

[35] Companies listed on the Johannesburg stock exchange have been required to produce a third-party assured integrated report since 2010 and in the same year the US SEC issued interpretive guidance on climate change risk disclosure In 2012, the Securities and Exchange Board of India mandated the top 100 listed companies to submit Business Responsibility Reports as part of their annual reports (WBCSD, 2014, p. 3).

governmental representatives from 40 countries. There it was declared that governments have to create basic conditions for sustainability and an economic reform package 'Europe 2020' was defined, including a growth strategy for intelligence and sustainable economic future (Riess, 2012, p. 779).

As in nearly every legal context, it is complex to evaluate whether corporate governance tasks such as sustainability should be enforced by government or whether companies themselves should regulate the market. Figure 6.3 outlines the range of possibilities from mandatory to voluntary regulation.

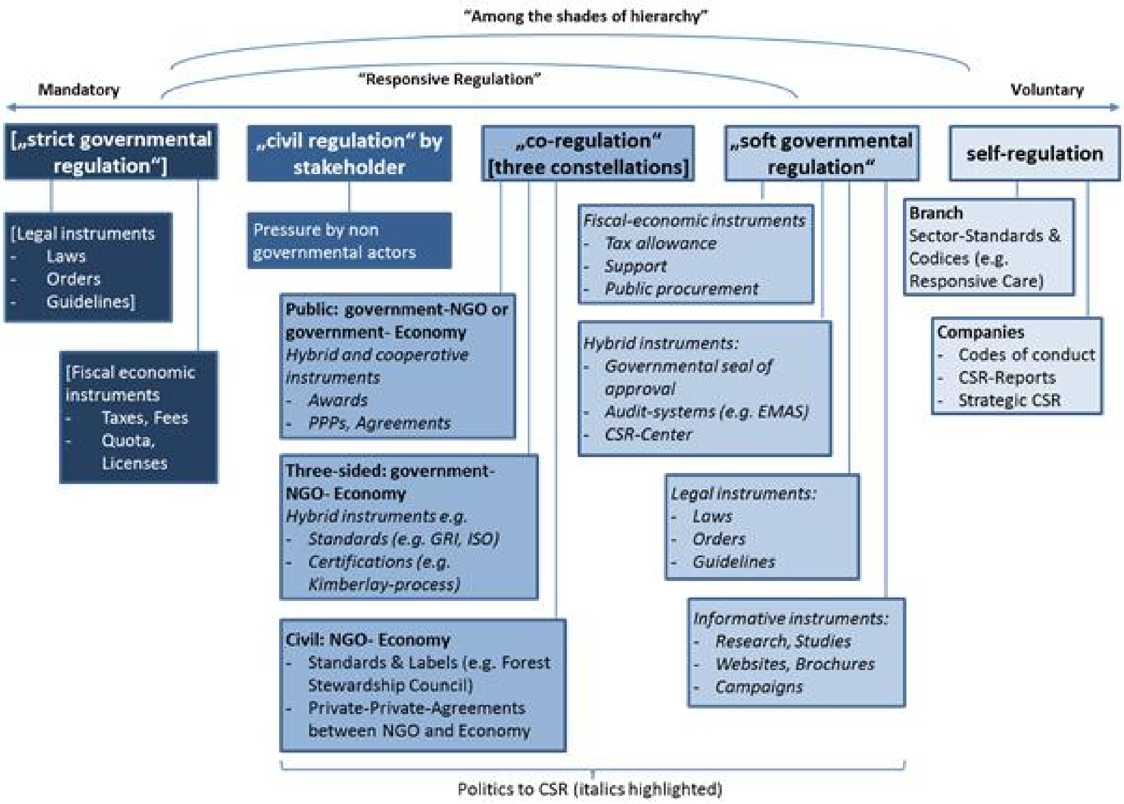


Figure 6.3: Regulation of CSR by companies and by policymakers (Steurer, 2012, p. 741)

To demonstrate where various countries worldwide fall out on their CSR initiative, KPMG provides a diagram (Figure 6.4). KPMG integrated in this figure data from 34 countries and created a proprietary model to assess a number of elements, particularly interesting in a worldwide corporate arena where little/no common legal criteria exists for CSR regulation.

Those elements, presented in a matrix with quality of communications and level of process maturity as the axes, include (KPMG, 2014a, p. 1):

- Information systems and processes
- Assurance, both level and scope
- Restatements
- Multiple channel communications
- Use of GRI standards
- Integrated reporting

Figure 6.4 aims to demonstrate, that CSR is still underdeveloped in some countries. As the PhD-thesis will focus mainly on Europe, it can be assumed that the topic of CSR is not only relevant for the developed countries, but also for the underdeveloped countries.

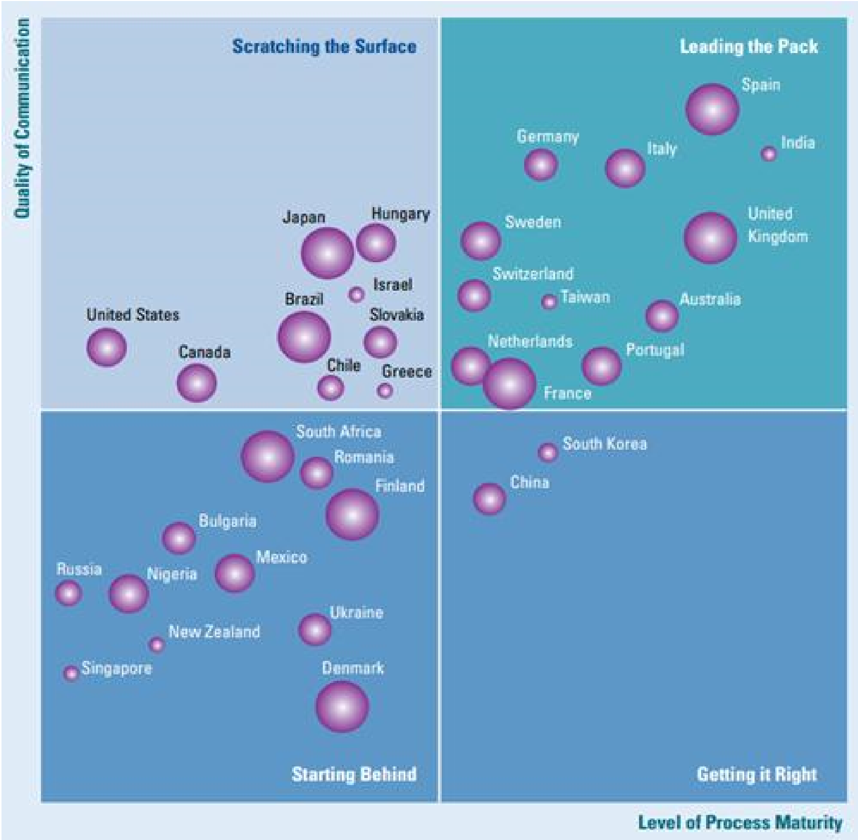


Figure 6.4: KPMG global survey of CSR trend (KPMG, 2014a, p. 1)

KPMG also illustrates, that there is not only a difference within the countries, but also in the industry sectors. It can be deduced that these differences occur due to the importance of public reputation in some key industry sectors. For example, industries like chemicals & oil and automotive are leaders in CSR in this diagram, due to the importance of their public reputation (see also Figure 6.5).

Figure 6.5: Results of the KPMG Global Survey, 2011 (KPMG, 2014a, p. 1)

An interesting comparison amongst CSR initiatives in European countries can be seen when comparing Germany, Denmark and the U.K. For example, the reporting of special CSR KPIs in annual reports is mandatory in Denmark and in the UK. In Germany, the legislature primarily focuses on the following topics (Steurer, 2012, pp. 735–736):

- Awareness raising and capacity building for CSR
- Improvements in transparency
- The promotion of socially responsible investments
- Best practices

One major initiator on CSR issues in Germany is the Federal Ministry of Labor and Social

Affairs, which held a CSR forum in 2009, with the goal of creating a common understanding of CSR as the foundation for further CSR proceedings (Nationales CSR Forum, 2013). Meanwhile, the federal cabinet in Germany has adopted a national CSR strategy in the form of a CSR action plan (Bundesministerium für Arbeit und Soziales, 2014). From a legal perspective, it appears that the federal government prefers a mentoring approach compared with demanding particular sustainability reporting formats as there is still no legal requirement to report on sustainability data in Germany.

6.5 CSR Controlling

Companies have started to integrate sustainability activities to improve their social and ecological performance. According to Gleich (2012), oftentimes these activities are imputed to have a conflict of objective with financial success. It is because of Gleich (2012, p. 47) suggests that controlling departments have to be involved in measuring which activities are actually successful. Furthermore companies are realizing, that they are externalizing social and ecological costs to the society (Gleich, 2012, p. 69)[36], and therefore integrate the topic sustainability more and more into the controlling departments. "*In many ways, environmental goals are not that different from any other corporate goals. They provide focus. They are a statement of commitment. They provide a target to manage to, a yardstick to assess performance, and serve as an indicator of whether tactics are working or need revision*"(Taticchi, 2013, p. 157).

Thematically, many programs are developed which are aimed especially at sustainability functions e.g. sustainable product controlling, carbon management or sustainable procurement (Colsman, 2013, pp. 78–88). A very significant approach is the sustainable life cycle costing, where the whole life cycle (of a product) is controlled from the development

[36] An example for this could be the treatment of employees, where the costs resulting due to bad working conditions are paid by health insurances.

phase, for example (as for example the development of prototypes) through to the lag phase (as for example service and disposal, see also Gleich, 2012, p. 115).

A further possibility is benchmarking as part of, for example energy controlling. Here, both internal and external benchmarking can be used to estimate the energy efficiency of the company but also to learn from other companies (Gleich, 2012, pp. 146–149). As the controlling of the financial departments (see also section 4.7), sustainability controlling differs according to lagging indicators (which illustrate if strategic goals are fulfilled) and leading indicators (which do not illustrate the result, but rather the development of the corporate performance) (Neßler and Fischer, 2013, p. 55). Key figures in contrast provide the opportunity the efficiency of a company (e.g. material efficiency = material input / product- or process-output, see also Gleich, 2012, pp. 80–81).

Gleich (2011, p. 148) states that the challenge in controlling will be to integrate this information into controlling initiatives and to not only report these indicators (like CO2 consumption) but to actually incorporate these indicators to improve business practices. Table 6 illustrates this in a hypothetical energy controlling scenario and uses this information to classify the status of a company regarding predefined ABC and XYZ criteria.

Criteria	A	B	C
ABC: Environmental law / political criteria: Requirements from the environmental law, thresholds, legal ordinances etc.	Legal thresholds of a material are exceeded, rules of storage are disregarded.	Increases of thresholds, appliance limitations are planned by law. Existing valid thresholds are exceeded for a short („announcement effects“)	Materials are applied according to regulations. No constraints respectively no increase of constraints is expectable.
Criteria	**X**	**Y**	**Z**
XYZ: usage relevance (volume effect of input material)	High consumption per year	Medium consumption per year	Consumption of minor importance

Table 6: ABC-XYZ-classification of environmental safety of materials (Gleich, 2012, p. 79)

6.6 Organizational Integration

Currently, many companies have started to implement a position for sustainability in the organizational diagram, to establish a CSR department, and to define roles and responsibilities for CSR oversight and implementation. Porsche (Porsche Cars Great Britain Ltd., 2014), for example, reported in 2012 that they had implemented a Corporate Social Responsibility department reporting directly to the CEO.

Not only big companies, but also small and medium companies followed the trend to define and implement their CSR position and strategy (Gelbmann and Baumgartner, 2012). In the Weleda corporation, this position falls within the corporate communications department and reports directly to the Weleda management (Weleda AG, 2014), a reporting structure which is typical of CSR positions in the corporate world[37].

[37] Corporate communication is the umbrella that summarizes a company's activities, methods and strategies to exchange information or any other immaterial resources with its stakeholders, inside and outside the company (Isenmann *et al.*, 2011, p. 2).

As described, it has become common for many companies to try and implement a CSR position within their company (Zastrau, 2012, p. 543). The described examples serve as an introduction and clarification of the topic. In SureBI (see also 8) it is assumed, that organizational conditions and responsibilities are defined.

6.7 Sustainability Balanced Scorecard

The Balanced Scorecard was proposed by Robert Kaplan and David Norton in 1996. It is a management practice that "*attempts to complement drivers of past performance (financial measures) with the drivers of future performance, such as customer satisfaction, development of human and intellectual capital, and learning*" (Business Dictionary, 2014a).

The balanced scorecard is divided into perspectives (financial, customer, internal business processes, learning & growth), which are then consolidated in the balanced scorecard thus providing an extensive view on company success and development.

"*By linking operational and non-financial corporate activities with causal chains to the firm's long-term strategy, the Balanced Scorecard supports the alignment and management of all corporate activities according to their strategic relevance*" (Figge *et al.*, 2002, p. 269).

The background for the balanced scorecard is not only to consider the financial success of a company, but also non-monetary strategic success factors[38], which influence the company's development (Figge *et al.*, 2002, p. 269). The standard balanced scorecard does not include a CSR perspective (Business Dictionary, 2014a), as shortage (ecologic and social) is still mostly discussed separately rather than in an integrative manner (Figge, 2001, p. 6). However, the concepts of BSC and CSR do have things in common. Both BSC and

[38] Like e.g. die development of the intellectual property of a company.

CSR try to integrate soft factors and financial performance by measuring the company development (Neßler and Fischer, 2013, p. 63). Per Figge (2002, pp. 273–275) there are four approaches on how to integrate both environmental and social aspects in Balanced Scorecards. The first one is to integrate the environmental and social aspects into the existing four balanced scorecard perspectives. The second one is to amplify the standard balanced scorecard with an additional non-market perspective. The third one is the deduction of a derived environmental and social scorecard. The last approach combines the three named approaches to build a sustainability balanced scorecard. Both Bieker and Figge (2002) recommend the amplification of the four perspectives with a non-market (Figge *et al.*, 2002, p. 277), societal (Bieker, 2003, p. 7) perspective. This new perspective is derived from the company strategy by defining the sustainability objectives and then generating the indicators, targets and measures for this perspective (Bieker, 2003, p. 7). Figge (2002, p. 277) additionally describes the measurement of the social and environmental exposures as a process step for the development of this new perspective. Figure 6.6 describes one possibility to identify the social exposure of a business unit.

Social exposure of a business unit							
Direct stakeholders				Indirect stakeholders			
Internal	Along the value chain	In the local community	Societal	Internal	Along the value chain	In the local community	Societal
particular stakeholder group ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...	*particular stakeholder group* ... *claim/issue* ...

Figure 6.6: Framework for the identification of the social exposure of a business unit (Figge *et al.*, 2002, p. 278)

The findings from the foregoing framework can then be evaluated by using the matrix in Figure 6.7 to derive the strategic relevance of the environmental and social aspects.

		Environmental exposure								Social exposure							
										Direct Stakeholders				Indirect Stakeholders			
		Emissions	Waste	Material input/intensity	Energy intensity	Noise and vibrations	Waste heat	Radiation	Land use	Internal	Along the value chain	In the local community	Societal	Internal	Along the value chain	In the local community	Societal
Strategic core issues	#1																
	#2																
	…																
Perfor-mance drivers	#1																
	#2																
	…																

Figure 6.7: Matrix to determine the strategic relevance of environmental and social aspects (Figge *et al.*, 2002, p. 280)

Table 7 gives an exemplary illustration of the environmental perspective of a sustainability balanced scorecard in extracts with its strategic objectives, the indicators, operational objectives and planned actions.

Strategic objective	Indicator	Operational objective	Actions
Double the percentage of sales with biological products till 2015 Improve ecological reputation	Percentage of sales Customer survey	Raise by 17% in 2012 Raise index by 5%	Raise R&D budget Expand cooperation with supplier Conduct surveys twice a year

Table 7: Environmental perspective of a SBSC (in extracts) (Gleich, 2012, p. 87)

6.8 Sustainability Maturity Models

To make sustainability implementations comparable, the sustainability activities of companies and NGOs have to be comparable in terms of "*ethical ideals, ethical principles, moral standards, lived morals, common sense about 'good' and 'bad', and the rules and standards of social interactions*" (Karmasin and Weder, 2011, p. 468). In this context, the difference between sustainability reporting and financial reporting can be seen. For example, ethical behavior (e.g. employee satisfaction) cannot be measured as easily as sales growth. Figure 6.8: shows the procedure that Accenture uses to classify the sustainability maturity of firms starting with companies where sustainability is mainly compliance driven (that means, sustainability actions are only driven by compliance deficiencies) to the overall reporting of sustainability as a value driver to all of the stakeholders of a company.

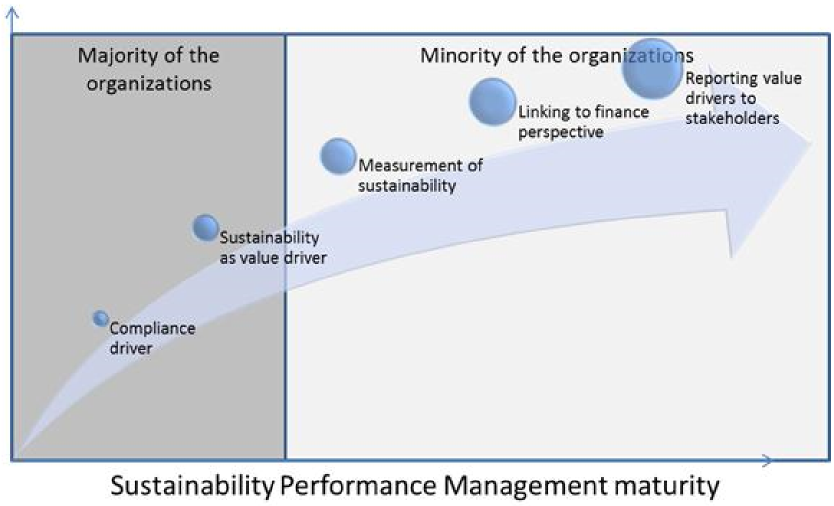


Figure 6.8: A classic maturity model (Accenture, 31.11.2011, p. 7)

An alternative CSR maturity model is presented in Figure 6.9. This model classifies a company's CSR activities according to four scales and has an open top for further improvements:

CSR 0.0: CSR is mostly carried out because of legal requirements or because of the existence of benefits from a purely economic perception.

CSR 1.0: In this step, the company encourages activities such as donations and sponsoring. These activities, however, have little influence on the company's strategy.

CSR 2.0: Here, CSR is a strategic (conceptual) management concept assigned by the top-level departments. Examples are product and process innovations, resource efficiency, and eco-friendly products. This stage even implies that the realization of profits is long-term and sustainable and that investments (e.g. from the realization of profits) are made in the CSR strategy.

CSR 3.0: In this step, the company consciously influences economic, social, and eco-political decisions.

Figure 6.9: CSR maturity model (Schneider, 2012, p. 29)

In summary, there are very well-engineered possibilities to describe the level of development of CSR or sustainability within companies. These maturity models concentrate mainly on the conceptual formulation and the target achievements (i.e. achievement of higher employee satisfaction or compliance to carbon emission targets). Technical aspects, such as the implementation of reliable reporting-tools, are still not represented by maturity models.

6.9 Sustainability Reporting

Sustainability reporting can be described as the reporting of the non-financial activities of a company. Traditionally, non-financials are, for example market share or customer satisfaction (DVFA, 2007, p. 3) . For the past couple of years, non-financials have also included information about the environment, employees, or the reputation of a company (Schmidt, 2012, p. 52). There are plenty of terms for sustainability reports[39], which normally concentrate on key-aspects but sometimes differ only in the wording (Visser *et al.*, 2009, p. 337). Regarding a study of WBCSD (2014, p. 12), 100 of 175 interviewed companies named their sustainability reporting 'Sustainability Report', 18 of 175 named it 'CSR Report' and 33 of the responding companies had already integrated their sustainability report into the annual reporting. In comparison to other communication instruments, the sustainability report includes a great deal of information (compared to a newsletter, for example) and aims its readership to the general public as compared to, for example, an email containing sustainability topics (Münstermann, 2007, p. 178).

Looking at the triggers of sustainability reporting, a distinction between involuntary, mandatory and voluntary can be made (Münstermann, 2007, p. 177). Involuntary reporting can be triggered by environmental campaigns or ecological tests of products. Mandatory reporting is often initiated through legal requirements. Voluntary reporting can be further classified into confidential (e.g. regarding credit approval process) and non-confidential (like e.g. the sustainability report).

Regarding the content of sustainability reports, Loew et al. (2004, pp. 77–79) state that the first classic environmental reports developed have now been enhanced with sustainability topics as well as sustainability reports containing the three sustainability dimensions (Loew *et al.*, 2004, pp. 77–79 refer to Triple bottom line, that contains economic, social and environmental figures). Sustainability reports aim to reach a wide variety of stakeholders

[39] For example Sustainability report, Corporate (social) responsibility report, Environmental report, Social report, Triple bottom line report, Corporate citizenship report, Health, safety and environment report, Community report.

(which are further described in section 6.10) including customers, suppliers, shareholders and NGOs (Bader, 2010, p. 23). Furthermore, company employees want to be informed about job security, pension payments and professional training programs (Bader, 2010, p. 24). Compared to financial reporting (see section 3.3), sustainability reporting aims not only to report on past data, but also about the future plans of the company since "*a company's value on the stock markets is not only determined by its current profits but by expectations about its future earning ability*" (WBCSD, 2015, p. 25).

As sustainability reporting is voluntary in most countries (see section 6.4), most of the companies publish a separate sustainability report in addition to their financial reporting but there is a tendency to integrate the sustainability reporting into the annual reporting[40].

6.10 The Business Case for Sustainability Reporting Projects

The quote "*arguing that CSR can come along with certain benefits that might outweigh its costs, they see CSR engagement as a necessity for business, not least for the sake of its own economic interest*" (Schreck, 2009, p. 1) supports the justification for sustainability reporting projects, often without regard to the cost. The WBCSD (2015, p. 11) also states that a company must be able to affirm that their "*commitment and contribution to sustainable development, including reporting, makes good business sense*".

In the case of CSR, it can be said that the business justification for CSR not only includes the earnings a company may achieve if they report on sustainability indicators, but also the

[40] See e.g. Eccles and Krzus (2010) or Eccles and Saltzman (2011)

damage they may experience if they fail to implement sustainability reporting[41]. The benefits of CSR can be difficult to measure on a monetary level since, for example the improvement of a company's public reputation cannot be quantified[42]. Increased sales, for example, could be a direct or indirect result of measuring and publishing CSR but it is difficult to measure this correlation, like e.g. (Corporate Knights, 2014).

However, it may be beneficial to write a business case for the project if there is no preliminarily defined project budget in the event that the project costs exceed the predefined budget, more resources can be effectively solicited through the showing of the revenue possibilities. When a CSR reporting justification of the project is demanded, it can be realized by using the process steps defined in section 5.3.1. "*It should be added that the act of producing a report can be a benefit in itself. A report requires a company to have a more systematic approach to sustainable development and it becomes a part of the learning process within the organization*" (WBCSD, 2015, p. 15).

6.11 Sustainability Data

Compared with financial KPIs (see also 3.2.3) which have been reported for decades, the reporting of sustainability KPIs is relatively new (see also 6.1). Companies face the challenge that not only hard, monetary factors have to be reported, but also soft factors such as employee satisfaction. CSR includes many important topics as shown in Figure 6.10.

[41] See also Hohnen and Potts (2007, p. 9). Possible benefits may include an improved reputation management, an enhanced ability to recruit, develop and retain staff and even access to capital as more and more financial institutions incorporating environmental criteria when deciding to give credit (Hohnen and Potts, 2007, pp. 11–12).

[42] Because of that WBCSD claims that "weighing cost versus benefits is substantially a judgmental process, and a company should develop its own approach, which often would include a gradual implementation over a number of years (WBCSD, 2015, p. 29).

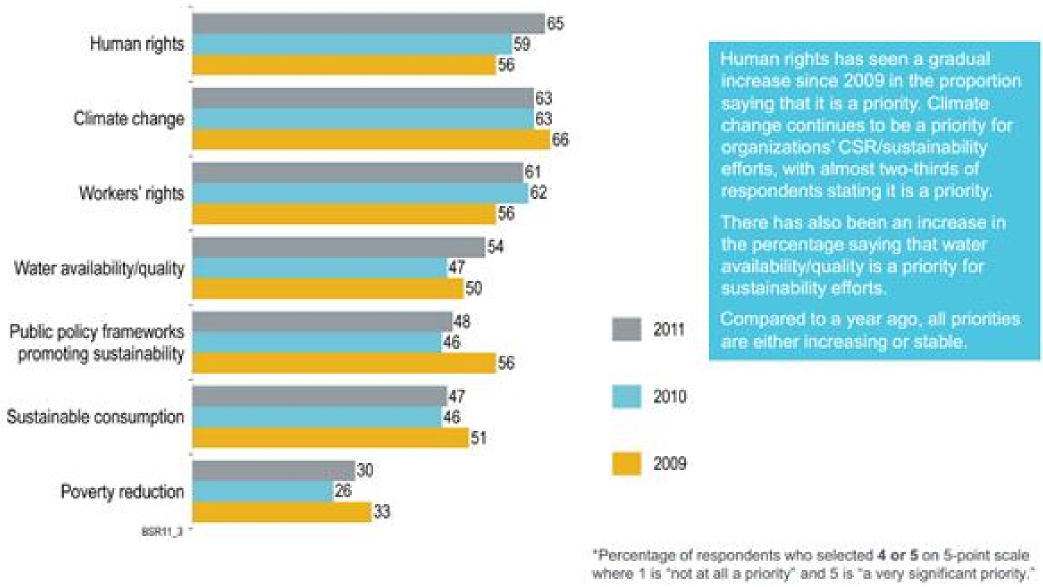


Figure 6.10: CSR A priority topics in the next 12 months (BSR, 2011, p. 15)

The following sub-chapters describe the various CSR KPIs, their source of data, as well as basic principles recommended for the report production.

6.11.1 CSR KPIs

There are many frameworks describing CSR-KPIs that can be used by companies reporting their sustainable development. In addition to the frameworks described in section 6.13, there are country specific approaches, for example the SD-M GmbH (2014) which is developing own sustainable development KPIs for companies. Additionally companies can get a general idea of possible CSR KPIs by comparing other sustainability reports.

The following section describes various perspectives on CSR KPIs.

First, Neßler and Fischer (2013, p. 34) describe a classification by resources within a company. They differentiate between capital resources (e.g. financial resources, human resources or social capital), trust resources like societal acceptance or good working atmosphere, and knowledge resources such as information, know-how and skills. In theory, CSR KPIs can be derived from each of the blocks, but especially regarding the trust and knowledge resources, the process can be quite complex. Specially, in regards to IT implementation, a complicating factor often includes the availability of data. Not only concerning if data is available within the company's existing data pool, but also if data can be stored within the company or if external provider databases have to be connected (i.e. external companies providing benchmarking data). Furthermore, differentiation into unstructured, semi-structured and structured data must be made which is already described in section 3.6.3.

A last but important classification can be made regarding the collection of CSR data. First of all, the automatic data collection describes the automatic loading of CSR data into the company's data pool. Contrary to that, the manual data collection takes place if data cannot be gathered from other databases. Similar to the manual data collection, the differentiation into quantitative and qualitative data describes whether data can be collected easily (quantitative data) or if the process will be more difficult (qualitative data). Qualitative data, in the case of CSR KPIs, can include, among others, employee satisfaction or work-conditions. To achieve these qualitative segments of KPIs, for example in the case of employee satisfaction measurement, workarounds have to be invoked, such as using employee interviews (Cahyandito, 2005).

6.11.2 CSR Data Sources

The CSR data sources are closely related to the CSR KPIs, described in the foregoing section. As a result, the differentiation between internal and external data sources can be made, as well as between automatic and manual data collection. As example, the fuel consumption figures are only collected automatically regarding the monetary figures. The actual consumption of energy, fuel or electricity is not loaded automatically and therefore has to be entered manually.

Regarding the data sources a further differentiation regarding the data format can be made, which is also described in section 3.6.6.

6.12 Stakeholder in the Context of Sustainability

As described in section 4.4, the stakeholder-theory "*asserts that business can be understood as a set of relationships among groups which have a stake in the activities of that business*" (Visser *et al.*, 2009, p. 434). Characteristics of stakeholders in the context of sustainability are, among others, the "*emerging power of non-state actors*" (Rieth, 2009, pp. 48–50). These characteristics are further investigated in the following sub-sections.

6.12.1 Stakeholder Classification

In principle, stakeholder classification can be made based on the question "*with which objective and in which intensity a company assumes societal responsibility in which area against which stakeholder groups*" (Münstermann, 2007, p. 46).

First of all (as in the case of the Business Intelligence stakeholder), possible stakeholder classification can include categorizing the stakeholder(s) into primary and secondary social stakeholders (Breuer, 2011, p. 11; Wheeler and Sillanpää, 1997, p. 167; Neßler and Fischer, 2013, p. 35; Maon *et al.*, 2009, p. 85; Hutter, 2012, p. 96). This list can be further expanded into primary and secondary non-social stakeholders (Wheeler and Sillanpää, 1997, p. 167).

Primary stakeholders in this context add value directly to the company whereas secondary stakeholders, while not having a direct influence on the company or project, can still affect the company and its objective in some way, positively or negatively, or are affected themselves by company activities (Schmiedeknecht, 2011, p. 73).

Another possibility to cluster stakeholder is to evaluate them from a company perspective or from a stakeholder perspective. From the company perspective, the first possibility is to evaluate whether they are critical or non-critical to company objectives (Hutter, 2012, p. 96).

Neßler and Fischer (Neßler and Fischer, 2013, p. 35) extend this approach by adding criteria regarding the stakeholder demand. He describes substitutability which defines to what extent a stakeholder can be replaced by another. He also discusses power whereby there is a contractual warranted law or potential sanctions which can be levied against the stakeholder. He also categorizes stakeholders by legitimacy – the extent of common interests as well as priority which indicates if the stakeholder requires immediate attention or not. Stakeholders can be further classified into transactional and organizational resources. Transactional resources include the technical or conceptual competencies of a team member, whereas organizational resources quantifies their willingness and ability to get involved with a team (Schmiedeknecht, 2011, p. 107).

Schmiedknecht (2011) expands this approach by clustering stakeholders by their willingness to invest in resources, their commitment to the contract (Schmiedeknecht, 2011, p. 112), and by their cooperative quality (their creditableness or accuracy) (Schmiedeknecht, 2011, p. 115). As a matter of principle, stakeholders can also be clustered by their degree of stakeholder involvement and information exchange as shown in Figure 6.11.

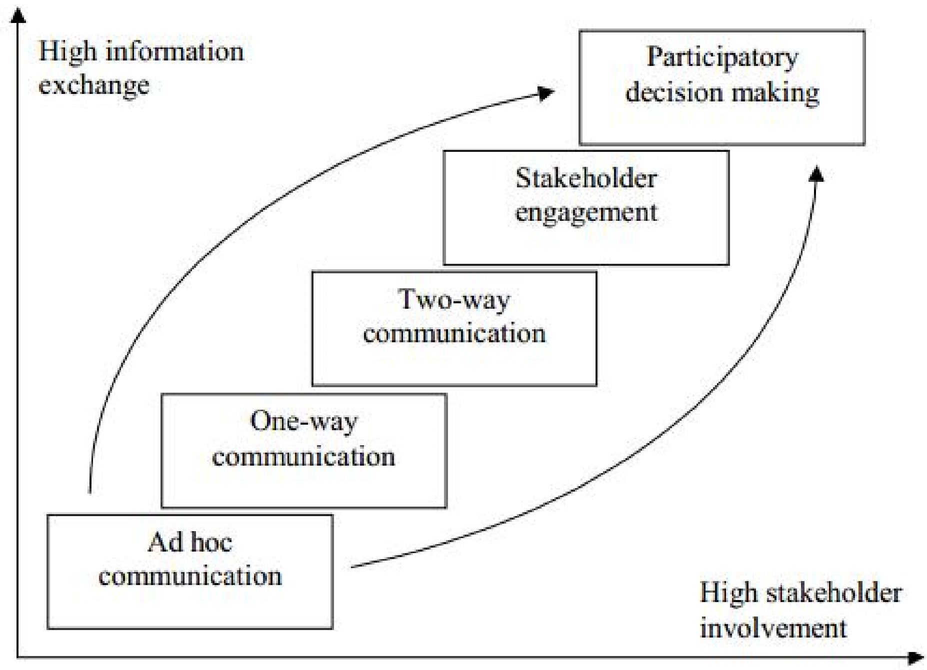


Figure 6.11: Types of communication that can be adopted for stakeholder dialogue (Isenmann *et al.*, 2011, p. 5)

According to Eppstein (2008, p. 42), DELL clusters stakeholders into authorizers (e.g. government, regulatory agencies, and shareholders), business partners (e.g. employees, suppliers, and trade organizations), customer groups (such as educational institutions) and external influences (for example, community members or media). To classify stakeholders, there are also some accepted models including the heuristic for stakeholder selection as shown in Figure 6.12.

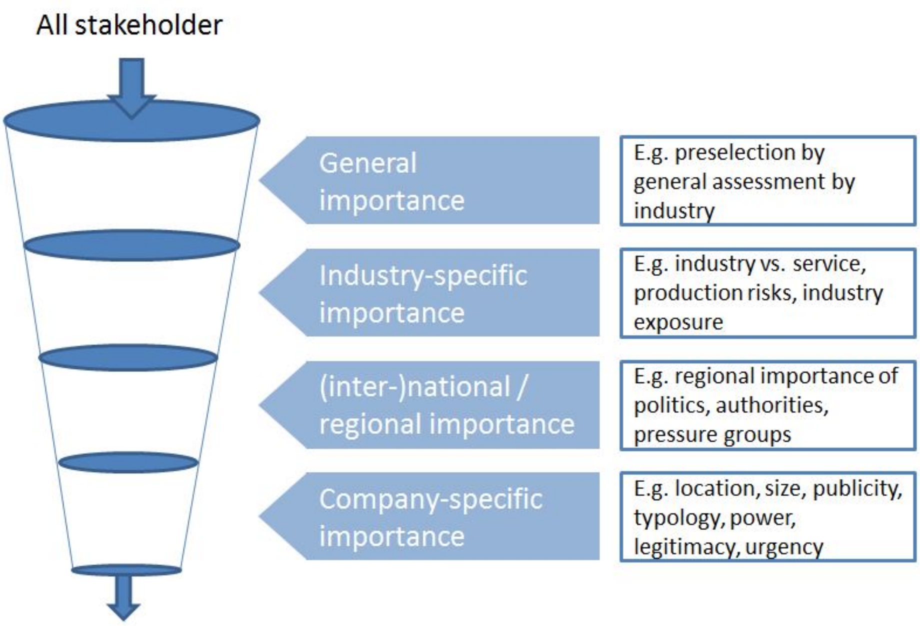


Figure 6.12: Heuristic for stakeholder selection (Münstermann, 2007, p. 86)

Here, stakeholders are primarily clustered first by their general importance, then by their industry specific importance, then by their international or regional importance and finally they are classified by their importance to the company. A further approach is the model of stakeholder structure based on the Zürcher Approach illustrated in Figure 6.13.

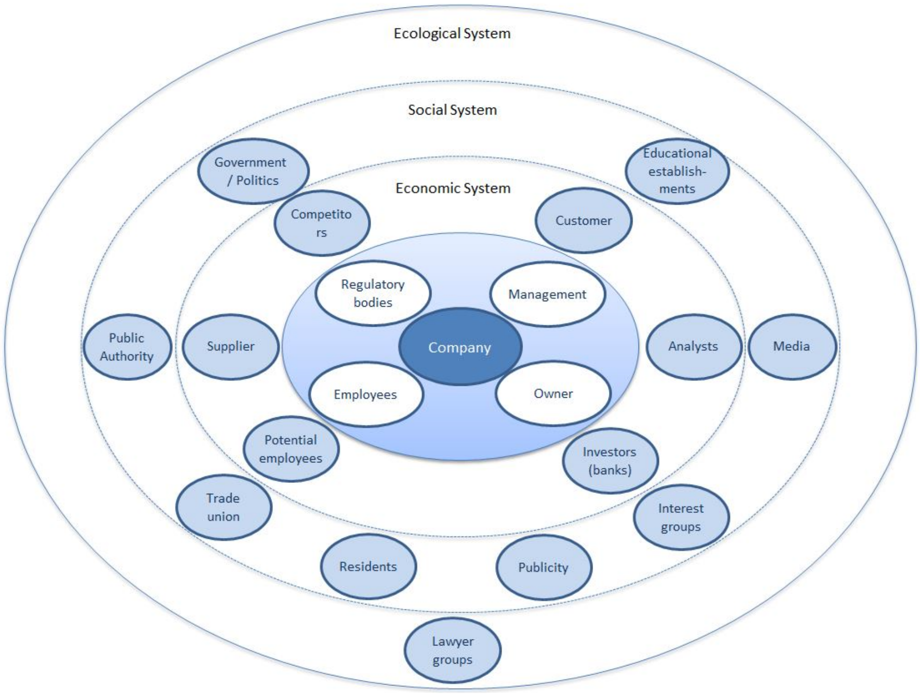


Figure 6.13: Stakeholder structure based on the Zürcher Approach (Münstermann, 2007, p. 89)

Here, the company is positioned in the center and the stakeholders are assigned to the company, the economic system, the societal system and finally to the ecological system.

6.12.2 Possible Stakeholder

As described in section 6.10, in comparison to the BI stakeholder in the case of sustainability, companies have to cooperate with new stakeholders like e.g. NGOs. NGO is the abbreviation for "*non-governmental organization: an organization with social or political aims that is not controlled by a government*" (Cambridge Dictionaries Online, 2014) and include organizations such as Greenpeace or Humans Right Watch. These institutions give guidelines and denunciate bad behavior and therefore can be classified as stakeholders, in this case with the role of improving the public's perception (possible sustainability stakeholders are listed in O'Connor and Spangenberg, 2008, p. 1405; Schaltegger *et al.*, 2011, p. 29; Rieth, 2009, pp. 105–107; Maon *et al.*, 2009, p. 85; WBCSD, 2015, p. 20).

Demands of stakeholders upon a company can also differ greatly in the case of sustainability. Figure 6.14 gives an overview about possible stakeholders and their demands.

Figure 6.14: Possible stakeholders for companies and their issues (Hutter, 2012, p. 96)

In the case of employees for example, the demand for a sustainable employer can be job security, salary or working conditions. In this case also the publicity has to be considered in case of high emissions or if NGOs publish about e.g. reduction of workplaces.

6.12.3 Prioritization

According to Schmiedknecht (2011, p. 114), the process of prioritization should not be primarily focused on acceptability or denial, but on the criteria of duration of team membership. Furthermore, Schmiedknecht (2011, p. 115) states that stakeholders should be prioritized by whether or not they are willing to invest in projects with a long-time horizon.

A general possibility to prioritize stakeholders according to Wieland and Schmiedknecht (2014, p. 21) is to prioritize primarily by contract relevance meaning by choosing long-term investors and employees before short-term investors. He goes on to say that the next step is prioritizing based on the relevance of resources (how important a stakeholder is for the realization of a project that could be based on the technical know-how of an employee or the societal know-how of a NGO). The third step Wieland and Schmiedknecht (2014) describes is the relevance of cooperation. This includes not only the willingness of a stakeholder to cooperate, but also their capability to deal with conflict management. In the last step, he describes the relevance of investments which means one's propensity to invest in a team can be viewed as an indicator for the quality and durability of stakeholder relations.

This prioritization can then be entered into the stakeholder prioritization matrix illustrated in Table 8:

Relevance	High	Medium	Low
Contract	**Employees**		**NGO**
Resources	**NGO**	**Employees**	
Cooperation		**Employees** **NGO**	
Investment			**Employees** **NGO**

Table 8: Stakeholder Prioritization Matrix (Wieland and Schmiedknecht, 2014, p. 22)

Stakeholders who are classified as 'high' in all fields should then be prioritized higher than stakeholders who are classified as 'low' in some fields (Wieland and Schmiedknecht, 2014, p. 22).

A further approach is illustrated in Figure 6.15. Here, stakeholders are entered into a matrix based on their level of influence and their level of interest.

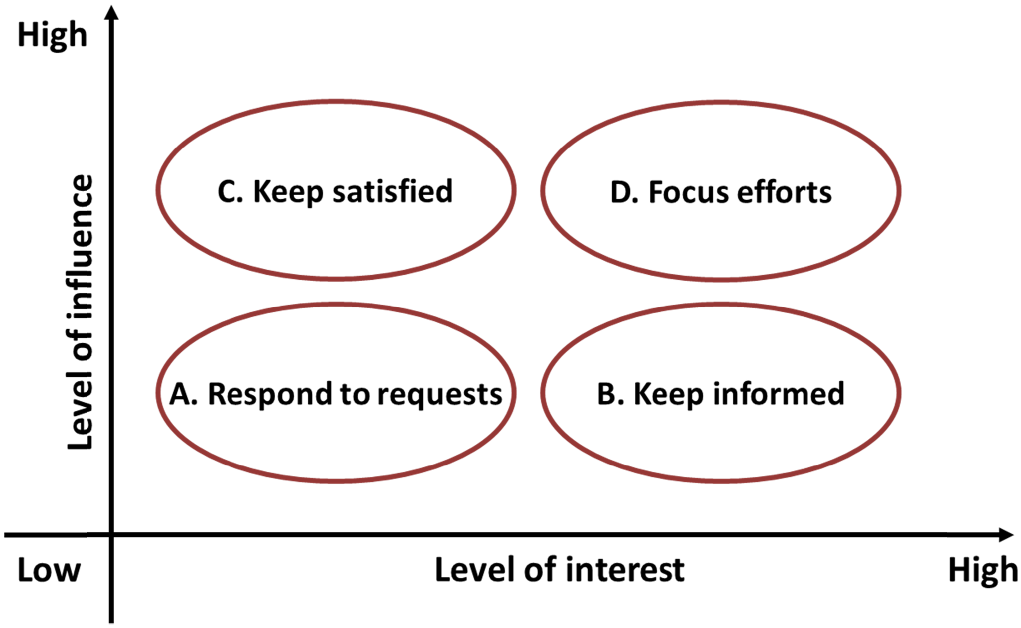


Figure 6.15: Stakeholder Matrix (WBCSD, 2015, p. 19)

By using this graphic representation, it can be determined which stakeholders only respond to requests, which stakeholders must be kept informed, which ones must be kept satisfied and on which stakeholders a company must focus its efforts and attention.

6.13 Standards for Sustainability Reporting

There are already a great deal of methods and guidelines which give a legal and/or conceptual framework for a CSR implementation, but also (as described in section 6.8) aim to help measure the output of CSR efforts (Schneider and Schmidtpeter, 2012, p. 341). CSR, at least in the EU, is voluntary based - not only the decision for or against sustainability reporting, but also the selection of instruments for implementation is under the sole direction of the company itself (Bader, 2010, p. 45). All of these social accountability standards have in common the premise that they represent formal ethics initiatives that aim at fostering ethical behavior by multinational corporations (MNCs) (Gilbert and Rasche, 2007, p. 188). The following sub-chapters aim to give an overview of these guidelines.

6.13.1 OECD Guidelines

The OECD Guidelines are intended for use by multinational companies. The participating governments of the 30 OECD member states have committed themselves to this broad code of conduct (Bader, 2010, p. 46). The objective of these guidelines is the compatibility between company activities and laws, the encouragement of trust between stakeholders and companies as well as to improve corporate image in the case of foreign investments (Bader, 2010, p. 46). Summing up, the OECD Guidelines aim to improve sustainability across borders.

6.13.2 UN Global Compact

On January 31, 1999, UN Secretary General, Kofi Annan, called to the economic leaders worldwide at the World Economic Forum (WEF) for more commitment regarding the social and ecological creation of the global economy (Bussler and Fonari, 2006, p. 31). The primary ten principles, which cover topics like human rights, ecologic and work conditions, have been supplemented since 2004 with a tenth principle containing the fight of corruption and bribery being added (Bader, 2010, p. 47). It can be described as a worldwide pact rather than a set of guidelines where companies can commit themselves to the ten principles by signing a defined letter to the UN Secretary General.

6.13.3 Global Reporting Initiative (GRI)

"*GRI was founded in Boston in 1997. GRI developed a comprehensive Sustainability Reporting Framework that is widely used around the world* (see also Figure 6.16). *The framework enables all organizations to measure and report their economic, environmental, social and governance performance – the four key areas of sustainability*" (GRI, 2013).

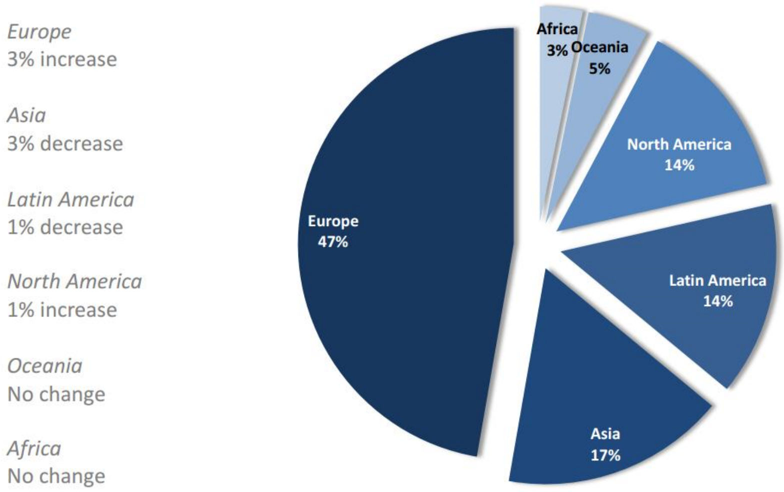


Figure 6.16: Regional distribution of 2011 GRI Reports (Global Reporting Initiative, 2012, p. 6)

The GRI guidelines aim to supplement the financial information portion of a financial report with non-financial information. The degree of sustainability which can be claimed, is based on the lessening of resources that means the usage and utilization of resources (Beiersdorf, 2012, p. 142). The effort to further develop the GRI guidelines has been contributed to by members of the investment industry, environmental and human-rights organizations, as well as science and employee representatives worldwide (Bussler and Fonari, 2006, p. 72). Gleich (2012, p. 84) maintains that the GRI guidelines lead the world regarding global distribution and standardization of sustainability reporting. The GRI norm not only gives guidelines for the content of a report, but also advises regarding report quality as well as reporting limitations (Bader, 2010, p. 51).

The GRI framework is well established in Germany, as the annual CSR-reports of many companies are already certified by the GRI-Index (Global Reporting Initiative, 2014a). Daimler, for example, states in their sustainability report that their CSR-report follows the guidelines of a specific version (G3.1) of the GRI-Initiative and that GRI checked their report and have given it an A+ rating. This means that they exceeded expectations concerning the content and the auditing acceptability:

"*GRI Level A+. The Daimler Sustainability Report for 2011 has been drawn up in line with the internationally recognized guidelines on sustainability reporting (G3.1) of the Global Reporting Initiative (GRI). In 2006 we joined the GRI multi-stakeholder network as an organizational stakeholder. The GRI has checked our report and given it a Level A+ rating, the best possible classification. It certifies that the content meets important reporting criteria and has been examined by a third party*" (Daimler, 2011, p. 2).

The preceding quote gives an example of the GRI certification regarding its classification levels and gives reference of its acceptance within respective industries since multinational companies (in this case Daimler Benz) highlight their GRI certification within their sustainability reports.

6.13.4 International Organization for Standardization (ISO)

There are several ISO standards which aim to help companies to improve their sustainability efforts and/or their reporting methods. The ISO 14000 family addresses various aspects of environmental management (ISO, 2013c).

The ISO 14063 standard suggests five quality criteria for environmental management and environmental communication suggesting a greater focus on the environmental aspects while providing guidance for the reporting of environmental issues (ISO/TC 207/WG 4

Environmental Communication, 2007; Freundlieb and Teuteberg, p. 1178). A relatively new comprehensive[43] approach is the ISO 26000 standard (Schneider and Schmidtpeter, 2012, pp. 259–270). This standard goes back to 2001 where the ISO recognized that they have to develop an all-embracing sustainability standard. In 2004 the decision was made to develop the standard 26000:2010 which has been available for a couple of years now (Puneet and Ashish, 2012, p. 7). The ISO 26000:2010 aims to help companies to clarify what social responsibility is and to help them to put it into practice. In comparison to other ISO standards, this standard provides guidance but a company cannot be certified based on it. In the last ten years, the ISO 26000 standard was furthered developed and gives guidance to companies integrating Corporate Responsibility regardless of their industry sector, size or location (ISO, 2013b).

6.13.5 AA1000

"*AccountAbility's AA1000 series are principles-based standards to help organizations become more accountable, responsible and sustainable. They address issues affecting governance, business models and organizational strategy, as well as providing operational guidance on sustainability assurance and stakeholder engagement. The AA1000 standards are designed for the integrated thinking required by the low carbon and green economy, and support integrated reporting and assurance*" (AccountAbility, 2012).

The AA standard merely concentrates on the ecological effects of the behavior of companies and provides guidance on how to report on these facts. Like the GRI framework, CSR reports can also be certified with the AA 1000. For purposes of the PhD thesis, the GRI index is suitable, as it not only focuses on ecologic KPIs but also on a comprehensive set of CSR topics.

[43] That means that it covers sustainability factors like social, economic and environmental issues.

6.13.6 SA8000

Unlike the other frameworks mentioned before, the SA 8000 concentrates more on the ethical treatment of employees including "*Child labor, forced and compulsory labor, health and safety, freedom of association and right to collective bargaining, discrimination, disciplinary practices, working hours, remuneration*" (SA8000® Standard, 2012). As in case of the AA standard, for building a sustainability reporting process (see chapter 6), an overall standard such as the GRI will be used as a guideline and to represent all CSR topics.

6.13.7 Others

- Carbon Disclosure Project (2014)

  An NGO founded in 2000 in London which collects annual environmental data such as greenhouse gas emissions and water consumption figures by interviewing major companies.

- Eco-Management and Audit Scheme (EMAS, 2014)

  The EMAS is a voluntary instrument of the European Union aiming to help companies to improve their environmental performance.

- United Nations Environment Programme (UNEP, Gregory Mwaura, 2014)

  The UNEP was founded in 1972 within the United Nations system and aims to assess global, regional and national environmental conditions and trends and help companies to develop environmental instruments.

- World Business Council for Sustainable Development (WBCSD, 2008)

  The WBCSD is a CEO-led organization providing a forum for its 200 member companies to share best practices on sustainable development issues.

6.13.8 Conclusion

Companies can be directed to a multitude of guidelines to develop their sustainability reporting, as described in the foregoing sections and as illustrated in Figure 6.17.

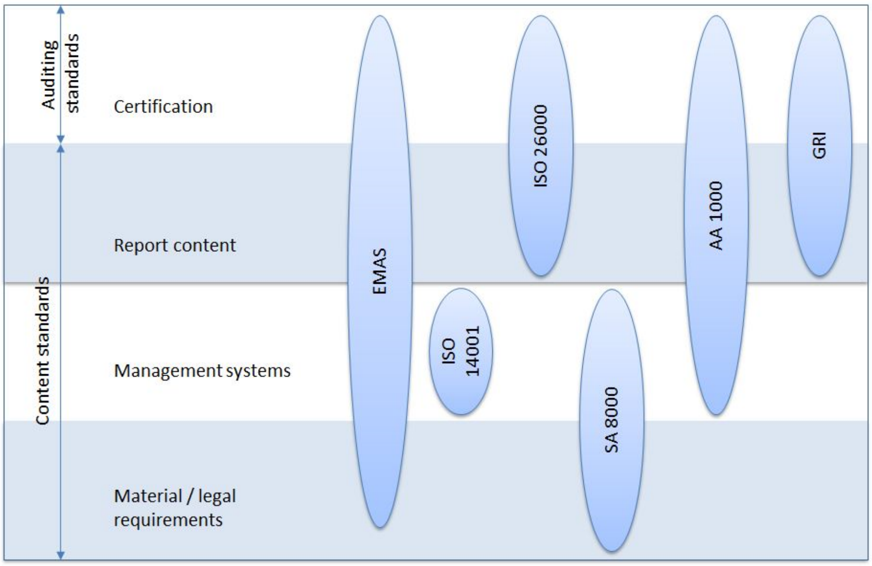


Figure 6.17: Standardization level for non-financial reports (based on Clausen and Loew, 2005, p. 26 and expanded with ISO 26000 standard)

Figure 6.17 also illustrates that these guidelines cover different (sometimes multiple) phases and ranges to achieve certification of the sustainability reports. As described in the foregoing sections, the GRI standard has emerged as the de facto standard within the range of reporting content and certification. Furthermore, since it is not aimed at a specific industry sector, it will be used in section 6.10 for the classification of the CSR KPIs and the derivation of the CSR Data-Sources.

Furthermore, the ISO 26000 standard is being used by more and more companies to plan their sustainability reporting (as described in section 6.13.4). Because of this, the ISO 26000 standard will be used both to develop SureBI in chapter 8 and for the evaluation of SureBI in chapter 8.

6.14 Distribution of Implementation Approaches

Many companies still report on CSR data using Microsoft Excel or similar programs. In 2011, 66% of the polled companies still used Microsoft Excel for the data collection of their sustainability data (see also Figure 6.18). That limitation occurs because data is derived from various sources that are rarely accessible via the company's BI solution and so it is often manually calculated. Nowadays, there is a large market for stand-alone CSR software, often referred to as *Enterprise Sustainability Management*.

The complexity regarding the software selection process is increasing due to Environmental Management Systems (EMS) which refer to the subarea of environmental management issues (see for example Crespo Cuaresma, 2013; Hauser *et al.*, 2013; Hřebíček *et al.*, 2011). The operation of an adequate software solution is necessary for companies, not only for their own employees and production procedures, but also for the entire supply chain (see also section 6.1).

Today, there are several software solutions covering the topic of CSR, which aim to facilitate the implementation of sustainability reporting. Most of them are from software providers who also offer BI solutions (e.g. SAP).

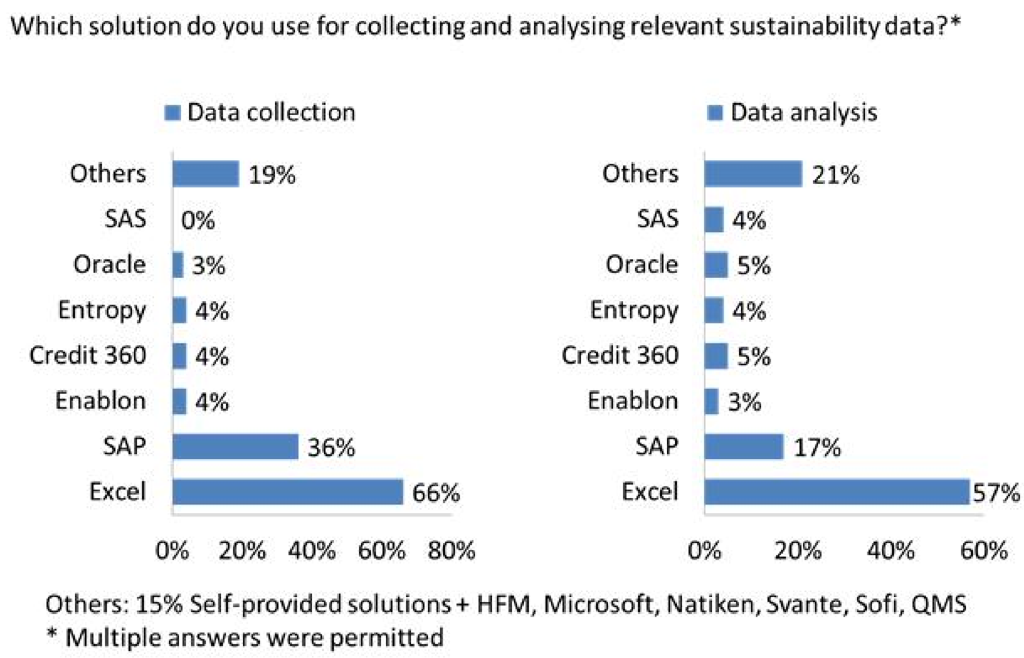


Figure 6.18: Usage of CSR tools (Accenture, 31.11.2011, p. 11)

In the following, an overview is given about the software products mentioned in Figure 6.18:

- SAP Sustainability Performance Manager: SAP is one of the largest BI providers with a broad knowledge of data collection and reporting. In 2007, SAP bought Business Objects and now uses Xcelsius Suite made for data visualization (SAP, 2015b)
- Enablon SD-CSR: Another large ERP company (Enablon, 2014)
- Credit 360: Credit 360 is dedicated to CSR, with a whole suite from strategy to implementation (Credit360, 2014)
- Entropy: Like Credit 360, Entropy is also a specialized CSR solution (BSI, 2013)(BSI, 2014)
- Oracle: Another large ERP provider also known as the Database Solution Company (Oracle, 2014)
- SAS Corporate Responsibility: Also a well-known software provider (SAS, 2014)

6.14.1 Functionalities of Sustainability Software Solutions

As described in Figure 6.18, many companies reporting on CSR-KPIs are still using spreadsheet software to collect and process their data to get it into CSR reports. As described in section 3.3., there are some software-solutions which are trying to facilitate the implementation of CSR-Reporting.

The advantages that the tools offer, as stated by the software providers, are described in the following Figure 6.19:

Figure 6.19: SAP Sustainability Performance Management (SuPM) (Deroost, 2012, p. 8)

CSR software solutions not only offer tools for the IT implementation requirements for CSR reporting, but also conceptual solutions for management processes. They also maintain that, with the use of these processes, reliable information and data can be generated.

Data Gathering process

Regarding the data gathering process, the various providers of these solutions offer different interfaces for their products. On the one hand, there are providers who only connect their solution with MS Excel (e.g. Credit360, 2014). On the other hand, there are providers, like e.g. SAP, which are offering a wide range of interfaces (see also Figure 6.20).

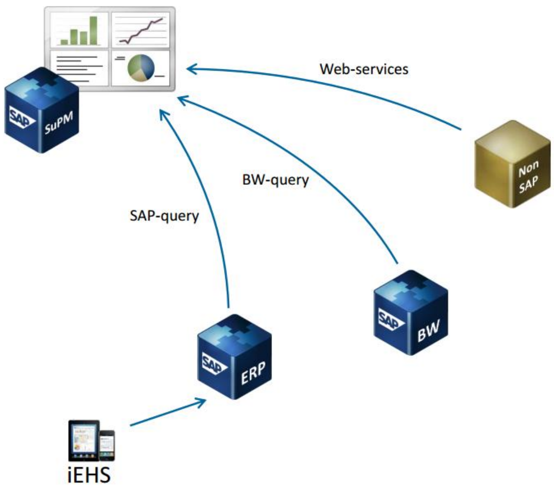


Figure 6.20: SAP SuPM Data Gathering (Deroost, 2012, p. 12)

Additionally, they offer ready-to-use solutions designed to collect qualitative data. They do not, however, only provide the process to collect this data, which is sometimes distributed worldwide. They also often have the ability to track the percentage of data collected. This is a critical feature because of the high amount of unstructured data (see chapter 6), that has to be collected via email from other departments

Figure 6.21: SAP SuPM Data Gathering from People (Deroost, 2012, p. 13)

Furthermore, the tools offer ready to use web-forms which are used to collect data not available electronically. For example, SAP offers a web-form designed to collect the amount of water recycled, for companies which do not track this information electronically (see Figure 6.22). The advantage of this method is that no additional process has to be set up to collect this data and only requires one person to complete the form. With the help of this functionality, sustainability-reporting can be set up very quickly. The disadvantage of this solution is that without a defined process, the data is harder to revise, and the data has to be collected manually at least every year (the period of the publication of a sustainability report).

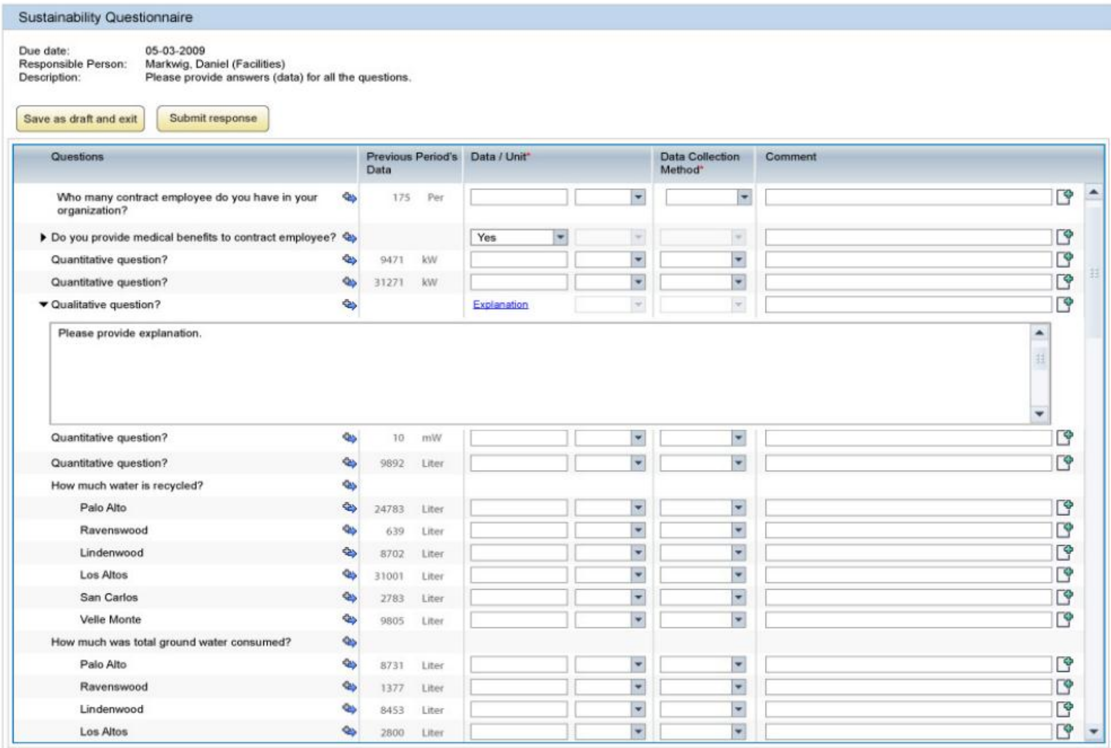


Figure 6.22: SAP SuPM Sustainability Questionnaire (Bodla, 2009)

Integrated KPI-Sets

All of the solutions (outlined in Figure 6.18), offer an integrated KPI-set, in compliance with well-known CSR standards. SAP SuPM published that *"± 85 % of quantitative GRI KPI's can be automated from SAP systems"* (Deroost, 2012, p. 12).

Ready-to-use reports

Furthermore, these software-providers advise that there are plenty of ready-to-use reports that are integrated, such as alerts, dashboards, scorecards and standard reports.

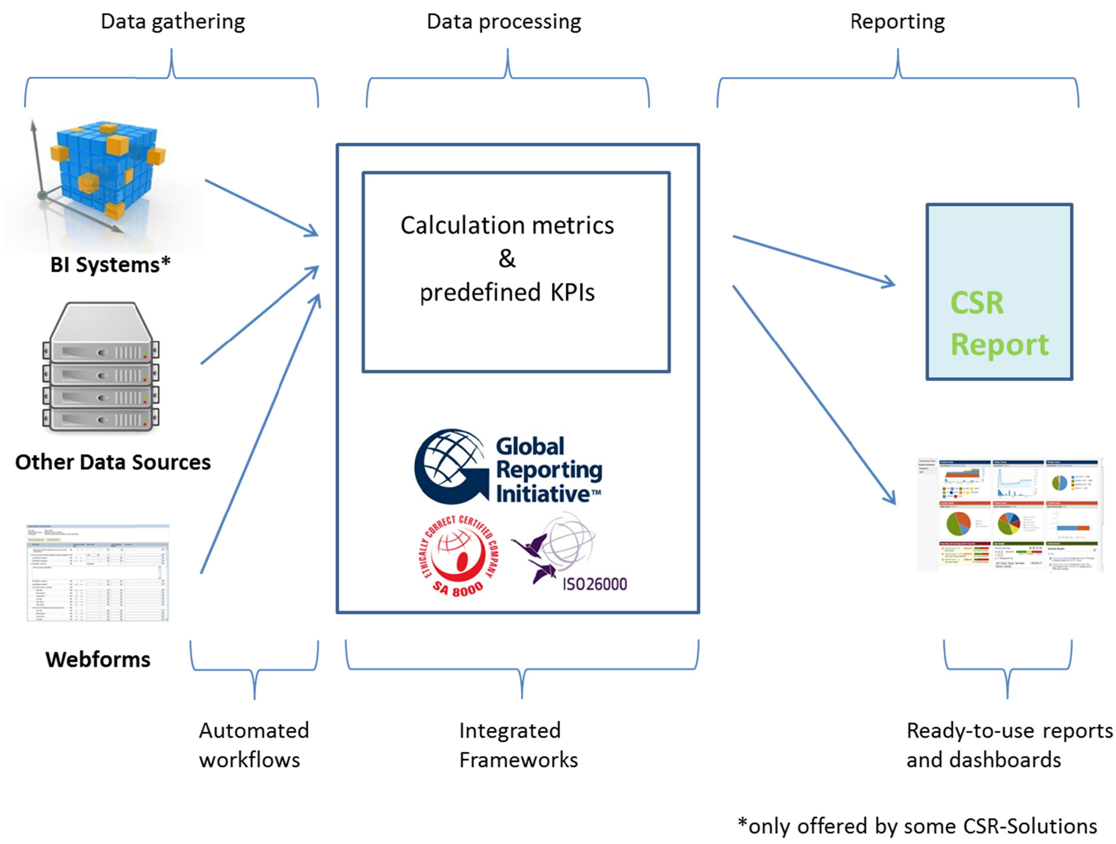


Figure 6.23: Functionalities of CSR-Tools

Figure 6.23 aims to outline the functionalities of CSR tools. As described in the foregoing sections, CSR tools support the whole (IT) implementation process beginning with data gathering, data processing, through to the reporting of the data. Furthermore, they offer additional functionalities like integrated frameworks (e.g. GRI) to facilitate the selection of KPIs, automated workflows to control the data gathering process, and ready-to-use reports and dashboards.

6.15 Conclusion

The chapter started with a brief description of the history of CSR and classified the various definitions of CSR as a foundation for the CSR part of this thesis. Subsequently, the motivation for reporting CSR was described and the legal restrains were stated and possible trends in CSR reporting were derived. The following section described the organizational impacts on controlling, possible organizational integration and linked the topic BI through the sustainability balanced scorecard. Consequently, the measurement of the maturity of sustainability development lead to the sub-chapter which described the topic of sustainability reporting. From the definition of sustainability reporting several sub-topics were derived, which were then described. Starting with the description of CSR data from a technical viewpoint, through the importance of stakeholder identification and prioritization and various standards for sustainability reporting which were useful to know. The section ended with an overview of actual IT implementation approaches and their functionalities for later analysis. This derivation of the topic CSR will be used in the following section to develop a process for the implementation of CSR.

7 A Conceptual Sustainability Reporting Process

Contrary to the BI models from literature (which focus more on the IT implementation than on the development of the reporting content), in case of sustainability the hypothesis can be derived, that there are many models from literature describing the company-wide development of sustainability within a company as well as for the development of the content of a sustainability report. Literature for sustainable development arises from research (Maon *et al.*, 2009; Hohnen and Potts, 2007; Maignan *et al.*, 2005; Castka *et al.*, 2004; O'Riordan and Fairbrass, 2008; Münstermann, 2007, p. 21), consulting companies IOLAP, 2014, and NGOs (ISO, 2013b) publishing frameworks, as well as from companies themselves publishing their own CSR approaches (see for example Schwerk, 2012, p. 336). These frameworks, introduced by literature, partially contain the development of the reporting aspects. The frameworks concentrating on the conceptual development of a sustainability reporting arise mostly from NGOs (see for example WBCSD, 2015; The Sigma Project, 2003; Global Reporting Initiative, 2014b, 2013b), but also from literature (Cahyandito, 2005; Eccles and Krzus, 2010). The developed process methodology which is described in the following sections illustrates the conceptual development of a sustainability reporting project and serves as a foundation for the overall implementation process with a BI solution (see chapter 8). The development of the CSR strategy, as well as, for example, the derivation of recommended actions (e.g. for sales or production), are addressed but are not a primary focus.

7.1 Definition of Sustainability Reporting Project in this Context

The objective of this sustainability reporting process is analogous to the novel reporting process for BI reporting project (see chapter 5) with the objective to achieve comparability between these two process models. The objective of this reporting process is primarily to support companies which want to establish an initial sustainability reporting program. However, it is targeted to companies which already publish single sustainability indicators and which are willing to reach a higher level of maturity with a structured project approach.

The presented sustainability reporting process can be implemented regardless of company size or industry sector. The characteristics of, for example, a special industry sector are addressed within the process model and additional methods to select the appropriate guideline and to prioritize sustainability indicators are presented.

As described in the foregoing chapter 5, the reporting process includes the organizational integration (see section 6.6), introduces methods for calculating the business case (see section 6.10), describes the handling of sustainability data (see section 6.11), gives a description of how to answer stakeholder claims (see section 6.12) and presents possibilities to evaluate and prioritize sustainability standards (see section 6.13).

Summarizing, the introduced sustainability reporting process describes the content-related design of a reporting process including the description of the project flow. The sustainability reporting process serves as foundation based on the content for the development of SureBI (see section 8).

7.2 Definition of Process Steps

Following the common project management steps (initiation, planning, execution and construction, controlling, completion) (IEEE Computer Society, 2011) a universal process model is developed which describes the creation and implementation of a sustainability (or ESG) reporting. This process model describes the development with regards to content with the objective to design the IT implementation of the sustainability reporting process from chapter 8. The first process step, planning, outlines the status quo (see also Hohnen and Potts, 2007, pp. 22–23, 2007, p. 26; Maignan *et al.*, 2005, pp. 968–969; Ecologia, 2003, p. 9; The Sigma Project, 2003, p. 62; Heinrich, 2013, pp. 4–5), the legal requirements (see also Hohnen and Potts, 2007, p. 25), the integration of stakeholders (see also Maon *et al.*, 2009, pp. 78–79; Hohnen and Potts, 2007, p. 25; Maignan *et al.*, 2005, pp. 965–968; Castka *et al.*, 2004, p. 13; Global Reporting Initiative, 2013b, pp. 9–10; Heinrich, 2013, pp. 12–15), as well as the actual planning of the content, the receiver and the objectives of the sustainability reporting (see also WBCSD, 2015, pp. 36–38, Global Reporting Initiative, 2013b, p. 32, 2013a; Münstermann, 2007, p. 170, The Sigma Project, 2003, p. 38, 2003, p. 62; Global Reporting Initiative, 2013b, pp. 13–15; Heinrich, 2013, pp. 16–19). Since sustainability reporting still is voluntary (see also section 6.4) and companies can choose between a variety of guidelines (see section 6.13) and a variety of sustainability KPIs, the next process step describes the prioritization (Global Reporting Initiative, 2013b, pp. 34–37) of the reporting content. This process step can be conducted voluntarily, in situations where the planned report contains more than the business case had approved.

After the planning of the reporting and the prioritization of the reporting components is completed, the reporting is then implemented (see also WBCSD, 2015, p. 39; Hohnen and Potts, 2007, p. 59; Castka *et al.*, 2004, p. 9; Münstermann, 2007, p. 170; Global Reporting Initiative, 2013b, p. 33). The implementation process contains (among others) the definition of the reporting (that is, among others, the receiver of the reporting, the reporting cycle etc.) and the description of the KPIs. When the implementation process is completed, the report is passed on for the validation process (see also Global Reporting Initiative, 2013b, p. 33; Hohnen and Potts, 2007, p. 67; The Sigma Project, 2003). Depending upon the results of the validation process and the requirements defined in the planning process, the report is then distributed (see also WBCSD, 2015, p. 40). If corrections are required, the implementation process is conducted again. Since the maturity of sustainability reporting is generally on a base level, due to the short existence of this kind of reporting, a concluding process to review & evaluate (see also WBCSD, 2015, p. 40; Global Reporting Initiative, 2013b, p. 33; The Sigma Project, 2003, p. 64) is undertaken. This process contains the controlling of sustainability communication but is also designed to collect feedback and therefore serves as a trigger for the next cycle of the overall process model. The process steps outlined here are further developed in the next sections.

Figure 7.1 gives an overview of the identified process steps and describes the section where each step is described in more detail.

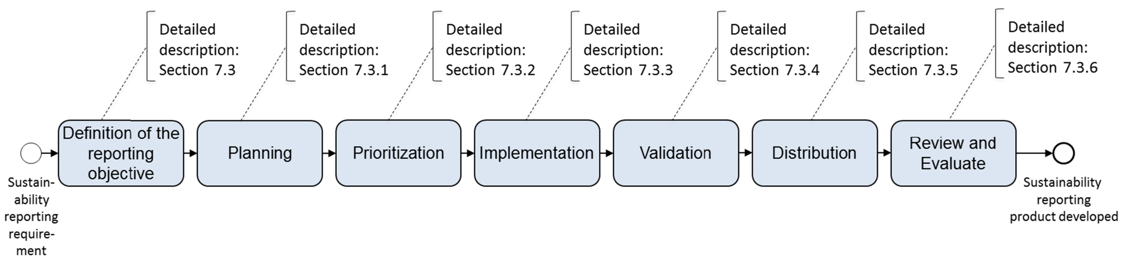


Figure 7.1: Sustainability Reporting Process - Process Steps

7.3 Definition of the Reporting Objective

As a matter of principle, regarding the definition of the reporting objectives, "*a primary goal for reporting is to publicity establish your commitment to social responsibility, regardless of existing shortcomings*" (Ecologia, 2003, p. 21). That means that sustainability reporting should also contain the disclosure of weaknesses (e.g. regarding production), with the objective to eliminate them. In both NGOs and in literature, the first step of defining the reporting objectives includes the analysis of the current situation. According to Münstermann (2007), this analysis includes investigating a company's self-perception and their public image followed by a comparison and analysis of the collected facts (Münstermann, 2007, p. 170). Ecologia (2003, p. 9) describes this step with the description of the business (e.g. what the company does, what it produces, where it is located, etc.) and the exploration of what social responsibility means for the company, "*What does a good company look like in your eyes*". This step can be expanded with the identification of stakeholders (e.g. Maignan *et al.*, 2005, pp. 965–968)[44] (see also section 6.10).

By identifying the stakeholders at this point, it can be assured that during the planning phase of the reporting process no important stakeholder is disregarded. Further, the identification of legal requirements is important (Hohnen and Potts, 2007, p. 25; The Sigma Project, 2003, pp. 40–41). That means identifying issues which have obligatory reporting either immediately or in the future.

The origin of these legal requirements can be internal or external. Legal requirements can be externally researched using accounting principles (for example, HGB in Germany) or external service-providers (such as consultancies or GRI). Internally, this information can be obtained from the finance and accounting departments of the company but also from corporate documents, processes and activities (Hohnen and Potts, 2007, p. 25). Once these steps are completed and documented, the actual reporting objectives can be formulated in detail. Table 9 gives an overview of possible questions which can be used for this definition.

[44] Maignan (2005) describes in fact the implementation of CSR in Marketing, his structured approach can be also used for the stakeholder analysis regarding sustainability projects.

Question	Description
What is the purpose of the report?	**Is the aim, for example, to report improvements or to improve public perception?**
Who are we reporting to?	**Definition of a stakeholder, as well as prioritization of key stakeholders. In this context among others, the language of the report is defined according to the key stakeholders.**
What are we reporting?	**Which indicators are going to be reported? (This is further developed in the planning phase.)**
How will the report be published?	**Stand-alone or as an integrated summary in the annual financial report.**
Can you experience from other reporting processes?	**Are there defined reporting processes (e.g. ISO 14000) within the company which would be useful for knowledge exchange?**
Which reporting guidelines / codes of conduct should you follow?	**Is there already a decision made as to which guidelines the sustainability reporting has to follow (e.g. GRI or SA 8000)**
What sustainable development information should you report?	**A definition of the reporting level including "*right-to-know*", "*need-to-know*", "*interesting to know*" can be defined before the planning phase**
What is the right format for reporting?	**E.g. print, CD-ROM, web-based. Therefore, other sustainability reports from other companies can be considered (e.g. (CorporateRegister com, 2014))**
Reporting cycle?	**Annual reporting or continual web-based reporting**
Should stakeholder participate in the reporting process?	**At this point, the decision can be made if it is beneficial to involve key stakeholders in the reporting process.**

What is the reporting business entity?	**Will the sustainability report only contain information regarding the company itself or also about connected companies (e.g. suppliers)?**
What accounting principles should you follow when disclosing information and data?	**Do general accounting principles exist within the company which have to be followed? Because of the relatively new development of sustainability reporting, not all data can be collected according to accounting protocols.**

Table 9: Necessary questions to accomplish the definition of the reporting objective (own illustration adapted from The Sigma Project, 2003, p. 62; WBCSD, 2015, pp. 36–37)

As described in Table 9, at this point the question arises, which general guidelines best support the development of sustainability reporting? Although a general process model is intended, the selection of KPIs will be based on the GRI, as it can be named as the de facto standard used by the 95% of companies reporting on sustainability and which is well accepted throughout many industries (KPMG, 2014a, p. 1).

7.3.1 Planning

As a first step in the planning process, several tasks can be subsumed under the sub-process step of definition of pre-conditions. As already described in the previous sections, there are no defined principles which have to be met regarding sustainability reporting but there are generally accepted guidelines, like the GRI (see section 6.13.3). GRI defines stakeholder's inclusiveness as a principle pre-condition in this process step (Global Reporting Initiative, 2013b, pp. 9–10). That means that stakeholders should be, if possible, included in the planning process. This is described further in the subsequent paragraphs. Furthermore a content balance (Global Reporting Initiative, 2013b, p. 13) should be achieved which means that the sustainability report should contain positive and negative aspects equally to illustrate the overall company's performance. As the next pre-condition, the GRI (Global Reporting Initiative, 2013b, p. 14) states that a report should be comparable which means that generally accepted KPIs should be used (at least within one industry sector), to make them comparable to other companies. As the next pre-condition, the GRI describes accuracy (Global Reporting Initiative, 2013b, pp. 14–15) which means that KPIs should be detailed and accurate enough to make them revisable. Furthermore, the GRI describes the topics' timeliness, clarity and reliability (Global Reporting Initiative, 2013b, pp. 14–15) which have to be determined first in the planning process. WBCSD (2015, p. 37) expands this process-step of the definition of pre-conditions with the definition of the responsibilities of the report. This is often defined before the start of the project but should be defined at this point at the very latest. The responsibilities include both the completion of the report by the due date as well as assuring the accuracy of the data.

After the definition of the pre-conditions, it can be determined to what extent stakeholders should be involved in the reporting process. Maignan et al. (2005, pp. 965–970) as well as Hohnen and Potts (2007, pp. 79–80) divide this process step into the identification of stakeholder and the identification of stakeholder issues. Stakeholders and their issues must be identified before it can be decided to what extent and which stakeholder will be involved in the process. The process of the identification of stakeholders can be done by using the methods described in section 6.10.

As a next step, the GRI (Global Reporting Initiative, 2013b, p. 33), Ecologia (2003, p. 21) and WBCSD (2015, pp. 37–38) all describe the identification of relevant sustainability topics which should be reported. Under GRI (Global Reporting Initiative, 2013b, p. 33), all relevant topics are considered important in order to reflect the organization's economic, environmental, and social impacts.

This process concentrates on the conceptual specifications of the GRI meaning which core subjects and consequently which KPIs are selected. The GRI guidelines (Global Reporting Initiative, 2013b, p. 33) provide indicators that might be relevant for a company within the CSR sphere. Furthermore, during this definition step the seven core subjects[45] of the ISO 26000 can be drawn upon (Ecologia, 2003, p. 21). Additionally, Ecologia (2003, p. 21) states that companies which decide not to report on one (or more) of the seven core subjects should justify this in written form within their sustainability report.

Next, the GRI recommends determining boundaries (Global Reporting Initiative, 2013b, pp. 34–35) for the defined topics. GRI differentiates boundaries "*within the company*", "*outside of the company*" and "*within and outside of the company*". Within the company means in this context, that the origin of an infringement is found within the company. GRI uses, as an example, anti-corruption measures that affect only the company itself and its subsidiaries. Boundaries outside of the company can be, for example, the working conditions a supplier imposes on its employees. As an example for measures which can be found within and outside of the company, GRI cites general emissions which are produced both by the company's production plant and by a supplier of the company.

After having defined the relevant topics and the indicators which should be reported, the indicators have to be defined in more detail. Therefore, as a first step, it has to be investigated where the data for the determination of the indicators comes from. Furthermore, it has to be defined how often the KPIs should be reported (e.g. annually or monthly). For these steps, the development of a KPI outline (as described in section 5.3.2) is recommended.

[45] 1. Organizational Governance, 2. Human rights, 3. Labour practices 4. The environment 5. Fair operating practices, 6. Consumer issues, 7. Community involvement and development. More information about ISO 26000 can be gathered from ISO (2013b).

WBCSD (2015, p. 38), furthermore, advises that within the planning process it has to be defined how to ensure data quality and how to implement internal controls for this, who validates the report, and if the report should be certified by a third-party provider (e.g. by a consulting company who certifies the sustainability report according to GRI specifications, see also section 6.13.3).

7.3.2 Prioritization

Regarding GRI (Global Reporting Initiative, 2013b, p. 35), the desired key topics and the KPIs should be prioritized based on the definition of the materiality principle. That is, the covered aspects should "*reflect the organization's significant economic, environmental and social impacts; or substantively influence the assessment and decision of stakeholders*" (Global Reporting Initiative, 2013b, p. 35). GRI (Global Reporting Initiative, 2013b, pp. 36–37) splits the prioritization further by the influence of a stakeholder[46] to the company and the significance for the economic, environmental and social impacts to the company. These prioritizations, utilizing estimated valued for each stakeholder and comparing each stakeholder can be illustrated as shown in Figure 7.2.

[46] That could be, for example, the influence of a stakeholder on the public reputation of the company.

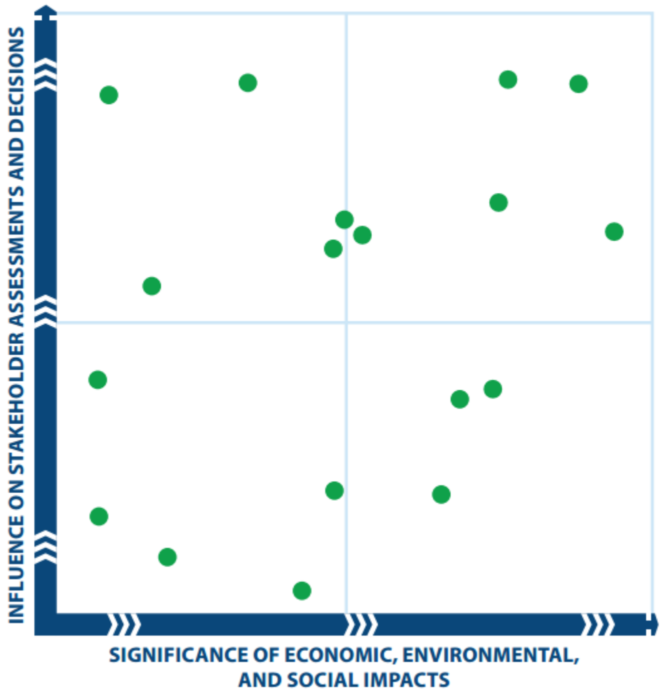


Figure 7.2: Visual representation of prioritization of Aspects (Global Reporting Initiative, 2013b, p. 37)

Additionally, the GRI suggests prioritizing the level of coverage, specifically, which data is reported, the narrative explanation of each indicator, and how often a report will be generated. For this, the GRI (Global Reporting Initiative, 2013b, p. 38) offers a classification method for the prioritization step:

- Aspects with low reporting priority can include aspects reported to fulfill regulatory or other reporting requirements. It may be decided to not include them in the report if they are not material.

- Aspects with medium reporting priority should be considered for inclusion in the report. It may be decided to not include them in the report if they are ultimately deemed immaterial.

- Aspects with high reporting priority should be reported on in detail.

Another possibility to help companies prioritize aspects of sustainability is to refer to actual consultancy studies. Figure 7.3 outlines the results from a study from Accenture (2014) showing how companies and NGOs rate the importance of including specific sustainability topics in the sustainability reporting.

Low Lower priority for disclosure	Medium Information tracked by management for performance improvement and disclosed to stakeholders where appropriate	High Important topics prioritized for disclosure
Waste Management & Resource Use Public Policy	Energy Efficiency & Carbon Emissions Sustainable Procurement Community Giving, Engagement & Impact Health, Safety & Security	Impact of Services & Solutions Inclusion & Diversity Corporate Governance Ethics and Compliance Innovation Talent Development

Figure 7.3: Reporting prioritization (Accenture, 2014)

The examples, outlined in Figure 7.3 intend to show that this form of prioritization seeks to help distinguish between reporting contents that are important for disclosure, information that should only be tracked or disclosed to appropriate stakeholders and information with low priority which can be reported, but does not have to necessarily.

7.3.3 Implementation

The actual implementation or creation of the sustainability reporting is neither described in detail in literature nor by NGOs[47] but merely the steps which facilitate the planning of the

[47] e.g. the GRI describes the process steps as far as the implementation as well as the validation very detailed, the implementation itself is kept open (Global Reporting Initiative, 2013b, p. 33).

reporting are provided. These are described in the following and a detailed description of the process steps is provided in section 7.2.

Münstermann (2007, p. 190) states that for the implementation of sustainability reporting the steps "concretion of communication content", the "definition of instruments, content and stakeholder groups" as well as the "securing of formal, contextual and temporal integration" are required. These steps are not described further. The WBCSD (2015, p. 39) describes the process of creating a sustainability report a bit more accurately. As a first step, they describe the definition of the reporting structure meaning that the report should be geared to the company's overall communication strategy which leads to the decision of whether the report should be geared, for example, to the company's marketing/communication department or by the requirements of the financial reporting. Next, it describes how to deal with stakeholder expectations including how stakeholders actually influence the company's performance. Following this, it describes how data has to be collected, aggregated and analyzed. Therefore, the recommendation is given that data has to be aggregated as soon as possible to leave more time to analyze this data. Furthermore, they advise that confidential data such as risk analysis information should be discussed with corporate accounting before reporting it. It then states that data which is reported should be based on a reporting theme so the report is built comprehensibly for the reader. In other words, the report should be built by using a storyboard which means in a consistent, well-structured way. Finally, the WBCSD highlights that during the construction of the report an external assurance of the reporting process and/or the results (or parts) should be considered mainly referring to the GRI (see section 6.13.3) and the AA1000 (see section 6.13.5).

Summing up, the construction of sustainability reports (not considering the IT implementation) is often done by a manual preparation of data (see also section 6.14) including the collection and aggregation of data, the calculation of KPIs, and the subsequent formatting of these values within a sustainability report.

7.3.4 Validation

Validation of the sustainability reporting can be divided into two main objectives; the validation of the report contents and the validation of the reporting process. In this section, only the validation of the reporting content is described. The validation of the reporting process is covered in section 7.3.6.

The validation of the report and its content includes the review of the results of the calculated KPIs but also the evaluation of whether the prioritized stakeholder issues are appropriately reflected in the report. The validation also includes whether a good balance of positive and negative aspects is covered within the report (Global Reporting Initiative, 2013b, p. 38).

Regarding Schmidt (2012) the principles for ensuring a quality report are:

- Balance - All positive as well as negative crucial sustainability aspects are reported.
- Comparability - All stakeholders can evaluate the sustainable development both in time and in comparison to other companies.
- Accuracy - Information has to be reported accurately and with sufficient details.
- Actuality – For companies that publish sustainability reports regularly.
- Clarity – Ensuring the report is understandable and comprehensible.
- Reliability – Methods utilized for data is collection and aggregation are clearly indicated.

The validation step can be conducted by the reporting project team but also by other key users from the corresponding departments or also by external stakeholders (depending on to what extent external stakeholders are involved in the reporting process) (Hohnen and Potts, 2007, p. 67). Furthermore the content of the report can be assessed and certified (e.g. according to the GRI standard, see also section 6.13.3) by external entities such as a consulting firm.

Both Sigma and WBCSD reference an external assurance of the reporting according to GRI (see section 6.13.3) and AA1000 (see section 6.13.5). The decision of whether or not a report should be assured by an external company should include considerations as to "*balance costs versus benefits as assurance may give further credibility but at a considerable cost*" (WBCSD, 2015, p. 39). This credibility issue is pertinent due to the fact that more and more companies are certifying their sustainability reports according to GRI (see section 6.13.3).

7.3.5 Distribution

It is usually defined in the first phases of the reporting process, generally in the defining of the reporting objectives or in the planning phase, to whom the reports will be distributed. Typically, companies provide a sustainability report to the main stakeholders defined in the first phase. If the sustainability report is developed only as a web-version, the stakeholder should be informed about the current version. The WBCSD (2015, p. 40) also provides additional suggestions that the sustainability report should be accessible to employees of the company and that sending the sustainability report attached to the annual reporting could enhance its acceptance. Additionally the WBCSD (2015, p. 40) suggests publishing a summary in international magazines as another way to promote the report.

7.3.6 Review and Evaluate

After the report is distributed and promoted it is advisable to analyze the lessons learned from the reporting process to benefit in the next reporting cycle. Feedback from internal and external stakeholders should be solicited (Global Reporting Initiative, 2013b, p. 39) with the WBCSD suggesting the inclusion of a reply card in the sustainability report to achieve such feedback. The WBCSD (2015, p. 40) recommends that if the response rate on the reply cards is low that companies can solicit feedback when meeting the addressed stakeholders.

Regarding the content of the review and evaluation process step, the GRI (Global Reporting Initiative, 2013b, p. 39) lists the examination of the application of the principles regarding the sustainability context and the stakeholder engagement. Hohnen and Potts (2007, p. 73) expand this general view with the following tasks:

- The examination of what went well, why it went well, and how to ensure that it continues.
- The analysis of what didn't go well, why it didn't go well, and how to ensure that it is corrected in future cycles.
- A survey of what competitors in the same sector reported and achieved.
- A revision of the original sustainability objectives, based on the foregoing tasks, as needed.

Münstermann (2007, p. 180) supplements these steps outlined by Hohnen (2007) and describes the controlling of the CSR communication. First, he calls for a situation analysis including, among other factors, reviewing the public opinion of the company and the company's CSR engagement. Next, he describes the perception of the company in the media, specifically coverage in the media over the last several months.

These steps are followed with the cognitive (referring to knowledge) and affective (referring to expression of emotion) assessment of the company. The cognitive assessment is the assessment of the corporate performance and the sustainability whereas the affective assessment describes whether a company is regarded as sympathetic, innovative or trustworthy. He concludes that with these assessments reference values can be derived which can (in case of reporting) be used for the next reporting cycle.

Additionally the reporting process must be evaluated. This includes not only a description of the execution of process-steps (as described in this section) but also how KPIs are calculated, are the KPIs revisable, and how the process steps are documented. As with the evaluation of the reporting content, the reporting process can be certified using international standards (for example, ISO 9001) and with the help of external consulting companies. In a study of the WBCSD (2014, p. 13) , 60% of the interviewed companies utilize some form of assurance to validate their sustainability reporting.

7.4 Conclusion

The chapter outlines the tasks needed to implement sustainability reporting grouped by process steps. The process described within this section aims to help companies acquire knowledge about the non-technical implementation of sustainability and builds on the overview of CSR in chapter 6. These process steps are developed as a basis for SureBI (see 8) and outline the non-technical aspects of a sustainability project. The challenge regarding this approach is that a generic process is developed which contains as few constraints as possible. The developed process steps are not intended to fulfill the requirements of every company, but to include every process step needed and are defined at an appropriate level. The developed process steps are derived from literature and are evaluated within SureBI (see chapter 8).

8 SureBI

This chapter outlines the main contribution of this thesis, a novel sustainability reporting process with BI (SureBI). The following sections are structured as follows: Section 8.1 gives an overview of how SureBI was developed. Section 8.2 describes the objective and components of the new SureBI. In section 8.3, the derivation of the main process steps is described and an overview of the novel reporting process outlined using the BPMN notation is provided in section 8.4. Finally, a detailed process description of each process step is described in section 8.5.

8.1 Overview

Figure 8.1 illustrates the main steps that were conducted in order to derive the new reporting process.

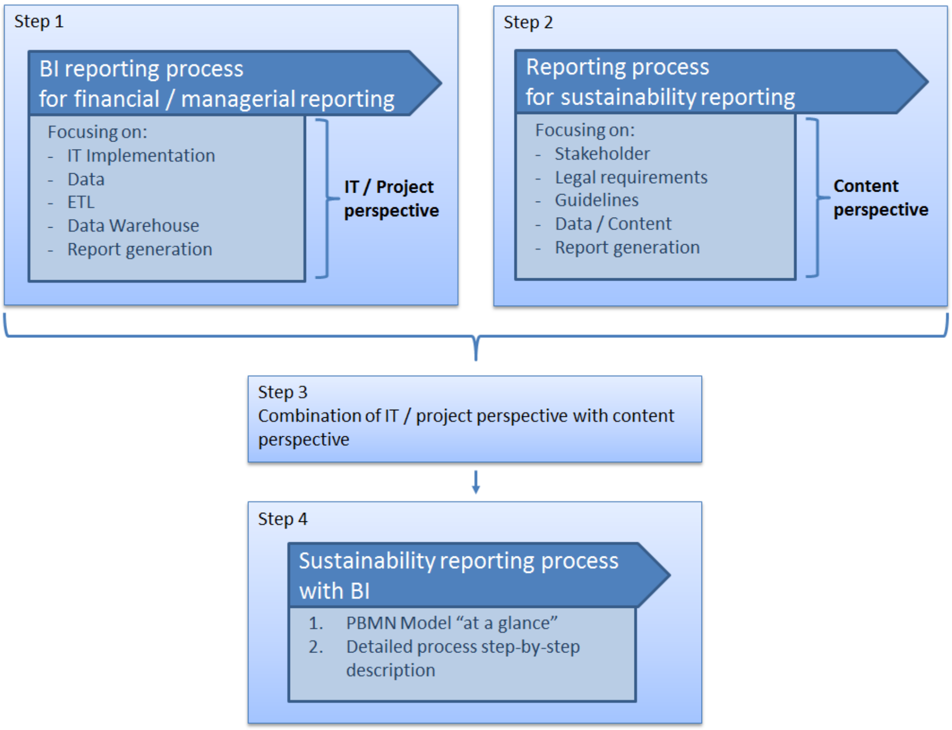


Figure 8.1: Derivation steps of the novel SureBI

As shown in Figure 8.1, the first step of this approach aims to form a BI reporting process from an IT / project perspective (see chapter 5). This BI reporting process was derived from the methodical preparation from both the IT perspective regarding the system base in chapter 3 as well as the requirements for a BI project in chapter 4. Secondly, a reporting process for sustainability reporting disregarding the IT implications, was developed contrary to the BI reporting process from a content perspective (see chapter 7). The second process was developed from the content perspective of sustainability reporting in chapter 6. Having derived these two processes, built upon the same requirements (the requirement of a new reporting) and the same objective (the completed reporting product), these two processes were analyzed and brought together, forming the novel SureBI, which is introduced in the following sections.

8.2 Objective and Components of SureBI

The objective of SureBI is to support companies which are trying to implement sustainability reporting along with their BI solution with a business process describing the project tasks needed to fulfill this objective.

For the development of such an implementation process, several components were developed to support companies using SureBI. The components include the definition of a start- and end- event of each process and sub-process in order to define the scope of each process step. Furthermore, inputs and outputs of each process step are included, to define the transitions of each task and to ensure the correct sequence of the process. Furthermore, the BPMN model includes further enhancements, normally not included in BPMN models, like methods, tools, checklists, and links to reference work as well as links to further literature to improve the feasibility of SureBI which are derived both from literature and project experience. Summarizing, SureBI includes the following components for each process step:

- Start-Event (What is the trigger for the process?)
- End-Event (What is the final status of the process step?)
- Input (Which input the process step gets, i.e. approval or a document?)
- Output (What are the deliverables for each process step/task meaning what is delivered to the next process step or task so it can be executed?)

- Methods / Tools / Checklists / Links to reference work (Additional assistance which were developed during this work are described for each process step and task)
- Further reading (Considerable further readings are assigned to the process steps and tasks)
- Organizational assignment (Designates for each process step who in the company / project team is responsible and/or who has to conduct a process step and task).
- Exemplary implementation (in case of technical procedures, these are illustrated with a prototypal implementation within the BI solution QlikTech, see section 9.3)

These components were developed to further assist companies using SureBI, to perform the implementation.

8.3 Definition of Process Steps

The definition of the process steps of SureBI is developed twofold. First, project management standards (like e.g. the PMBOK standard, see PMI - Project Management Institute, 2015), as well as project management literature (Daojin Fan, 2010; IEEE Computer Society, 2011; Ó Conchúir, 2012) was used to define the main process steps of SureBI. Daojin (2010, p. 499), the IEEE computer society (2011, p. 6) as well as Conchúir (2012, p. 6) describe the generally accepted process steps as:

- Initiating
- Planning
- Executing

- Monitoring and Controlling

- Closing

Secondly, the definition of the process steps of SureBI is geared to the novel reporting process for BI reporting projects (see chapter 5) and the process steps from the conceptual sustainability reporting process (see chapter 7). In the following, the formation of each main process steps of SureBI is described.

As described in 8.1 SureBI combines the IT implementation approach from chapter 5 with the conceptual sustainability reporting process from chapter 7. The requirement for a new sustainability reporting product (as described in section 7.1) is the trigger for SureBI.

The first process step "plan" describes the planning of the sustainability reporting project with BI. It is derived from both the plan phase of the BI reporting process (see 5.3.1) and the planning phase of the conceptual sustainability reporting process (see 7.3.1). In general project management literature, this would be the initiating phase, where the objective, the scope and the requirements are set (see also Daojin Fan, 2010, p. 499). In contrast to that, the process step was named "plan" as it was geared to BI implementation approaches (see, for example, idhasoft, 2013; Moss and Atre, 2006). The subsequent "analyze" phase outlines the analysis of the reporting requirements focusing both on the analysis of the IT infrastructure, as well as the analysis of the reporting requirements. Again, this process step is geared to BI implementation frameworks, where project management literature names that phase "planning", describing the same tasks, like "*working out in detail how to implement the project*" (Ó Conchúir, 2012, p. 26). Within the "design" phase, the IT design of the BI solution is described in order to implement sustainability reporting with the existing BI solution. This phase is supplementary to the general project management phases. It is derived mainly from the requirements of an IT project, described in 5.3.3.

In the "develop" phase, the technical and non-technical requirements defined in the foregoing process steps are implemented within the BI system. In project management literature this phase can be described as execution. The "validation" process step shows methods and tools for how to validate the output of the development phase and describes the steps required to conclude this process step. Generally, this phase is analogous to the "monitoring and controlling" phase, which is conducted through most of the phases, but especially controlling the results from the development phase (Ó Conchúir, 2012, p. 28). The final process step "deploy" describes how the developed and validated sustainability reporting product is deployed within the BI system. It reflects an IT characteristic where the developed product (in this case the sustainability reporting product) is moved to the production system. Regarding project management, this phase also includes formal project conclusion tasks, where the project participants "evaluate performances, summarize the experience, and apply lessons learned to extended projects" (Daojin Fan, 2010, p. 499).

8.4 SureBI at a Glance

This section describes SureBI in the BPMN notation. BPMN is used as it is often cited as the de facto standard for processing models (see also Recker, 2010, p. 195). Furthermore, it targets professionals from both the IT and business departments (Wikipedia, 2014c) like the context of this thesis. The notation is, therefore, readable for IT and business users as several quick reference guides facilitate the first steps (see for example Business Process Incubator, 2014). Due to the IT proximity of SureBI, the BPMN notation is used, although, the BPMN notation is similar to other process notations, like, for example the event-driven process chains (ARIS, 2014).

This section provides a quick overview for people familiar with the BPMN notation. The quick overview illustrates the connections of each task within the process and provides further guidelines in addition to the detailed process description. Section 8.4.1 describes the main process steps (derived from section 8.3), whereas the following sections describe each main process step in detail. The derivation of each process step as well as the textual description of each process step starts from section 8.5.

8.4.1 Overview

Figure 8.2 illustrates the process steps derived in section 8.3. The BPMN process model illustrates the linear process, since the objective is to demonstrate one reporting cycle of a reporting project. Within the detailed process description (see section 8.5), several methods are described on how to document challenges and problems (for example, the addressing of stakeholders and the prioritization of the reporting content) which can be instrumental to improving future reporting cycles.

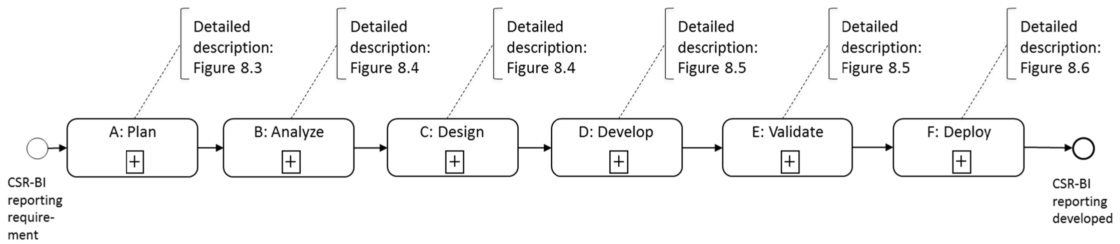


Figure 8.2: SureBI – overview

Within the following sections, the relation of each task within the sub-processes is described. Therefore, each task is numbered continuously. This assignment of the tasks aims to help link each BPMN task to the corresponding described process step described in section 8.5.

The assignment is done using the following structure:

- Each sub-process (plan, analyze, design etc.) is a letter assigned in ascending order (e.g. "A" for plan, "B" for analyze" etc.).

- Within each sub-process (plan, analyze, design etc.) the tasks are consecutively numbered (e.g. A1, A2 etc.).

- In the case of a condition or tasks which can be conducted simultaneously, the number of the corresponding task is equipped with a decimal place (e.g. A14.1, A15.1). In the situation where there are several tasks within one parallel thread, only the decimal place is incremented (e.g. E3.1, E3.2, E3.3).

8.4.2 Plan

Figure 8.3 presents the first process step (defined in 8.3) of SureBI in the BPMN notation starting with the sustainability reporting requirement.

The sub process describes the planning of the sustainability reporting project and concludes with the kick-off meeting including all project participants as the initiator of the project.

Each task within this sub process is conducted sequentially, but there are specific tasks (A14.1/A15.1 as well as A17.1/A18.1) which can be conducted parallel, as no common dependences exist.

As SureBI represents an ideal process[48], with the objective to develop and implement a sustainability reporting, each process step of the planning sub process should be conducted. Also, as described in 8.5.1, the calculation of the financial effort (A13, A14.1, A15.1) should be conducted to gain planning security within this complex project.

48 "Ideal" is used in this context to describe the contrast to most BI projects, conducted in a grown environment and infrequently implemented using detailed process frameworks like SureBI.

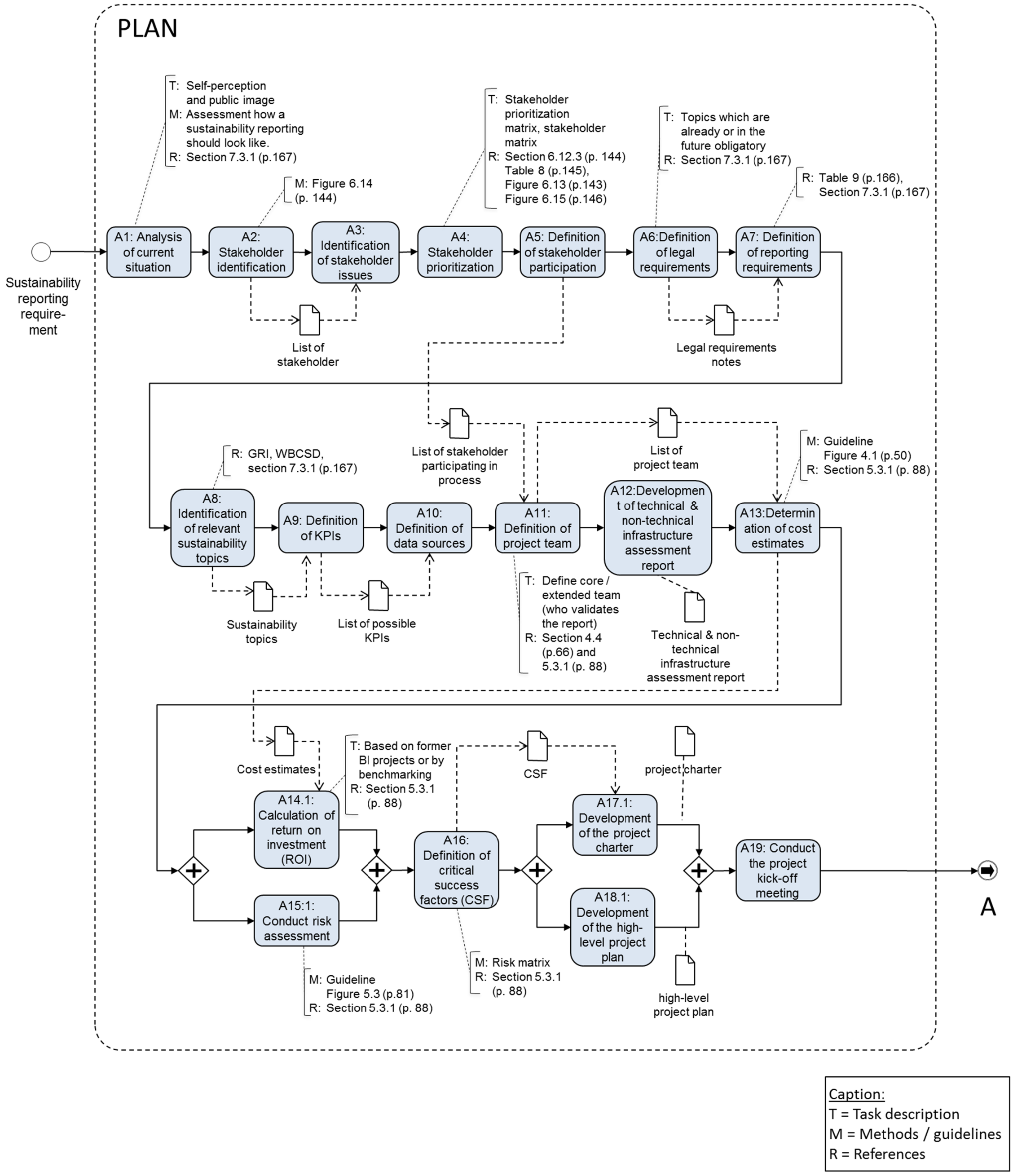


Figure 8.3: SureBI – Plan

8.4.3 Analyze and Design

After conducting the first process step, Figure 8.4 describes the next two process steps. These two process steps are presented together in order to outline the requirements which have to be developed within the Analyze phase and to be able to conduct the Design phase.

The sub process analyze can mostly be conducted sequentially. As further described in 8.5.2 the possibility to prioritize the reporting content is included. This step is regarded as essential, as sustainability reporting is still merely voluntary and by prioritizing the KPIs, the reporting scope can be delimited. The final phase of this sub process furthermore includes a loop which aims to ensure that the developed prototype reflects the defined content and functionality of the reporting. If the prototype isn't approved, the process tasks B6-B8 should be conducted again to include adjustments of the prototype.

The sub process design is conducted sequentially, however several conditions have to be fulfilled or these tasks have to be conducted again. The illustration of the sub process design reveals that strong dependencies exist in the sub process analyze. Furthermore, the BPMN illustration outlines the deliverables which each process task should deliver. The detailed description of each tasks is found in 8.5.3.

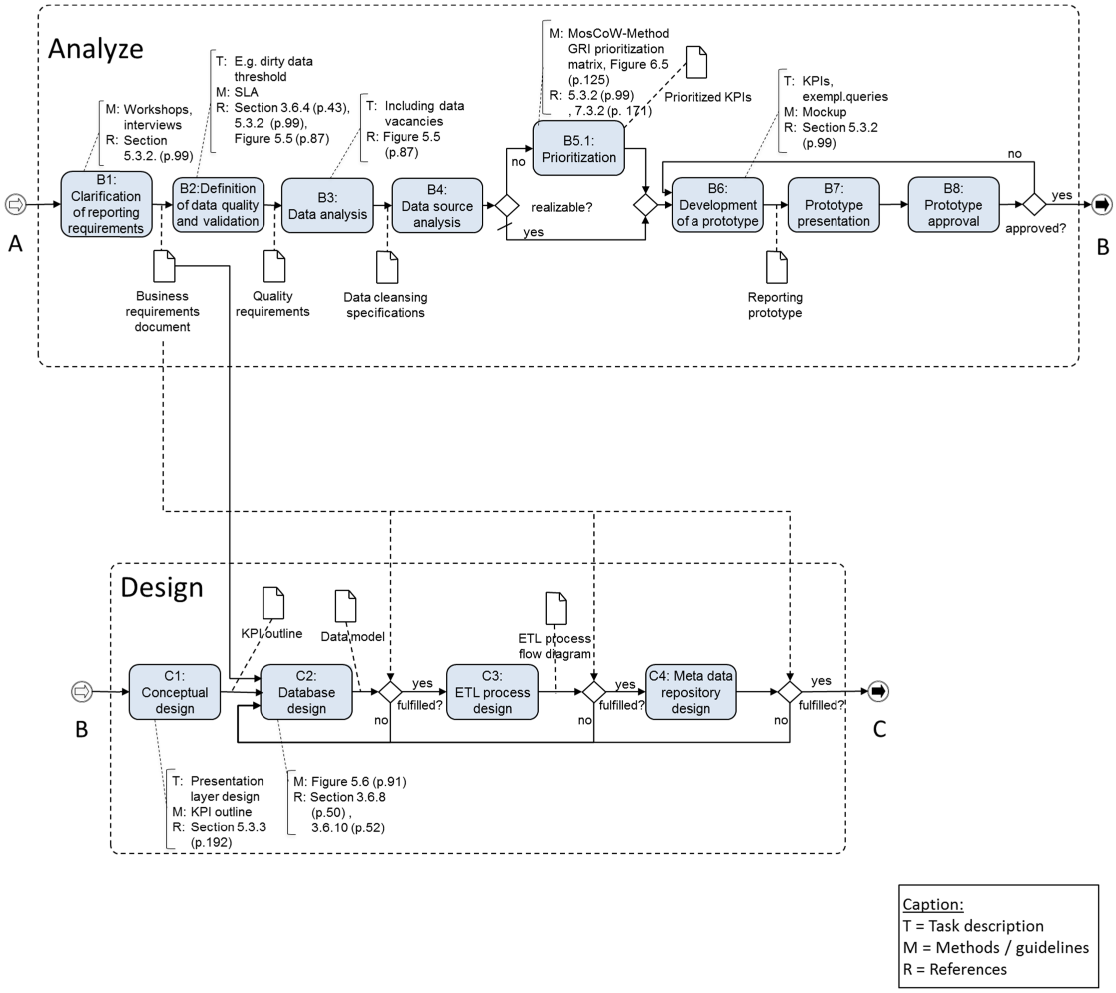


Figure 8.4: SureBI - Analyze & Design

8.4.4 Development and Validate

As in the previous section, the next two process steps, represented in Figure 8.5 are shown in one figure to highlight how these two phases are connected. In the event that errors occur during the validation phase, the resulting issue lists have to be handed to the appropriate tasks in the development phase in order to conduct these tasks again.

Within the development phase, the tasks D2.1, D2.2 as well as D.2.3 can be conducted simultaneously. This is possible since no content dependencies exist and the responsibility for the implementation could be held by various project participants.

Apart from that, the sub process is conducted sequentially. As described above, it is possible that single tasks of the sub process may have to be conducted again, such as in case where process steps from the sub process validation revealed errors. The detailed description can be found in section 8.5.4.

The validation sub process is triggered by the porting (see also section 3.6.1) of the reporting product in the test stage. After the definition of a test schedule, the process runs in parallel, separated into non-technical tests and test affecting the BI environment. If these tests outline errors, the respective process step within the development phase highlights the error(s) to be fixed. The validation sub process terminates after the tests are concluded and a documentation of these tests for the next reporting cycle is created. The detailed description of the sub process steps can be found in section 8.5.5.

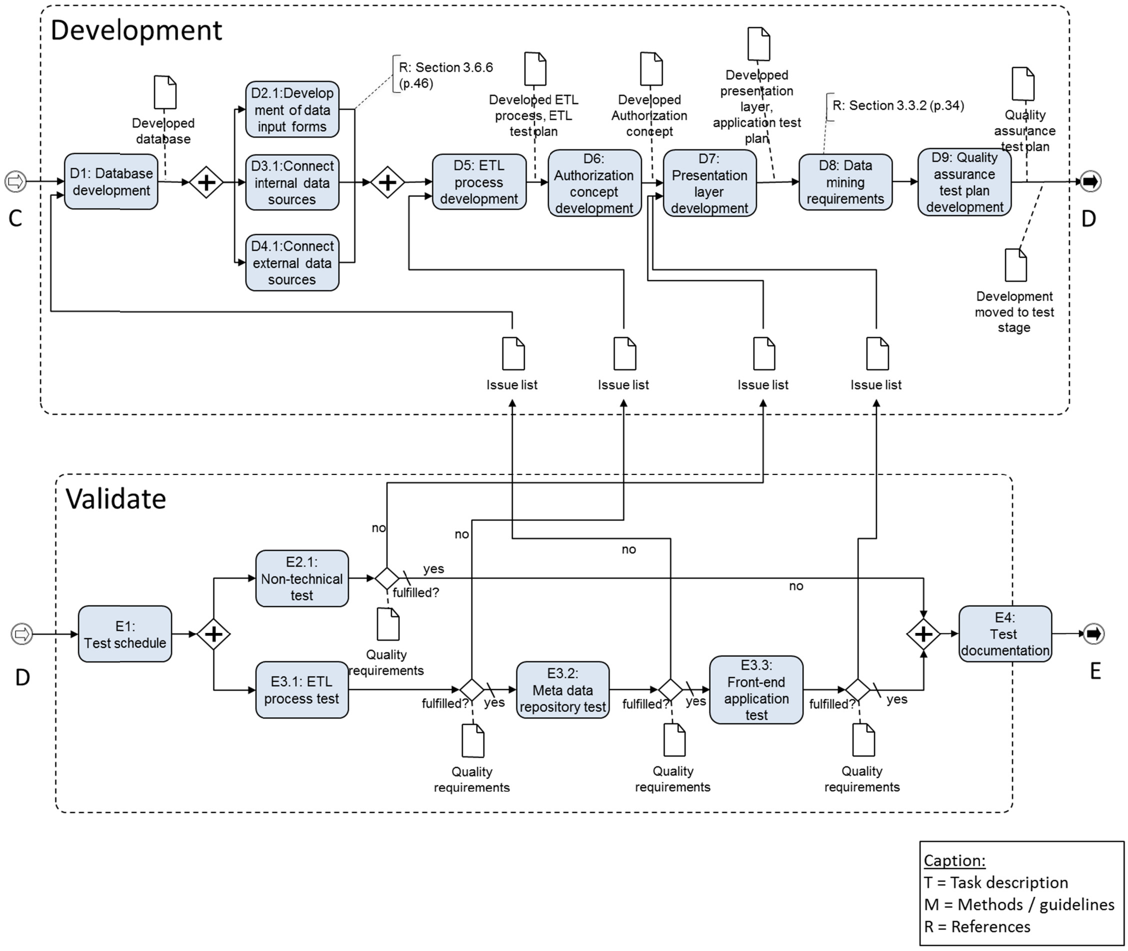


Figure 8.5: SureBI - Development & Validate

8.4.5 Deploy

In conclusion, Figure 8.6 outlines the last phase of SureBI - the deployment of the reporting solution. To supplement the sequential procedure of this sub process, the definition and conduction of user trainings including user support can be conducted in case the integration of a dashboard or analytical tools require end user support. These tasks are included for the sake of completeness but only have to be conducted if a new reporting tool is introduced which needs further instructions. A description of these optional tasks can be found in section 7.3.6. The other tasks included in this sub-process are described in detail in section 8.5.6.

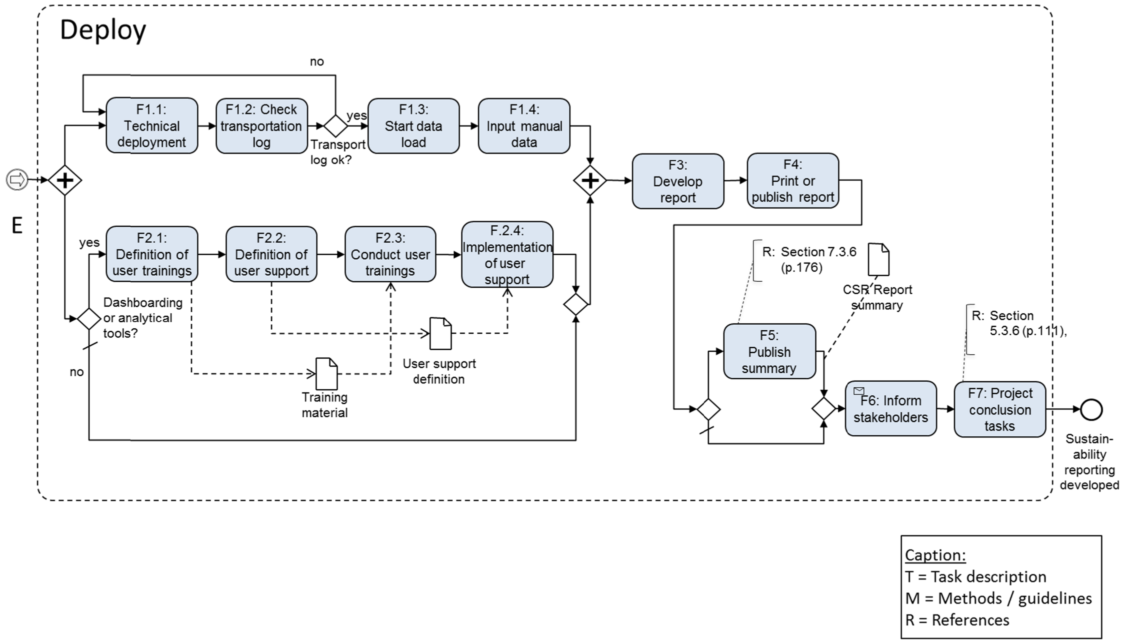


Figure 8.6: SureBI - Deploy

8.5 Detailed Process Description

In this section, each of the main process steps is defined in detail, as well the derivation of each task. Contrary to the overview in section 8.4, a textual description including additional information not included in the overview is illustrated here. The process steps are numbered (see section 8.4.1) and can be assigned exactly to each task of the BPMN illustrations (see section 8.4).

8.5.1 Plan

The planning phase is initiated when a new requirement for sustainability reporting arises, without further differentiation, as it is defined within this reporting process. As the described sustainability reporting process is an ideal process, a major focus on the planning phase is shown, oftentimes not realized in BI reporting processes (see section 5.1).

A1: Analysis of the current situation

Since it is assumed for the reporting process that there is little knowledge about sustainability reporting, the first process step is the analysis of the current situation[49]. It contains the investigation of the company's self-perception as well as its public image. This could be summarized by the question "*what does a good company look like in your eyes*" (Ecologia, 2003, p. 9)[50]. In comparison to financial or managerial reporting projects, the stakeholder theory has a higher relevance (see for example Visser *et al.*, 2009, p. 434)[51], therefore the stakeholder discussion is placed as next step.

A2: Stakeholder identification

It starts with the identification of stakeholders. Figure 6.13 (p. 141) provides of an overview of the most important stakeholders. This list can be extended if there are further considerations such as the company having a bad reputation concerning a peer-group. The identification of stakeholders at this point[52] helps to assure that no important stakeholder is disregarded in the context of the reporting process. The output of this process step is a list with the identified stakeholders.

A3: Identification of stakeholder issues

After the stakeholders have been defined, this step has to be expanded by the identification of stakeholder issues[53]. The identification of stakeholders and the issues these stakeholders may have against the company, help to generate an overview of possible topics which could be addressed by publishing a sustainability report, in comparison to the stakeholders, BI systems address in their unique function (see also 4.4).

[49] As further described in section 7.3.
[50] See also section 7.3.1.
[51] See also section 6.12.
[52] See also section 7.3.1.
[53] See also section 7.3.1.

A4: Stakeholder prioritization

The topic of sustainability brings up new stakeholders[54] which then have to be classified[55] and prioritized[56] using a stakeholder prioritization matrix, see Table 8 (p. 143), a stakeholder matrix (see Figure 6.15), and/or a power/interest grid as described in Figure 4.3 (p. 68). Furthermore, the RACI method can be used helping to define the extend of responsibilities of each role of the project[57].

A5: Definition of stakeholder participation

The GRI (Global Reporting Initiative, 2013b, pp. 9–10) suggests including the stakeholder in the reporting process, therefore after having defined the stakeholders, the stakeholder issues, and their prioritization, the degree of stakeholder participation can be defined as the next process step. This helps to enhance the quality of the reporting product but can also improve the transparency towards the participating stakeholders[58].

A6: Definition of legal requirements

Although sustainability reporting is mostly voluntary[59], it is important to identify legal requirements which already exist such as those in the subsidiaries as well as legal requirements which are planned or likely forthcoming. This is placed after the stakeholder participation since stakeholders can often function as a source of new legal information. This process step includes the analysis of internal departments and affiliated companies, their corresponding countries, and a list of inevitable indicators is created as a result of this process step[60].

[54] Further described in section 6.12.2.
[55] As described in 6.12.1 focusing on sustainability and 4.4 focusing on BI.
[56] See also section 6.12.1.
[57] See also section 4.4.
[58] See also section 7.3.1
[59] Further described in section 6.4.
[60] See also section 7.3.1.

A7: Definition of reporting requirements

The planning of the reporting requirements can take place at this point, as the requirements for the reporting product are roughly defined by the requirements of stakeholders and legal requirements. This process step aims to outline the sustainability reporting. Therefore, the questions from Table 9 (p. 165) Table 9: Necessary questions to accomplish the definition of the reporting objective (own illustration adapted from The Sigma Project, 2003, p. 62; WBCSD, 2015, pp. 36–37)can be used as guideline. These questions span from formal definitions like the reporting format or reporting cycle to complex determinations of the reporting guidelines[61], accounting principles and organizational definitions[62] which the sustainability reporting should be based upon.

A8: Identification of relevant sustainability topics

Once the claims of the prioritized stakeholders and the legally demanded KPIs have been defined, the identification of relevant sustainability topics, which are also addressed in Table 9 (p. 165) on a rudimentary level, can take place and can be deepened within this process step. These topics can be derived from the GRI codex, but also be deepened with other sustainability guidelines[63]. Generally, companies have to bear in mind that they should also justify if they are not including sustainability topics within their reporting (Ecologia, 2003, p. 21).

A9: Definition of KPIs

By preparing a structure which defines which sustainability topics should be reported on, the detailed definition of sustainability KPIs can also be developed. These KPIs can be

[61] An overview of possible reporting guidelines can be found in section 6.13.
[62] The organizational requirements are described in section 4.4 and 4.6.
[63] See also section 6.13.

derived from the GRI guidelines (and additional guidelines[64]) and should be further described using a KPI outline. Table 10 (p. 194) outlines an example of one KPI based on the GRI guidelines, describing the total weight or volume of materials used to produce and / or package the primary products and services of a fictitious company.

KPI Outline	
Name:	**G4.EN1**
Description:	**Materials used by weight or volume**
Unit:	**Weight or volume**
Periodicity:	**Yearly**
Reporting dimensions:	**Country / location**
Receiver of KPI:	**Controlling**
Calculation:	**Non-renewable materials used + renewable materials used**

Table 10: Exemplary KPI outline for one KPI (based on Global Reporting Initiative, 2013a, p. 48)

It is important to keep in mind that this KPI outline primarily serves as the planning for the reporting project and will be further developed within the analyze phase. This may include, for example, analysis regarding from where the data of the KPI can be derived.

A10: Definition of data sources

As with the defining of KPIs, the definition of data sources[65] also must be described at this point essentially for the planning of the reporting project. Since it can be assumed that new KPIs have to be derived from various data sources, these sources have to be named, to address the effort the implementation of these data sources could cause. This process step

[64] See also section 6.13.
[65] See section 3.6.6.

has to be conducted after the KPIs are defined since the KPIs are the basis for the data source definition.

A11: Definition of project team

The project team can be assembled using participants derived from the list of participating stakeholders. Team members can also be identified by matching available know-how with the knowledge requirements ascertained in the established reporting requirements section as well as by the definition of sustainability data and the data sources. Therefore, Table 3 (p. 67) provides an overview of possible BI project roles. Furthermore, the project roles outlined in section 5.3.1 (p. 77) could serve as basis. These recommendations could be used, extending the sustainability requirements for team members. To define the responsibilities within the project team, the RACI Method (see for example Hei and Linden, 2010, p. 20)[66], described in section 4.4 can be used.

A12: Development of technical & non-technical infrastructure assessment report

For documentation purposes, but also as a deliverable for the analyses phase, a technical and non-technical infrastructure assessment report[67] should be created. It combines the outcomes of the foregoing process steps, excluding the definition of the project team, and could therefore be conducted simultaneously with the foregoing process step.

A13: Determination of cost estimates:

With the description of the project team as one cost driver and the summarizing technical and non-technical assessment report, a cost estimate (this is also described in Moss and Atre, 2006, pp. 98–99) of the planned reporting process is recommended at this point. As

[66] There are further developments to structure the roles more in detail, e.g. Supportive (S), a supporting role; Verify (V), a person verifying the results; Sign-Off (S), a person who affirm the result of role V; Omitted (O), a person who is explicitly not involved.

[67] Further described in section 5.3.1.

the reporting process as described here is an ideal process, this and the following process steps, obtained from project management literature, are recommended. Figure 5.2 (p. 90) outlines the typical cost drivers of a BI project which has to be expanded by project specific cost drivers as well as cost drivers related to sustainability reporting.

A 14.1: Calculation of return on investment (ROI)

The cost estimates derived from the foregoing process step are then used to calculate the ROI. As there is already a high complexity involved in calculating the ROI for BI projects (Elliott, 2004, p. 10; Boyer *et al.*, 2010, p. 29), the implementation of a sustainability reporting product is even harder to measure due to qualitative components such as the improvement of a company's public reputation[68].

A 15.1: Conduct risk assessment

To cope with the reporting process, ideally, a risk assessment should be done to define possible risks (See also Kemper *et al.*, 2010, pp. 174–175) which can occur during the implementation of the sustainability reporting and to be able to react in case these risks occur. To provide an overview of the possible risks, the risk assessment matrix from Figure 5.3 (p. 93) can be used.

A 16: Definition of critical success factors (CSF)

Based on the identified risks, the CSF can be developed[69]. Similar to the BI reporting process, this should include hardware, software, data, people and procedures (Anandarajan *et al.*, 2003, p. 192) including the defined stakeholders[70], sustainability data[71] and

[68] See also section 6.3.
[69] As described in section 5.3.1.
[70] Typical sustainability stakeholders are described in section 6.12.
[71] Sustainability data is defined in section 6.11.1.

sustainability data sources[72]. The outcome of the CSF definition can implicate a re-assignment of project roles, for example, or even an adjustment of the stakeholder inclusiveness[73].

A 17.1: Development of the project charter

To define the agreement between the IT department and the business sponsor regarding the planned sustainability reporting project, a project charter as exemplarily shown in Figure 5.4 (p. 95), should be utilized. The project charter represents a formal agreement between the IT department and the project sponsor about the objective, constraints and the schedule of the planned reporting project[74] and should be developed using input from the risk assessment and the definition of CSF. This document has to be approved by the project sponsor in order to proceed with the project.

A 18.1: Development of the high-level project plan

The development of the high-level project plan[75] could be conducted at the same time as the development of the project charter since no input is needed from one another (this is also described in Moss and Atre, 2006, p. 98). The high-level project plan contains the detailed task estimates, task and resource dependencies and is undertaken during the course of the whole process. The activities needed to create the project plan are described in 5.3.1.

A 19: Conduct the project kick-off meeting

After the formal approval, that is the written approval by the project sponsor, of the project charter and the project plan, the project starts with the project kick-off meeting.

[72] Typical sustainability data sources are described in section 6.11.2.
[73] As described in section 5.3.1.
[74] See also section 5.3.1.
[75] See also section 5.3.1.

Generally, the kick-off meeting serves as an orientation for the entire project team and should include the set-up of the communication channels (email, newsletter etc.) to keep project members and other stakeholder up-to-date on the progress of the project. During the kick-off meeting, the project roles are assigned and the agenda for the following days is established.

8.5.2 Analyze

The analysis phase follows the planning phase assuming all appropriate approvals are obtained during the planning phase. The foregoing planning process phase defines the project requirements in order to gain an overview of the whole project, its stakeholders, the project costs and the initiation of the project. The analysis phase deepens the project know-how and concentrates more on the IT background and content requirements, already involving the project participants, and defines the parameters necessary to accomplish the subsequent design phase.

B1: Clarification of reporting requirements

The clarification of reporting requirements takes place as the first process step within the analysis phase. This process step is placed at the beginning as the parameters of what to analyze have to be defined at this point[76]. The clarification of the reporting requirements is the continuation of the definition of the reporting requirements of the planning phase. At this stage defined reporting requirements, specifically the KPI and data source definitions, are brought together and expanded with the reporting functionality (e.g. drill-down and further analytical functions) and written down in a business requirements document. The

[76] See also section 7.3.1.

involvement and inclusion of employees is expanded and input is collected using interviews and workshops (e.g. with other stakeholders).

B2: Definition of data quality and validation

The subsequent process step following the clarification of reporting requirements regarding the BI reporting process[77] would be the data analysis. Based on the suggestions regarding sustainability reporting to enhance reporting quality (WBCSD, 2015, p. 38) and as described for an ideal sustainability reporting process, the next process step is dedicated to defining data quality and validation. Typical quality challenges could include consistency, completeness, accuracy, validity or uniqueness of data, further described in Figure 5.5 (p 99). Before analyzing the data and the data sources, the requirements for data quality and how to validate the reporting product is defined. Furthermore, at this point, the decision can be made if external assurance of the reporting product is advisable. The output of this process step are the written data quality requirements.

B3: Data analysis

Based on the written data quality requirements, the KPIs (defined in the foregoing planning phase) can be further analyzed. As the definition of KPIs in the planning phase was conducted merely to define the effort needed to undertake the project, in this phase the data needed to create the KPIs is further researched. Based on the KPI outline developed in section 8.5.1, it has to be determined how the KPIs should be calculated and what further data is required for the calculation. Furthermore, KPIs where assumptions have to be made are highlighted. After this analysis, it can be determined if data required to calculate the sustainability KPIs is available (within the companies databases, available from accounts etc.) and what data isn't currently available (e.g. greenhouse gas emissions,

[77] See also section 5.3.1.

qualitative data). Within this process step, not only is the data analyzed, but also data discrepancies[78], like e.g. missing information, are revealed. Based on the data quality requirements developed in the foregoing process-step and the data discrepancies derived from this process step, the data cleansing specifications are developed as an output resulting from this process step. Additionally, further deliverables from this output are the enhanced KPI outlines.

B4: Data source analysis

After the analysis of the data, the analysis of the data sources[79] takes place. This process step can be conducted only after the clarification of the KPI outline derived from the foregoing process step takes place. Sustainability reporting data sources must be analyzed during this step to determine whether the new data sources for this reporting can be connected and automatically filled with data. Therefore, as the first step, a classification regarding already connected data sources / new data sources and internal / external data sources has to be made. Additionally, data sources which can't be connected directly, like qualitative data or unstructured data[80], have to first be examined and converted to structured data. Furthermore, as described in the data analysis process step, data which is based on assumptions has to be analyzed to determine the optimal way to add them to the reporting process (e.g. manually entered using web-forms). The output of this process step is an overview of data sources needed to accomplish the sustainability reporting product and a classification of the data sources as well as the efforts required to connect the data sources.

[78] Data discrepancies are further described in section 3.6.3.
[79] BI data sources are further described in section 3.6.6.
[80] Qualitative and unstructured data is further described in section 3.6.3.

B5.1: Prioritization

Due to new data sources and an assumed high effort to implement sustainability reporting with BI, a possible prioritization process step is recommended after the data and data analysis process steps are completed. The prioritization process step can be conducted discriminately such as in instances where only part of the reporting requirements defined in the foregoing process steps can be conducted such as instances where there is a prohibitively high effort required to include data sources or where a conflict exists regarding the data quality requirements and the existing data quality. The prioritization is done by challenging the KPIs regarding their data and their data sources. Generally, for prioritization, the MoSCoW-Method, where KPIs are classified according to "*must*", "*should*", "*couldn't*" and "*won't*", can be used. Furthermore, the GRI prioritization regarding the level of coverage[81], where KPIs are prioritized according to priority (low, medium and high), and/or consultancy studies (see Figure 6.5, p. 123) can be used to prioritize the KPIs. The deliverables from this process step include a list containing the prioritized sustainability KPIs.

B6: Development of a prototype

The development of a prototype – an exemplary reporting - for the planned sustainability reporting product follows either directly after the process step data source analysis or the prioritization process step. Therefore, the input of this process step is either the complete list of data and data sources or the prioritized KPIs and the derived data and data sources. The purpose of the prototype is a proof of concept derived from a review of the implementation view and the business user view and therefore a good disclosure source for

[81] See also section 7.3.2.

possible errors[82]. The prototype should include exemplary KPIs, exemplary analytical functions and the basic layout of the planned sustainability reporting product.

B7: Prototype presentation

The prototype should then be presented to the project team focusing on the business user and the project sponsor.

B8: Prototype approval

After the presentation of the prototype, the business user decides whether to approve the prototype or to reject it. If the prototype is rejected, the process is looped to the sub-process development of the prototype again to fix the findings from the prototype presentation.

8.5.3 Design

The design phase mainly includes the design of the technical BI environment. Additionally a conceptual design is created which describes the sustainability reporting product and serves as a basis for the technical design.

Therefore, the first process step involves describing the conceptual design.

C1: Conceptual design

The conceptual design describes the general structure and layout of the desired sustainability product, the arrangement of KPIs, and the required reporting functionalities[83]. If the planned reporting product is oriented to the GRI guidelines, the segmentation of general standard disclosure (Global Reporting Initiative, 2013b, pp. 22–60)

[82] See also section 5.3.2.
[83] See also section 5.3.3.

and specific standard disclosure (Global Reporting Initiative, 2013b, pp. 62–221) should be considered. The deliverables of this process step include the defined reporting functionalities and a mockup of the planned report which can be used to test the IT implementation.

C2: Database design

Based on the reporting requirements defined and enhanced in the foregoing sections as well as the KPI outline, a data model (Moss and Atre, 2006, p. 120) should be developed. This model, a relational model for database management, should describe the database, the tables, keys as well as the table connections, as exemplarily shown in Figure 5.6 (p. 103), and serves as a basis for the development of the database. Regarding the sustainability portion, the database has to be prepared for qualitative and unstructured data. The output of this process step is the data model which describes the database as the basis for the ETL design.

C3: ETL process design.

The design phase of the ETL process delivers an ETL process flow diagram which has to be designed. Figure 5.7 (p. 104) outlines an exemplary ETL process flow diagram illustrating the source databases, the extraction routines, and other calculation logics. The basis for the ETL process flow diagram include the defined data-sources, the KPI outline, and the conceptual design. The ETL process flow diagram supports the conceptual ETL design. Martínez et al. (2012) further describe the logical and physical ETL process design including a more precise view on database tables, dimensions, operations, restrictions and indexes[84]. Furthermore, the design of the ETL process includes the definition of automatic loading processes[85].

C4: Meta data repository design

The concluding process step of the design phase is the design of the meta data repository. Assuming that the running BI system already includes a meta data repository, the reporting requirements have to be reviewed and missing meta data has to be identified and loaded into the repository. The process steps of database design, ETL process design, and meta data repository design are each checked against the reporting requirements and looped if the requirements are not fulfilled.

8.5.4 Development

The development phase describes the IT implementation of the sustainability product derived from the foregoing phases. In general, the development phase is conducted within the development stage of the BI system[86].

D1: Database development

As the first process step, the development of the database is conducted in order to provide the structure for the subsequent development of the data sources and the ETL process. The development of the database describes the implementation of the multidimensional data[87] using the data model described in 8.5.3. The deliverable for this process step is a developed target database within the BI system. The subsequent data source development is threefold and can be conducted simultaneously. First, data forms are developed for

[84] See also section 8.5.3.
[85] See also section 5.3.3.
[86] The system structure of most BI solutions is described in section 3.6.1.
[87] The multidimensional data model is described in section 3.6.10.

qualitative data not available in company databases. Second, internal data sources are connected, and third, external data sources are connected.

D2.1: Development of data input forms

Data input forms are used to add data that is qualitative data which have to be collected through web forms, or data which has to be added manually, for example in case of assumptions or that data is only available from accounts. As this sustainability reporting process describes an ideal reporting process, this data should be integrated in the reporting process to be revisable. Derived from the KPI outline, the data input forms are developed using the tools the BI solution offers. Data can then be entered directly to the database, or be looped through an audit trail. The deliverable of this process step is the developed web forms which are connected to the database.

D3.1: Connect internal data sources

Connection of the internal data sources to the database is provided by most BI systems. There are multiple interfaces which BI solutions offer as described in the methodic BI chapter[88]. If there are further internal data sources which have to be connected, the interfaces have to be programmed. The output of this process step are the connected internal data sources.

D4.1: Connect external data sources

If there are external data sources which have to be connected such as external benchmarking data, these data sources have to be connected as described in the foregoing process step. The output of this process step are the connected external data sources.

[88] See also section 3.6.6.

D5: ETL process development

After the development of the web-forms and the connection of internal and external data sources, the ETL process can be developed based on the defined ETL flow diagram. As described in section 5.3.4, this process can be geared to the following conditions (Moss and Atre, 2006, p. 261):

- Cleansing: Clean
- Summarization: Condensed
- Derivation: New
- Aggregation: Complete
- Integration: Standardized

The ETL process can be subdivided into the initial load, historical load, and incremental load (Moss and Atre, 2006, p. 276). The development of the ETL process can be regarded as complete when the automated ETL process is operating in the development stage[89]. As described in section 5.3.4, Moss and Atre (2006, p. 276) additionally recommend defining an ETL test plan which "*should state the purpose for each test and show a schedule for running the tests in a predefined sequence*".

D6: Authorization concept development

The authorization concept, which can be developed after the ETL process, describes who is allowed to view and/or change which data. Regarding this sustainability process, only restrictions regarding the development of the reporting are made which is only conducted

[89] See also section 3.6.1.

by the BI implementation team of the project. There could be, however, a restriction which might be on the input of manual data for which the sustainability department could be responsible.

D7: Presentation layer development

The development of the presentation layer, as described in section 5.3.4, contains the development of the frontend report including the general layout, the arrangement of KPIs including their description in case of print reports and, in the case of web-based reports, additional analysis possibilities. Therefore the mock-up from the design phase is used as well as the overall reporting requirements and the data provided by the foregoing process steps is included. This process step is finished when the presentation layer is implemented in the development stage[90] and filled automatically with data.

Furthermore, the development of an application test plan describing what should be tested during the validation phase as it relates to the presentation layer is, recommended by Moss and Atre (2006, pp. 276:297).

D8: Data mining requirements

In the event that there are special data mining requirements, like e.g. coherencies between sales and improvement methods regarding employee satisfaction, these data mining methods (as in the case, for example, of the association analysis) have to be implemented at this stage. The technical implementation to provide real-time data to the data mining specialists has been described in section 3.3.2.

D9: Quality assurance test plan development

The concluding process step of the development phase is the formation of a quality

[90] See also section 3.6.1.

assurance test plan. Subsequent, the ETL test plan and the application test plan are combined, test people are identified, and a test schedule is developed[91]. The porting of the developed target database, the data input forms, the connected internal and external data sources, the ETL process, the authorization concept, and the presentation layer for the test stage[92] marks the end of the development phase.

8.5.5 Validate

The validation process aims to identify errors based on the quality requirements defined in the analysis phase. The validation is important as voluntary sustainability reporting includes qualitative figures and assumed figures, which have to be revisable in order to fulfill the objectives of the reporting (e.g. to improve public reputation).

The validation process for sustainability reporting not only includes technical accuracy, but also usability, interfaces to other systems, satisfaction of functional requirements, and performance metrics[93] (Anandarajan *et al.*, 2003, p. 192). Other key criteria involve inclusion of prioritized stakeholder issues as well as whether or not a good balance of positive and negative aspects is covered within the report (Global Reporting Initiative, 2013b, p. 38).

E1: Test schedule

The first process step[94] is the setup of a test-schedule for the quality assurance test plan as developed in section 8.5.4. This test plan assigns the testing team to the test plan.

[91] As described in 5.3.4.
[92] See also section 3.6.1.
[93] As described in 5.3.5.
[94] As described in 5.3.5.

The following process steps can be classified into non-technical tests and technical tests, which can be conducted concurrently, since different knowledge is necessary to accomplish these tasks.

E2.1: Non-technical test

The non-technical test describes the testing of reporting content including the indicators, descriptions, and, if appropriate, the analytical functions. Furthermore this process step includes the testing of the scope of the sustainability reporting. That means, for example, determining if the GRI principles have been fulfilled and the reporting product covers a good balance of positive and negative aspects (Global Reporting Initiative, 2013b, p. 38). Furthermore, ensuring acceptable report quality should be undertaken. Essentially, it involves testing whether the reporting requirements (defined in 8.5.2) and quality requirements (defined in 8.5.2) are fulfilled. It is possible to seek external involvement in order to assure the report content as described in 7.3.4. The process proceeds if no errors are detected. In the event that conflicts do arise, the corresponding task in the development phase is repeated.

E3.1: ETL process test

As described in 5.3.5, the testing of the ETL process includes the following:

- Are the data sources connected correctly?
- Is the data transformed as defined within the reporting requirements?
- Is the data loaded correctly to the target database?
- Is the ETL process is running automatically?

Therefore, as outlined in 5.3.5, the following tests are recommended by Moss and Atre (2006, pp. 269–273):

- Unit test
- Integration or regression test
- Performance test
- Quality test
- User acceptance test

These tests are also based on the quality requirements defined in the analysis phase (8.5.2). If these tests are conducted without any major errors, the process step is completed. If errors occur which indicate conflicts with the quality requirements, an issue list is passed to the BI development team, looping to the process ETL development in the foregoing development phase.

E3.2: Meta data repository test

The data of the Meta data repository base on the ETL process[95]. Because of that, the meta data repository test cannot be conducted before the ETL process test. The meta data is tested based on the reporting requirements developed in 8.5.2. This process tests whether the indicators of the reporting product are supported with the required meta data. Moss and Atre (2006, p. 331) recommend a unit test to make this determination. As in the case of the ETL process, this process step is concluded when the quality requirements are fulfilled. Again, if these requirements are not fulfilled at this point as in the preceding case,

[95] See also section 5.3.5.

the process is looped back to the development phase including an issue list with the negative outcome.

E3.3: Front-end application test

If the sustainability reporting is not only published as a printed product, but also, for example, as a dashboard with ongoing access or on the company's website, the functionality of the application displaying the data has to be tested as well. This tests can include the analytical functions such as the ability to drilldown analyze the data further[96]. Furthermore, it can include the verification of the data input forms discussed in 8.5.4. In the event that errors occur during this test, an issue list is generated and passed to the process step "presentation layer development" in the development phase again. If there are no findings, the process moves forward to conclude the test documentation.

E4: Test documentation

As concluding process step the tests conducted regarding the content, the ETL process, the meta data repository and the front-end application are documented for enhancing the process in the next reporting cycle and as documentation if further errors occur.

8.5.6 Deploy

The deploy phase is triggered by the approval of the project sponsor assuming that no findings from the validation phase conflict with the defined reporting or quality requirements.

F1.1: Technical deployment

On the IT side, the tested target database, the tested data input forms, the tested internal

[96] As described in section 5.3.5.

and external data sources, the tested ETL process, the tested authorization concept and the tested presentation layer are transported to the production stage[97].

F1.2: Check transportation log

Most BI solutions offer a log where the execution of any process is documented and can be checked. If there is a transportation log, it has to be checked for errors. If the transportation log does not reveal any errors, the process is concluded.

F1.3: Start data load

When the developed content is transported correctly – that means the transportation log does not outline errors - into the development stage, the ETL process involving loading the data to the report can be started.

F1.4: Input manual data

If manual data has to be entered (such as assumptions or manual entries from accounts), this has to be done at this juncture.

The reporting process for BI projects developed in chapter 5 includes, at this point, the defining of user trainings and user support, the conducting of user trainings, and the implementation of user support. The trainings only have to be developed and conducted if business users have to operate, for example, dashboards or reporting tools. In the case of sustainability reporting implementation with BI, it is assumed that a yearly reporting cycle is implemented and no additional trainings are necessary. For the sake of completeness, these process steps, which are described in 5.3.6, are illustrated in the process diagram (see F2.1, F2.2, F2.3 and F2.4 in section 8.4.5), but not described further here.

[97] See section 3.6.1.

F3: Develop report

After the data has been loaded through the ETL process and manual data has been entered, the actual sustainability report can be developed. This includes the layout and the formatting as well as further descriptions of the KPIs, and the introduction as described in the corresponding guideline (e.g. GRI) and the conceptual design (see 8.5.3).

F4: Print or publish report

After the development of the report, it can be printed or published to other sources such as the company's website.

F5: Publish summary

Optionally, as recommended by the WBCSD (2015, p. 36)[98], a summary can be published in international magazines as another way to promote the report.

F6: Inform stakeholders

When the report is printed or published, the stakeholders, defined in 8.5.2, have to be informed about the new sustainability report.

In theory, the informing of the stakeholders marks the end of the reporting process. For the sake of completeness and as defined in 5.3.6, the ideal reporting process includes further project conclusion tasks which are described in the following.

F7: Project conclusion tasks

First, the documentation made during the course of the process should be saved and enhanced by further findings from the project, for example difficulties reported by project members. This serves to improve further reporting projects and also assist with the next

[98] See also section 7.3.5.

reporting cycle for the developed report. As described in Figure 5.8 (p. 111), there are several tasks which have to be concluded before the project can be transferred for ongoing implementation. This includes the evaluation of the achievements made relative to the objectives, a project completion report, and includes the project documentation. Furthermore, lessons-learned should be documented. At the final meeting, after the presentation of this documentation, the project is dissolved.

8.6 Conclusion

The introduced SureBI aims to satisfy the demand from companies trying to implement their sustainability reporting with BI. The process steps are derived from the BI reporting process (see chapter 5) which are described on a profound level in literature and by consulting companies. The BI reporting process was then brought together with the rather conceptual sustainability reporting process (see chapter 7) which assure that no essential components are missing in the overall reporting process.

SureBI can be regarded as an ideal[99] process, pragmatically describing the practical requirement of an sustainability reporting using the theoretical foundation of a structured implementation process model. Therefore specific parts (such as the project team) are not described on a profound level as there are various pre-conditions which exist within companies like, for example, the BI organization (see section 4.6).

This illustration of the implementation possibilities is the first one in literature combining the topics of BI and sustainability. Furthermore, the PBMN model (see 8.4) supports

[99] In contrast to most BI projects, conducted in a grown environment and infrequently implemented using detailed process frameworks like SureBI

companies who are interested in implementing sustainability with BI, to get a quick overview of the whole process.

It can be concluded that conducting SureBI can be an implementation project which requires a high effort. Keeping in mind that an external BI professional costs around $800/day and the complexity of including new data in existing BI landscapes strongly increases the required effort, the overall effort is hard to quantify but involves weeks or even months with several project members involved (Evelson, 2014). Therefore, a complete test of the process within a company is not possible in the context of this thesis, however, the difficulties of implementing sustainability with BI (i.e. the integration of qualitative data and assumptions) illustrated within the process model are evaluated with the help of a prototypical implementation in section 9.3. Furthermore, the process is evaluated to include qualitative criteria such as completeness, sequence, transitions and operational suitability.

9 Evaluation & Implementation

As described in chapter 2, this thesis is aligned with applied science, using a deductive design-oriented approach. The evaluation of this work, in the field of BISE (like derived in 2.2), is development-oriented (Becker *et al.*, 2009) and therefore appropriate evaluation methods have to be used which are described in the following.

Generally, the objective of evaluation is to prove that the artifact (SureBI) is developed appropriately to solve the defined goal (a sustainability reporting product with BI) (Becker *et al.*, 2009, pp. 72–73). Thereby the evaluation should be goal-oriented, i.e. the objective of the evaluation should be stated explicit as the case may be exemplified (Frank, 2000, p. 42; Becker *et al.*, 2009, p. 72). The criteria for the evaluation therefore should be reasonable and reliable, that means that the scientific demand should not be sacrificed only to preserve the practical relevance. Methods for the evaluation of artefacts in BISE are multilayered. Österle and Otto (2010, p. 287) describe that the following methods are appropriate to evaluate research in BISE:

- Review workshop
- Function test
- Experiment
- Simulation
- Pilot application

SureBI aims to provide guidance to companies regardless of sector, company size, BI solution and organizational conditions (see section 4.6). Within this PhD thesis, the process of implementing it within a company is out of scope, but there are several methods which can be utilized to evaluate SureBI (see chapter 8).

Figure 9.1 outlines these various possibilities. These possibilities are then processed further in the following sub-sections.

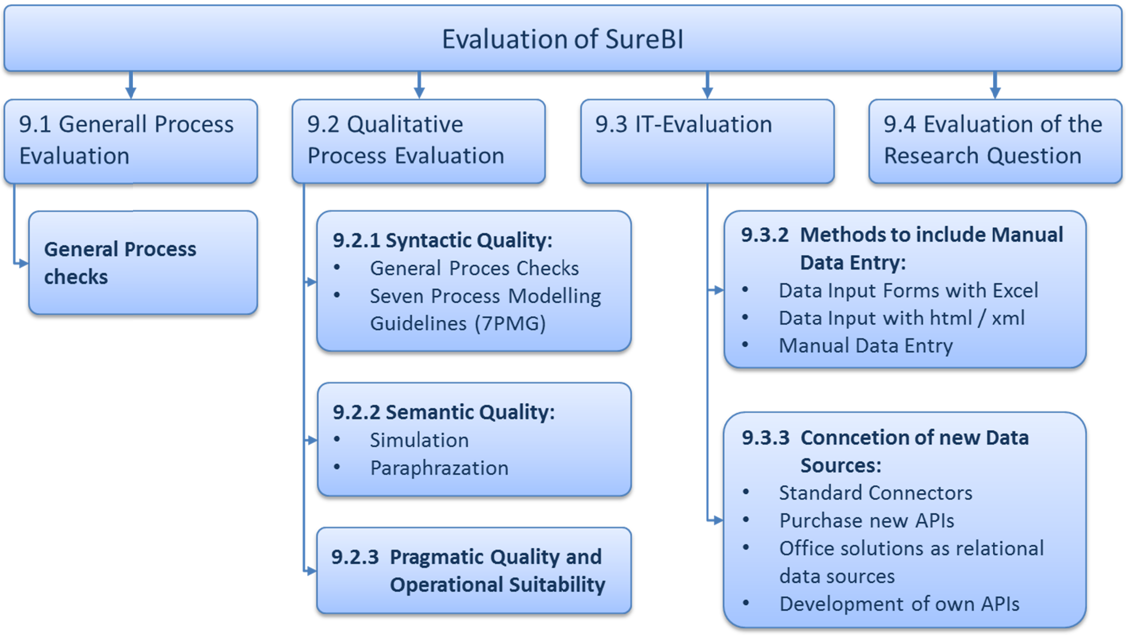


Figure 9.1: SureBI evaluation process

The evaluation of this approach is fourfold. First, the general structure of SureBI is evaluated in section 9.1 using literature. Second, a qualitative evaluation of SureBI is made in section 9.2. The identified qualitative possibilities to evaluate the process model are further described and conducted there. To cover the practical implications of the research, as third part, a partial implementation of crucial IT tasks is done in section 9.3, representing to some extend a kind of prototype. Concluding, as fourth step, the research questions from 2.3 are then addressed and evaluated in 9.4 to prove the goal of the thesis.

Furthermore, a process model can be evaluated quantitatively as opposed to the qualitative evaluation described in the foregoing paragraph. During a quantitative evaluation, each step of the process model is simulated and indicators (for example processing time or elapsed time) are set. This is useful for evaluating, for example, a to-be process in comparison to an as-is process as well as to benchmark the possible improvements resulting from the new process and therefore not included in the evaluation of SureBI.

9.1 General Process Evaluation

Besides the qualitative (see section 9.2) and the IT implementation evaluation (see section 9.3), evaluation techniques introduced in literature, are described within this section.

Generally, a process model should fulfill several objectives, which can be conducted using the following process checks (Posluschny, 2012, p. 162):

1. Improve process performance
2. Ensure goal orientation
3. Ensure unambiguousness and simplicity
4. Discover and resolve modelling errors
5. Identify problems at an early stage
6. Demonstrate development potential

As described in section 2.2, Fettke et al. (2010, pp. 351–352) also describe the effect of a model (or goal-orientation) as one of the minimal requirements for a design oriented model.

Posluschny (2012, pp. 162–163) identifies four process steps which can be used to evaluate a business process and which are generally conducted during the process development:

- Goal-fitting check: Verifies if the process model fits to the goals of the company vision and objectives of the business process.
- Top-Down check: Within this check the start event of the process is utilized to verify the process model.
- Bottom-up check: Contrary to the top-down-check, the last event of the process model is utilized to validate the process model.
- Rule check: This check ensures that the formal design of the process model is based on the notation rules.

Utilizing the goal-fitting check in the context of this thesis, SureBI (see section 8) is aligned to the goal to implement a sustainability reporting system using BI instead of sustainability software solutions (see section 6.14).

The top-down as well as the bottom up check were tested during the development of SureBI (see section 8). Regarding the top-down check, it was analyzed whether the start event of the process, the analysis of current situation, describes the clarification of the objective of the process. As the sustainability reporting process aims to describe an ideal process, valid for various companies from different industry sectors, including various requirements for the resulting sustainability reporting product, a detailed analysis phase (see section 8.5.2) was included which defined both the reporting requirements as well as the IT conditions available. Regarding the bottom-up check, the last process step could be identified as determining if the project conclusion tasks, aimed to ensure that the project through which the process model was guiding, could be properly terminated. The final step could also be identified as the step of informing stakeholders. In the context of this process model, the last process step, the project conclusion tasks, were integrated to support companies which have used this process ones, to collect the experiences of this process loop for the next cycles. The last process check, the rule check, will be further described in section 9.2.

Furthermore, as described in section 2.2, Fettke et al. (2010, pp. 351–352) states that the minimal requirements for design oriented models should be repeatability and impersonality. Repeatability and impersonality are ensured by the derivation of SureBI, based on theoretical and practical frameworks, as well as project experience in a wide field of different companies.

9.2 Qualitative Evaluation of SureBI

Vom Brocke and Rosemann (2010, p. 174) illustrate the SIQ framework (see also Figure 9.2) as an essential guideline to qualitatively evaluate a business process. At the center of the framework, subcategories are highlighted, distinguishing the process model's qualities. These subcategories are syntactic quality, semantic quality and pragmatic quality. Syntactic quality requires that the developed models conform to the rules of the technique that it is modeled with or, in other words, that the syntax of the modeling language is appropriately used. Semantic quality is subdivided into validity and completeness. Validity of the process model means that all statements in the model are properly used and are relevant to the problem the model seeks to address. Completeness means that the business process contains all relevant statements. Vom Brocke and Rosemann (2010, p. 175) further state that the syntactic quality differs from new processes to as-is / to-be models as "*the validity of a model describing an existing situation may obviously be checked more stringently that that of a hypothetical situation*". Pragmatic quality describes the comprehensibility of a project model, so that it "*can be understood by people*" (Vom Brocke and Rosemann, 2010, p. 175).

The wall of checking (Figure 9.2) describes the methods used to achieve syntactic, semantic and pragmatic quality. According to Vom Brocke, the verification of the syntactic quality can be conducted without knowing the real-world process. The verification of the syntactic quality can be distinguished into static and behavioral properties. Static properties relate to the types of elements used in the model and how they are connected. Behavioral properties relate to the termination of the process model. Vom Brocke and Rosemann (2010, p. 176) states, "*a process should never be able to reach a deadlock and that a proper completion should always to be guaranteed*". Summing up, a process should have the option to be completed in any state, it should have a proper completion with no process steps still active, and there should be no tasks in the process that can never be executed. The validation of the semantic quality is distinguished into simulation and paraphrazation. "*A simulation shows the user which paths he can use to navigate through the process, and which decisions have to be made*" (Vom Brocke and Rosemann, 2010, p. 176; Becker *et al.*, 2012, p. 462). Vom Brocke describes paraphrazation as an alternative method to make the model understandable for someone not familiar with the modelling notation. By translating the modelled business process into a natural language (the process description), it can be discussed with a business expert.

The second "wall" of the SIQ framework distinguishes between correctness-by-design, truthful-by-design and understandable-by-design and Vom Brocke outlines several methods to assure the quality of each topic. For example, the 7PMG (seven process modeling guidelines) aim to help validate the pragmatic quality (Vom Brocke and Rosemann, 2010, p. 180).

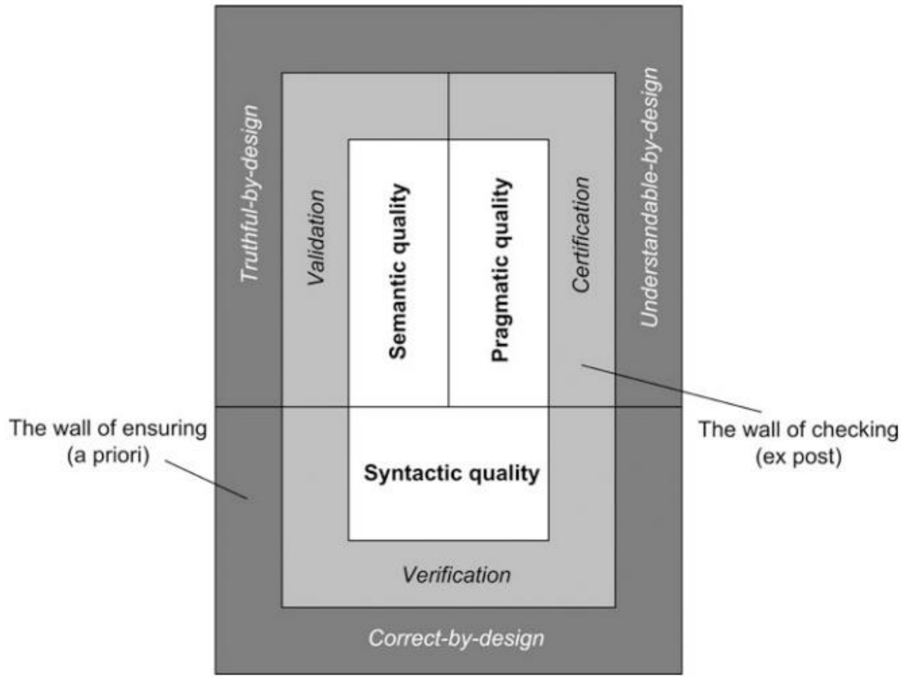


Figure 9.2: The SIQ framework (Vom Brocke and Rosemann, 2010, p. 174)

9.2.1 Syntactic Quality

There are several guidelines which aim to check the syntactic quality of a process model. First, the model should conform to the rules which means that is modelled based on the notation of the respective modelling language. In case of the process model of SureBI (see section 8.4), the BPMN notation is used and verified using literature (Claudia Kocian, 2012) as well as using the official BPMN guide (Object Managment Group, 2014). As a further syntactic quality check, the process model should be valid which means that all statements in the model are properly used and relevant to the problem as well as complete, which means that the business process contains all relevant statements. The validity as well as the completeness are insured by the derivation of the resulting SureBI. Like described in section 8.2, the derivation is based on the IT aspects from the novel reporting process for BI projects (see chapter 5) as well as the content perspective from the conceptual sustainability reporting process (see chapter 7), which both include all tasks, recommended by literature, consulting companies and enhanced with BI project experience. During that modulation, all statements were included and therefore the completeness of the process can be regarded as fulfilled.

A further important validation of the syntactic quality is that a process should never reach a deadlock – a situation whereby any process step is reached without further possibility to proceed further within the process. That is ensured by adding the prioritization loop within the analyze phase (see section 8.4.3), the development of a prototype also within the analyze phase (see section 8.4.3) as well as by adding a detailed validation phase (see section 8.4.4). These additional process steps aim to limit large and cumbersome reporting processes by offering process steps to limit the extension of the project and therefore avoid that a project from being terminated before it passes through the whole process model. Furthermore the proper completion of a process should always be guaranteed. That is ensured by adding the last process step, project conclusion tasks, which help to complete the project and move the project towards submission to the business sponsor and / or management - as well as to collect knowledge from the process to be utilized in the next reporting cycles.

Furthermore, the syntactic quality of a process can be verified by using the seven process modelling guidelines (7PMG) (Mendling *et al.*, 2010), which is done as follows:

- G1: Minimize the number of elements in a model:
  This was done during the development of the process. The resulting process steps represent the minimum number of elements required to implement a sustainability reporting with BI. Furthermore, elements containing various steps, like, for example

the project conclusion tasks which were summarized in the process model (see section 8.5.6) but explained in detail in the process description (see section 8.5)

- G2: Minimize the routing paths per element:

  Here, the process model contains a maximum of two paths per element.

- G3: Use one start and one end event:

  The process model (see section 8.4) contains one start and one end event.

- G4: Model in as structured of a manner as possible:

  This was ensured by referring to general IT project guidelines which define the main process steps.

- G5: Avoid OR routing elements:

  This guideline ensures that XOR routing elements, like used in the process model, are used instead of OR elements and that the process model does not contain any OR element.

- G6: Use verb-object activity labels:

  Inspired by this rule, short descriptions are used in the process model. The detailed description of each process step (see section 8.5) ensures that no essential information is lost.

- G7: Decompose a model with more than 50 elements:

  The process model contains fifty nine elements overall. However, there are seven elements which can be included optionally. Fifty two elements do not conform that rule, but based on the rule for completeness, these additional elements are regarded as essential.

Summing up, the syntactic quality of the process model (see section 8.4) was checked thoroughly. In the next sections, the process model is further evaluated regarding its semantic and pragmatic qualities.

9.2.2 Semantic Quality

Regarding the evaluation of the semantic quality of the introduced SureBI (see section 8.4), there are several methods which strive to verify the semantic quality.

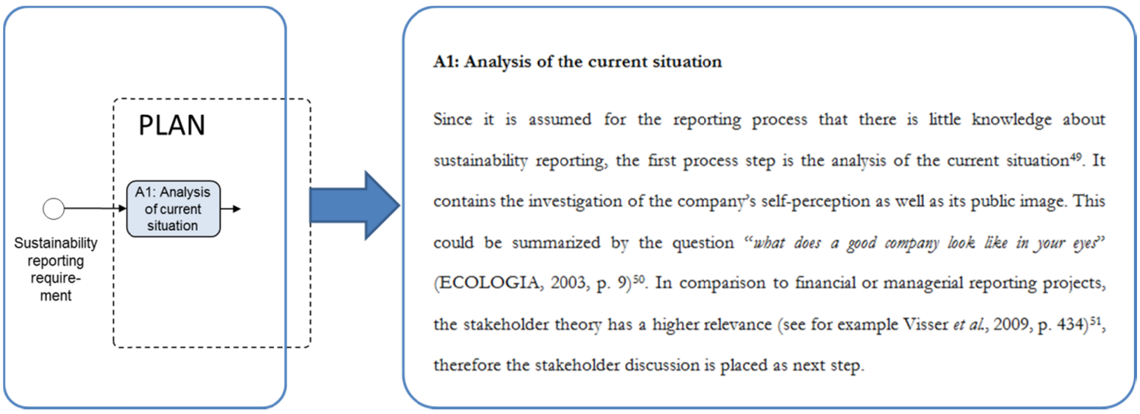
First of all, one possibility is to run a simulation of a process which means that the process is conducted step by step. In this simulation, a company conducts the defined process and measures the elapsed time for each process step and reviews whether all process steps can be conducted and are sufficiently described. In principle, the IT evaluation of distinctive process steps (see section 9.3.1) can be regarded as a partial simulation. Furthermore, the simulation of a process targets companies comparing, for example, the as-is process with a planned to-be process thus evaluating the process improvement. As SureBI represents an ideal-typical process suitable for a wide range of companies, the full simulation of a test-case cannot be conducted within the scope of this thesis.

Another possibility, as previously described in section 9.2, is the paraphrazation of the process model, which is the translation of the modeled business process into a natural language. The detailed process description in section 8.5 can be regarded as paraphrazation. As the modeled process is geared toward established BI reporting processes (see section 5), conceptual sustainability reporting projects (see section 7) as well as IT project management literature, the resulting process itself does not include process steps which can be formally incorrect. The more crucial part of the evaluation is the IT feasibility which is tested in section 9.3.

9.2.3 Pragmatic Quality and Operational Suitability

The pragmatic quality can be described as the comprehensibility of a project model or, in other words, determining if it "*can be understood by people*" (Vom Brocke and Rosemann, 2010, p. 175).

To achieve this comprehensibility in the process model, the first important reference for the receiver are the first chapters, outlining the technical aspects and basic principles of BI (see chapter 3) as well as providing the chapter which gives an overview of relevant sustainability topics (see chapter 6). These introducing chapters aim to help readers from both the IT and sustainability perspective to comprehend process tasks they are not familiar with. Furthermore, within SureBI (see chapter 8), there are additional links to literature, as well references to the chapters introducing the topics BI and sustainability. Finally, a detailed description of each process step should be provided in order to improve the comprehensibility of the process model. As illustrated in Figure 9.3, every process step described within the BPMN notation (in this case A1, see 8.4.2, p. 184) is described in detail (in this case in section 8.5.1).



A1: Analysis of the current situation

Since it is assumed for the reporting process that there is little knowledge about sustainability reporting, the first process step is the analysis of the current situation[49]. It contains the investigation of the company's self-perception as well as its public image. This could be summarized by the question *"what does a good company look like in your eyes"* (ECOLOGIA, 2003, p. 9)[50]. In comparison to financial or managerial reporting projects, the stakeholder theory has a higher relevance (see for example Visser *et al.*, 2009, p. 434)[51], therefore the stakeholder discussion is placed as next step.

Figure 9.3: Relationship between BPMN and detailed process description

Contrary to the detailed process description, the process model (see section 8.4) aims to give an overview of each step needed to fulfill the objective of implementing sustainability reporting with BI. To improve the comprehensibility of the process model, the BPMN notation is extended by using the text annotation element to additionally add a description of the task (if it is not self-explained), methods (which have to be conducted) and additional references for further readings. Furthermore, the list element within the process model represents deliverables of the related process step, illustrating the outputs needed to proceed to the next process step. In the case of the first process steps, as exemplarily illustrated in Figure 9.4, the additional information for the first process step (analysis of the current situation) included the tasks (measuring self-perception and public image), methods (assessment of how a sustainability reporting should look) and references to the text (in this case to section 7.3.1). Furthermore, as deliverable for accomplishing the second process step (stakeholder identification), a list of stakeholders should be developed in order to identify the stakeholder issues within process step three (A3).

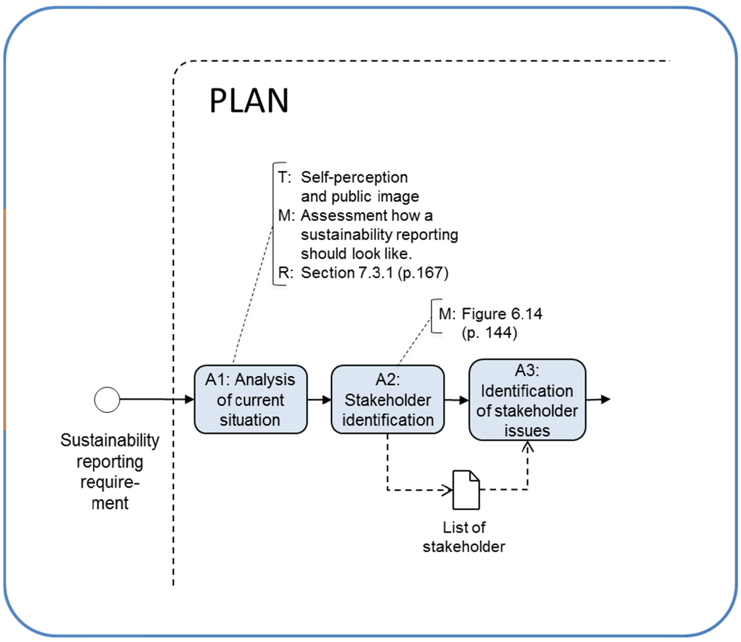


Figure 9.4: Additional information within the BPMN model

Summing up, the pragmatic quality is hard to measure quantitatively. For that, this thesis offers a detailed process description (see section 8.5) as well as a BPMN based process model (see section 8.4) for users familiar with this notation.

9.3 IT Evaluation of SureBI

Since within this PhD thesis an overall implementation of SureBI (see 8.5.4) isn't conducted, the crucial tasks identified (see 9.3.1) as being specific to the implementation of sustainability reporting with BI are exemplarily implemented technically. Therefore, the development phase of SureBI (see 8.5.4) is compared to the development phase of the reporting process for BI reporting projects (see 5.3.4) and the implementation tasks requiring special consideration are derived from there. The derivation of these distinctive implementation tasks is described in section 9.3.1.

The subsequent sub-sections describe each identified development task within the BI system. First, the challenge regarding the task is described using real-world examples and the implementation challenges are stated. Then, the possible implementation solution is exemplarily tested and described using QlikTech. Finally, the proposed solution is discussed and the advantages and disadvantages regarding the operational suitability are assessed.

9.3.1 Identification of distinctive Process Steps

By comparing the development phase of the sustainability reporting process (see 8.5.4) with the development phase of the reporting project of a BI reporting project, the first thing to analyze is the database development. Since BI databases often deal with the integration of qualitative and unstructured data (see 3.6.3), the challenge of integrating sustainability data is within the definition of the data input, including the ETL process (see 3.6.7). BI target databases support the establishment of a data structure where qualitative data can be integrated. Within the sustainability reporting process (see 8.5.4), the first function which has to be implemented exemplarily, is the development of data input forms which are able to integrate qualitative data and data where assumptions are possible. The second task, which is tested in the following sections, is the connection of new data sources which have to be connected when implementing a sustainability reporting using BI.

9.3.2 Methods to include Manual Data Entries

As mentioned previously, this section describes the methods needed to integrate manual data for situations where, for example, assumptions have to be made or where data isn't available in other databases and therefore has to be integrated manually.

Unlike financial BI applications where one objective is not to use BI as a transactional system but rather as a tool to load data from other databases, this is a function of the application in the case of sustainability reporting as described in section 8.4.4. To outline the methods described in the following, the example will be used, that consumption figures (like km driven per vehicle) are available in source systems, but that the average CO2 consumption per vehicle has to be added manually. This example is derived from a project example which the author has conducted.

Data Input forms with Excel

The first example outlined in this section is that the required manual data (the average CO consumption/km/vehicle) must be added manually. In the following Figure 9.7 represents the manual data entry form, while Figure 9.5 and Figure 9.6 represent data loaded from other source systems.

CO2-calculation-transportation_id.xlsx

	A	B	C
1	ID	Transportation	
2	1	Car	
3	2	Bus	
4	3	Train	
5	4	Plane	
6			

Figure 9.5: Table CO calculation transportation ID

CO2-calculation-total_km.xlsx

	A	B	C
1		Total km	
2	Car	1200000	
3	Bus	230000	
4	Train	2400000	
5	Plane	18900	
6			

Figure 9.6: Table CO2 calculation totals

CO2-calculation-average-CO2.xlsx

	A	B	C
1	ID	Average CO2 / km / kilogram	
2	1	0,16	
3	2	0,02	
4	3	0,04	
5	4	0,38	
6			

Figure 9.7: Table manual data entry average CO2 / km / kg

When xls files have to be integrated within QlikView, the first step is to set up the load process in the Qlikview application. In the case of QlikView, this is done by using a QlikView developed script language as shown in Figure 9.8. Regarding QlikView, this script mode can be regarded as ETL process (see section 3.6.7), where besides the loading process, further transformation routines also can be implemented.

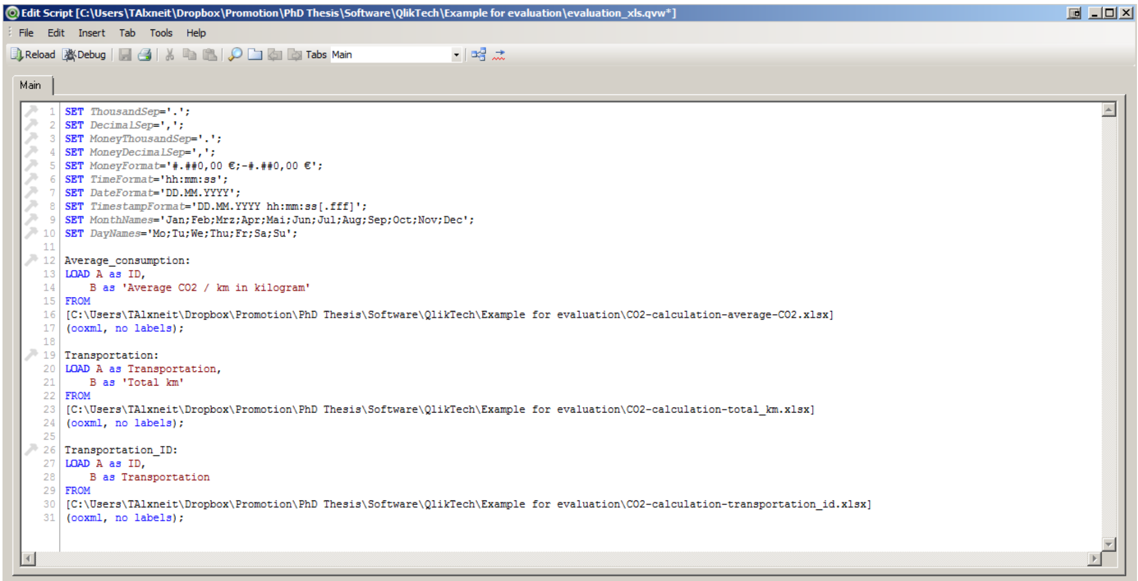


Figure 9.8: QlikView excel load script

After the loading script is developed and the data is reloaded, the data from the exemplary tables (see Figure 9.5, Figure 9.6 and Figure 9.7) is available within the QlikView system.

In the QlikView application, the last process step can be checked by viewing the table view option within the application. Figure 9.9 illustrates the loaded excel tables and the connected IDs within the tables (ID and Transportation). As seen in Figure 9.9, this view does not reflect a formal data relationship model, as is often used when illustrating the relations between database tables. But Qlikview offers an additional possibility. When the mouse is hovered over the database, database consistency and the keys are checked and displayed.

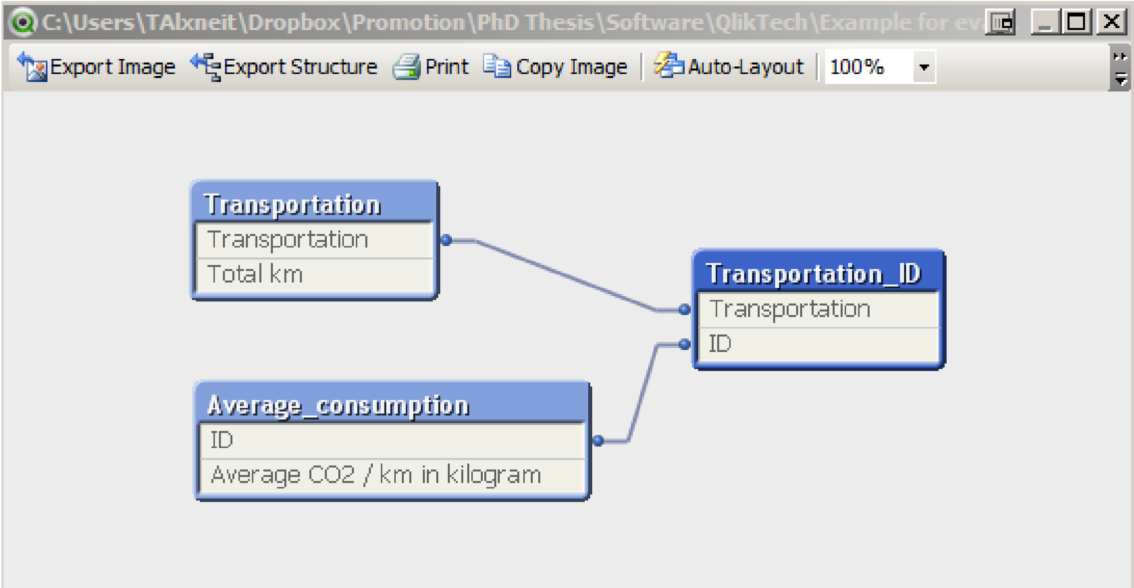


Figure 9.9: Excel data load table view

The next steps describe the setup of a simple reporting example utilized in order to further process the data loaded into the QlikView data repository. A new chart object is placed on the QlikView workbench and within the properties of the chart, a new expression is defined by multiplying the total km with the average CO2 consumption data and added manually by a user (see Figure 9.7). A screenshot of this is shown in Figure 9.10.

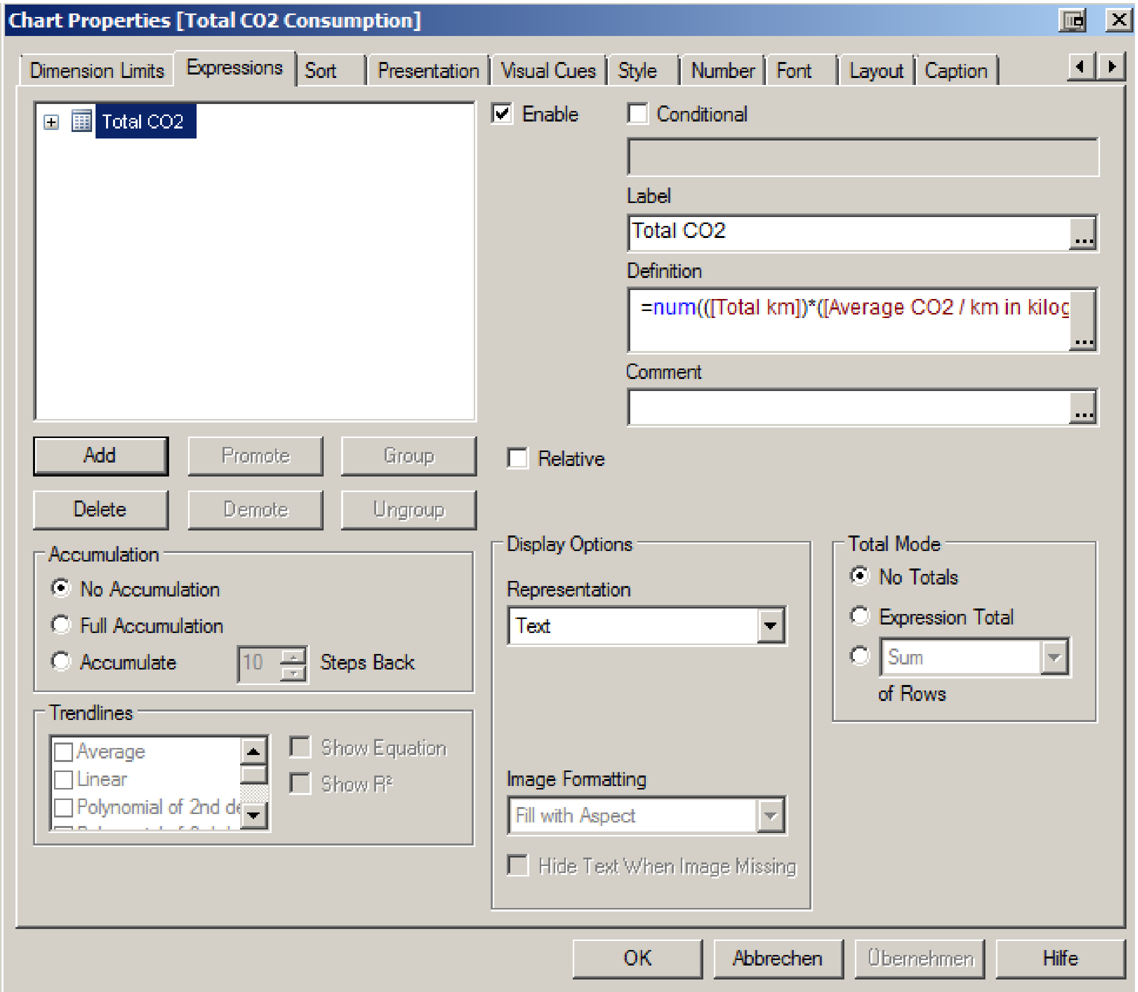
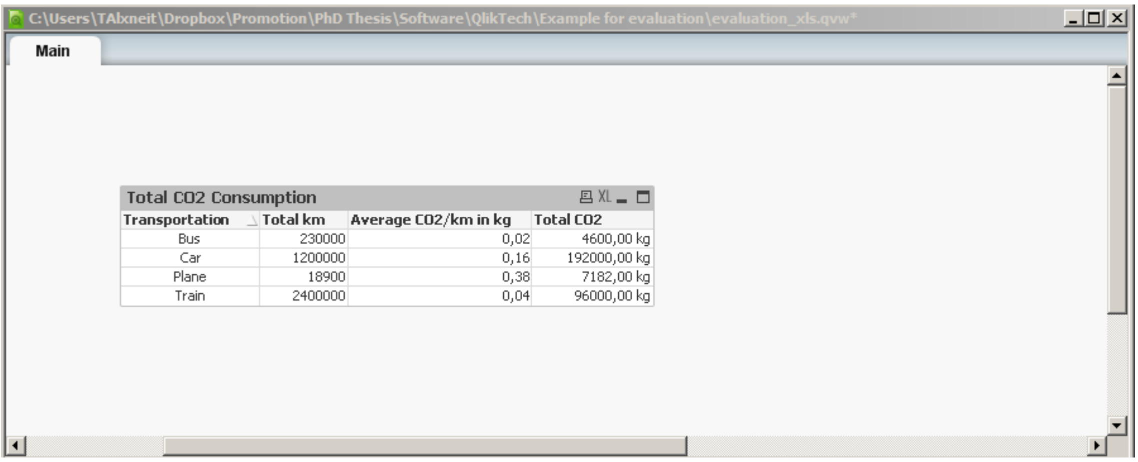


Figure 9.10: QlikView chart expressions

The result, as shown in Figure 9.11, is a simple reporting product. Within this example, the average CO2/km in kg (see Figure 9.7) is multiplied with the total km per vehicle (see Figure 9.6) and the total CO2 is shown per vehicle.



Transportation	Total km	Average CO2/km in kg	Total CO2
Bus	230000	0,02	4600,00 kg
Car	1200000	0,16	192000,00 kg
Plane	18900	0,38	7182,00 kg
Train	2400000	0,04	96000,00 kg

Figure 9.11: Report example QlikView

Since many companies rely on Excel when establishing their sustainability reporting (see Figure 6.18), this option offers the possibility to make the sustainability reporting more reliable, to make it a process where each step is comprehensible, and where data consistency can be checked and calculations are completed within one software solution. Furthermore, the Excel files for manual data entry can be distributed to the responsible data accounts and ensured by encryption of the Excel files. A possible disadvantage can be the revision control of the Excel files. This disadvantage could be alleviated by adding version data to the Excel files.

Data Input with html / xml

A further possibility when integrating manual data using QlikView is the integration of web data. Figure 9.12 outlines a simple web-form where the average consumption per vehicle can be entered and submitted.

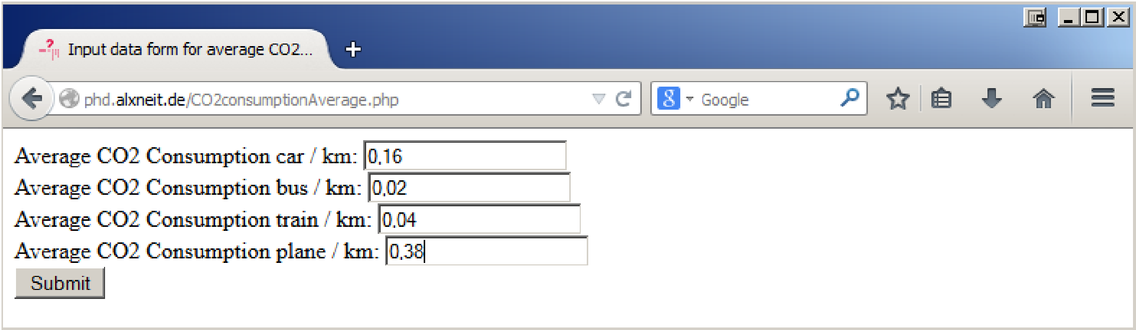


Figure 9.12: Data input web form

The simple web form is build using html and php as described in Figure 9.13.

```
<?php
  if (isset($_POST) && isset($_POST['average1']))
    {
      $id[1] = htmlspecialchars($_POST['id1']);
      $average[1] = htmlspecialchars($_POST['average1']);
      $id[2] = htmlspecialchars($_POST['id2']);
      $average[2] = htmlspecialchars($_POST['average2']);
      $id[3] = htmlspecialchars($_POST['id3']);
      $average[3] = htmlspecialchars($_POST['average3']);
      $id[4] = htmlspecialchars($_POST['id4']);
      $average[4] = htmlspecialchars($_POST['average4']);

      // CO2consumption as the root node.
      $node = new SimpleXMLElement('<CO2consumption></CO2consumption>');

      $n=1;
      while ($n < 5)
      {
        $subnode = $node->addChild('Transportation');
        $subnode->addChild('id', $id[$n]);
        $subnode->addChild('average', $average[$n]);
        $n++;
      }

      // Export the node to an XML string.
      $xml = $node->asXML();

      // Write the XML string to file.
      file_put_contents('CO2consumption.xml', $xml);
    }
    $xml = simplexml_load_file('CO2consumption.xml');
?>

<html>
  <head>
    <title>Input data form for average CO2 consumption figures</title>
  </head>
  <body>
    <form action="" method="post">
      Average CO2 Consumption car / km:
      <input type="hidden" name="id1" value="1"></input>
      <input name="average1"></input>
      </br>
      Average CO2 Consumption bus / km:
      <input type="hidden" name="id2" value="2"></input>
      <input name="average2"></input>
      </br>
      Average CO2 Consumption train / km:
      <input type="hidden" name="id3" value="3"></input>
      <input name="average3"></input>
      </br>
      Average CO2 Consumption plane / km:
      <input type="hidden" name="id4" value="4"></input>
      <input name="average4"></input>
      </br>
      <input type="submit" value="Submit">
    </form>
  </body>
</html>
```

Figure 9.13: Web form source file

The html part describes the data form and by clicking submit, the php part of the code saves the post transmitted values into an xml structure, described in Figure 9.14.

```
- <CO2consumption>
  - <Transportation>
      <id>1</id>
      <average>0,16</average>
    </Transportation>
  - <Transportation>
      <id>2</id>
      <average>0,02</average>
    </Transportation>
  - <Transportation>
      <id>3</id>
      <average>0,04</average>
    </Transportation>
  - <Transportation>
      <id>4</id>
      <average>0,38</average>
    </Transportation>
  </CO2consumption>
```

Figure 9.14: XML structure of web form

The xml data can then be processed within QlikView using the script language of the QlikView ETL functionality again. In this example, the xml file is loaded directly from the web address into the database. The script code of this loading process is shown in Figure 9.15.

```
SET ThousandSep='.';
SET DecimalSep=',';
SET MoneyThousandSep='.';
SET MoneyDecimalSep=',';
SET MoneyFormat='#.##0,00 €;-#.##0,00 €';
SET TimeFormat='hh:mm:ss';
SET DateFormat='DD.MM.YYYY';
SET TimestampFormat='DD.MM.YYYY hh:mm:ss[.fff]';
SET MonthNames='Jan;Feb;Mrz;Apr;Mai;Jun;Jul;Aug;Sep;Oct;Nov;Dec';
SET DayNames='Mo;Tu;We;Thu;Fr;Sa;Su';


Transportation:
LOAD A as Transportation,
    B as 'Total km'
FROM
[C:\Users\TAlxneit\Dropbox\Promotion\PhD Thesis\Software\QlikTech\Example for evaluation\CO2-calculation-total_km.xlsx]
(ooxml, no labels);

Transportation_ID:
LOAD A as ID,
    B as Transportation
FROM
[C:\Users\TAlxneit\Dropbox\Promotion\PhD Thesis\Software\QlikTech\Example for evaluation\CO2-calculation-transportation_id.xlsx]
(ooxml, no labels);

// Start of [CO2consumption.xml] LOAD statements
Average_CO2_Consumption:
LOAD id as ID,
    average as 'Average CO2 / km in kilogram'
FROM [http://phd.alxneit.de/CO2consumption.xml] (XmlSimple, Table is [CO2consumption/Transportation]);
// End of [CO2consumption.xml] LOAD statements
```

Figure 9.15: Data load script for web xml data

Again, like in the foregoing example, the loaded data can be verified by using the table view functionality of QlikView (see Figure 9.16).

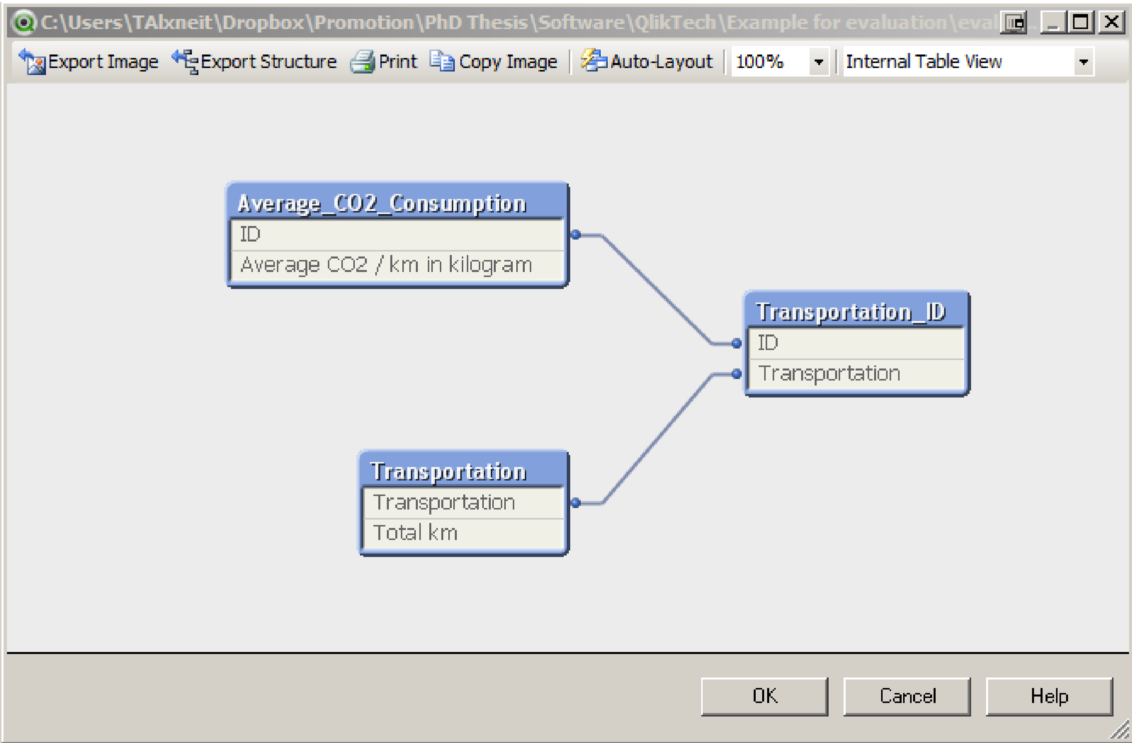


Figure 9.16: Database view for xml data

As the last step for this example, the chart utilized in the Excel example can be used to show a simple report outlining the total CO2 per vehicle (see Figure 9.17).

Total CO2 Consumption

Transportation	Total km	Average CO2/km in kg	ID	Total CO2
Bus	230000	0,02	2	4600,00 kg
Car	1200000	0,16	1	192000,00 kg
Plane	18900	0,38	4	7182,00 kg
Train	2400000	0,04	3	96000,00 kg

Figure 9.17: Sample reporting product for xml data input

The described method is also a good example for combining survey data (for example, in the case of employee satisfaction surveys). The advantage of this method is that mass-data from various sources (ex. Employees) can be integrated. One disadvantage of this method is that, compared to the Excel integration, further IT know-how is required to set up the web-form. Also, when distributing a web-form for entering manual data, further security aspects have to be considered in order to, for example, prevent the hacking of the website.

Manual data entry:

One further possibility to integrate manual data is to implement data input forms within the reporting software. In the case of QlikView, as the first step, it has to be defined within the loading script that besides the loaded data an additional input field is required (see Figure 9.18).

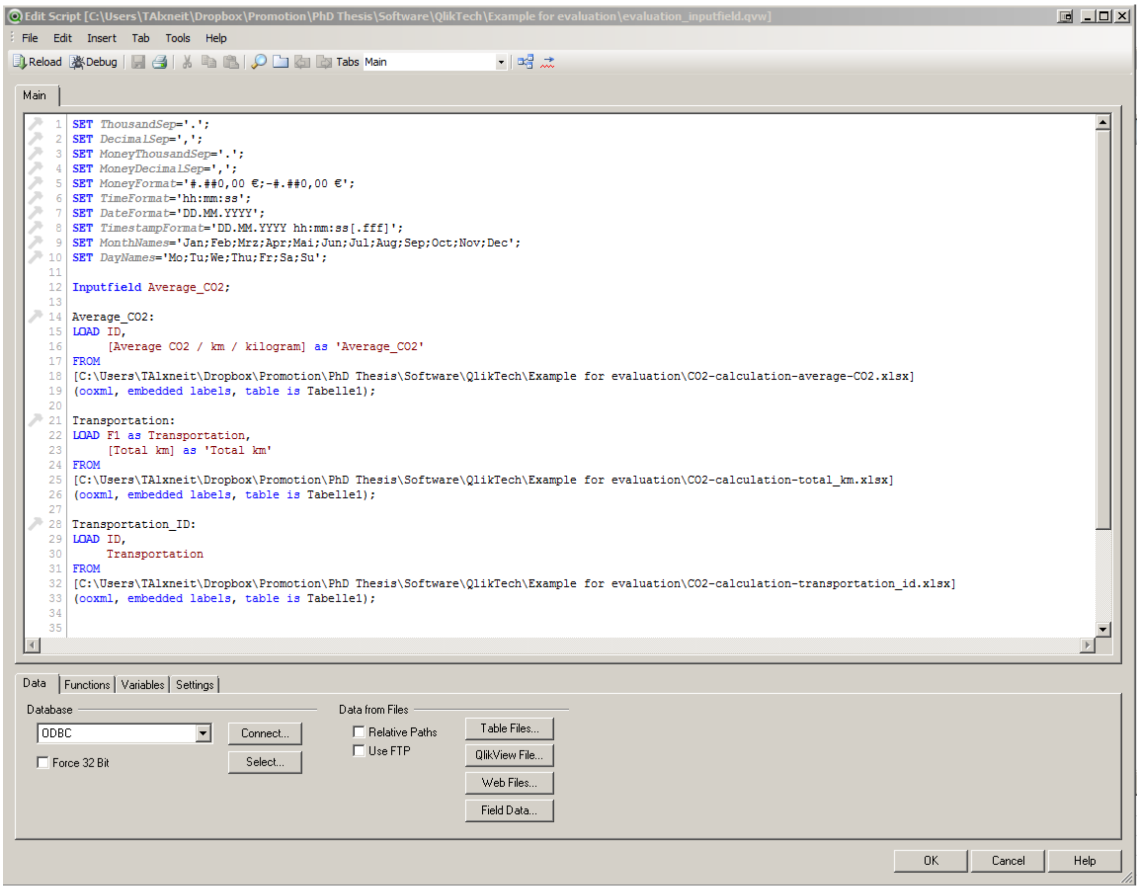


Figure 9.18: Script for data input forms

Next, the input field is defined within the expressions of the chart properties. Therefore, like shown in Figure 9.19, a new variable (Average CO2 / km in kilogram) is assigned to the input field. This variable is then used to calculate the Total CO2.

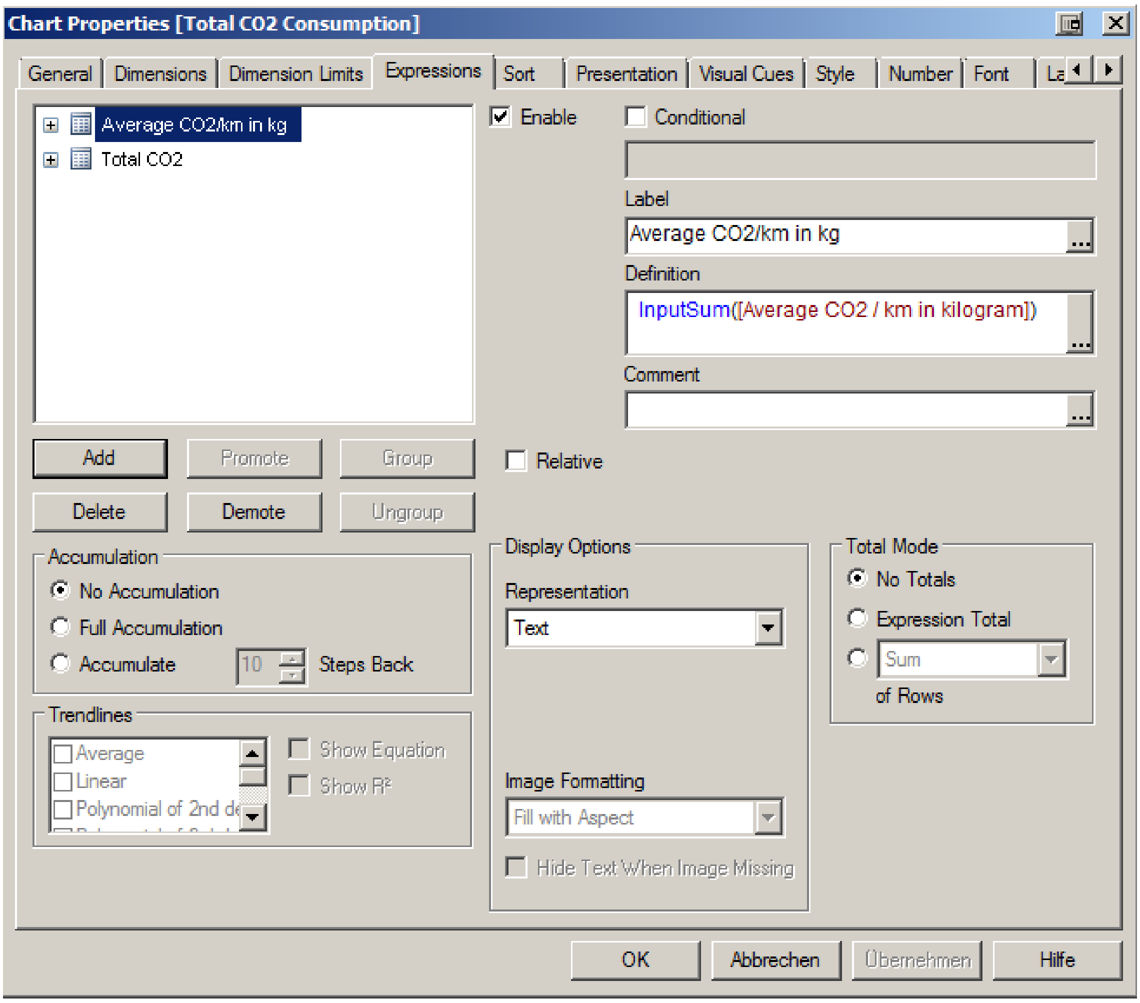


Figure 9.19: Input field properties

As shown in Figure 9.20, the values for the average CO2/km can be entered within the table. The total CO2 is then calculated automatically. In order to outline the operational suitability, a new button "save manual data entry" is included.

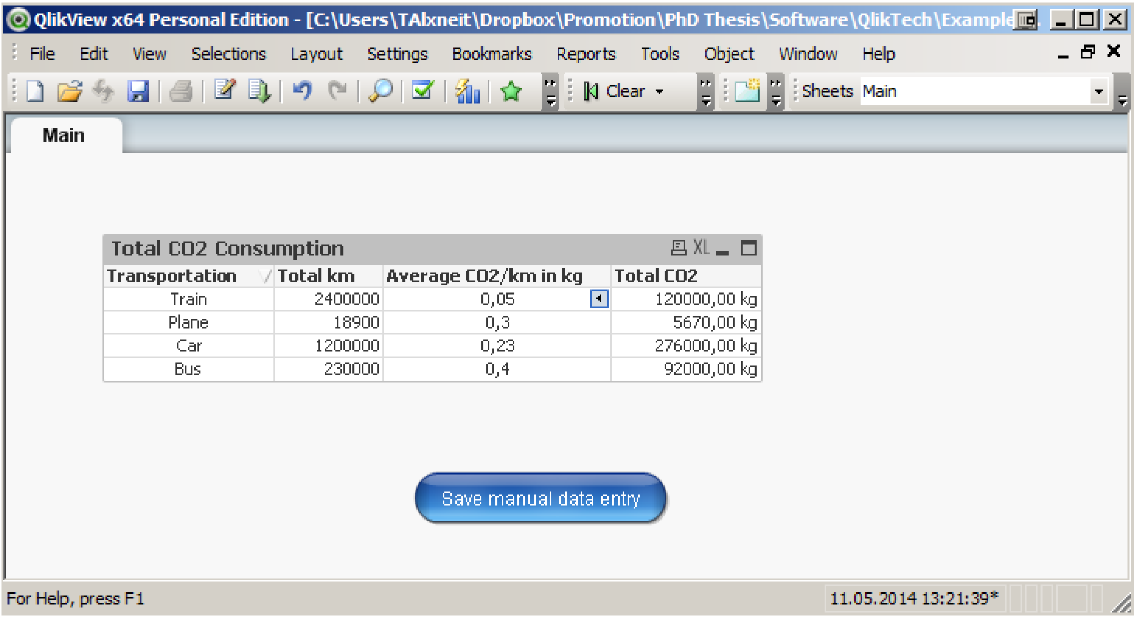


Figure 9.20: Reporting product including manual data

The purpose of this button is to save the manually entered values to an Excel file. Therefore, as shown in Figure 9.21, a VBScript can be used to open a new instance , begin in the next empty row and save the output of the whole chart in the Excel file.

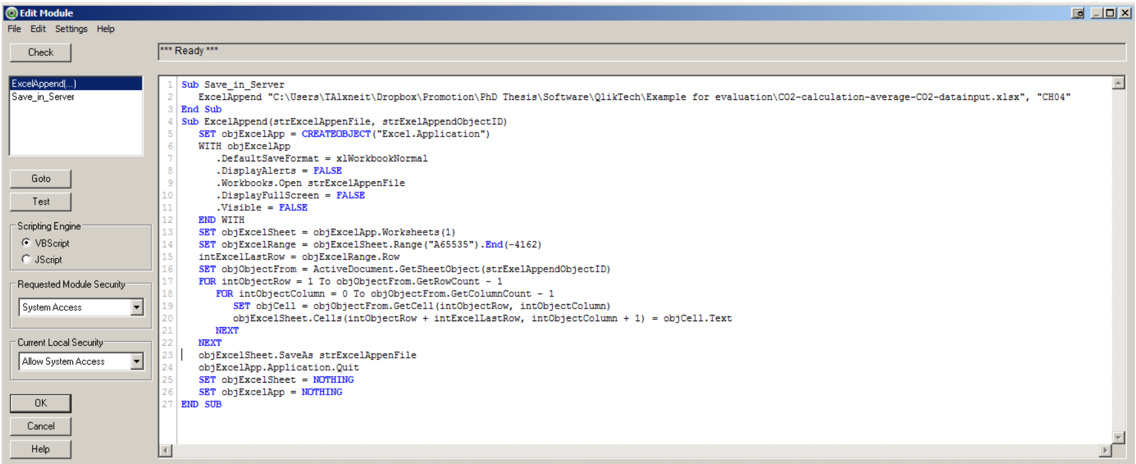


Figure 9.21: VBScript for saving manual data to excel

The resulting xls file (see Figure 9.22) shows the automatically saved data within one excel file.

CO2-calculation-average-CO2-datainput.xlsx

	A	B	C	D	E
1	Total CO2 Consumption				
2	Transportation	Total km	Average CO2/km in kg	Total CO2	
3	Train	2400000	0,04	96000,00 kg	
4	Plane	18900	0,3	5670,00 kg	
5	Car	1200000	0,23	276000,00 kg	
6	Bus	230000	0,4	92000,00 kg	
7					

Figure 9.22: Excel file showing the automatic saved input data

The main advantage of this option is that data to manipulate the output data can be added at the end of the whole reporting process. However, this could only be done by the person responsible for the reporting product as it has to be included in the reporting frontend of the BI tool. A disadvantage is that revisability of this method is difficult to achieve since, as data in the outlined basic example would have to be modified to include data such as who changed the data and a version control. Furthermore, employee(s) with additional IT skills (in this case VBScript) have to be available within the company.

9.3.3 Connection of new Data Sources

There are a great deal of possibilities to connect new data sources to the BI solution which are described in the following.

Standard connectors

Every BI solution offers standard connectors which can be used "out-of-the-box" to connect new data sources.

In the case of QlikView, Figure 9.23, illustrates the databases which can be easily connected.

Actian Vectorwise	IBM DB2	ParAccel
Amazon EC2	IBM Netezza	ParStream
Amazon Redshift	IBM (Lotus) Notes	PostgreSQL
Aster Data nCluster	Infor Lawson	Progress OpenEdge
Cloudera Hadoop Hive	Intuit QuickBooks	Sage 500
Cloudera Impala	Informatica Powercenter	Salesforce
CSV	MapR	SAP
DataStax	MicroStrategy	SAP HANA
Epicor Scala	Microsoft Access	SAP NetWeaver Business Warehouse
EMC Greenplum	Microsoft Dynamics NAV (Navision)	Siebel
Firebird	Microsoft Excel	Sybase ASE
Google BigQuery	Microsoft SharePoint	SybaseIQ
Hortonworks Hadoop Hive	Microsoft SQL Server	Teradata
HP Vertica	MySQL	Web pages
	OData	XML
	ODBC	
	Oracle	
	Oracle Hyperion	
	Oracle JD Edwards	
	Oracle Peoplesoft	

Figure 9.23: QlikView standard connectors

Purchase new application programming interfaces (APIs)

Another option is to buy new connectors which are available for many BI solutions.

In the case of QlikView, the company QVSource (2014) sells new APIs, whereby new data sources, like for example the integration of google analytics or Facebook fan-pages can be realized.

Office solutions as relational data sources

Another method, partially described in the foregoing section is to use Excel as a relational data source for the integration of large amounts of data. With QlikView, the connection to the Excel data can be actualized every time. This could be used, for example, to integrate statistical data from external providers See for example (European Environment Agency, 2015). Furthermore, QlikView enables the connection of MS Access through its ODBC interface, provided by QlikView.

Development of own APIs

An additional possibility to connect new data sources is the development of new APIs. The connection of the German Federal Office of Statistics database (Statistisches Bundesamt, Wiesbaden, 2014) using QlikView is illustrated below. The database allows users to directly connect to the database through a URL, as shown in Figure 9.24. Within that URL, login data (like username and password), the table to be downloaded (in this case 91111-0001), and further attributes like download format (csv) and the reporting period (in this case from 1995 till 2012) are included.

```
https://www-genesis.destatis.de/genesisWS/web/ExportService_2010?method=TabellenExport
&kennung=USERID&passwort=PASSWORD&namen=91111-0001&bereich=Alle&format=datencsv
&strukturinformation=true&komprimieren=true&transponieren=false&startjahr=1995&endjahr=2012
&zeitscheiben=&regionalmerkmal=&regionalschluessel=&sachmerkmal=&sachschluessel=&sachmerkmal2=
&sachschluessel2=&sachmerkmal3=&sachschluessel3=&stand=&auftrag=false&sprache=de
```

Figure 9.24: Database connection URL

The resulting xml output delivers a structured xml file with csv data within the “tabellenDaten” element (see Figure 9.25). The exemplary dataset represents several sustainability indicators published by the German Federal Office of Statistics.

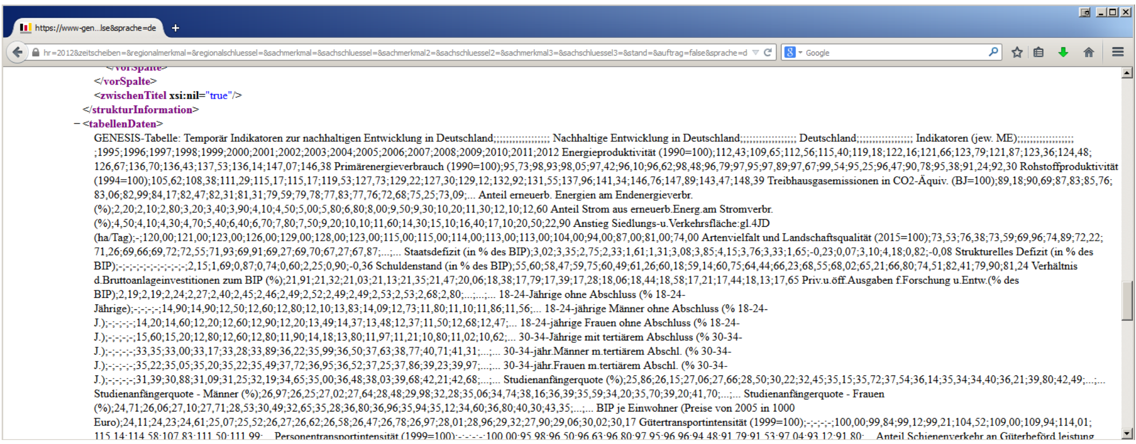


Figure 9.25: DeStatis xml output

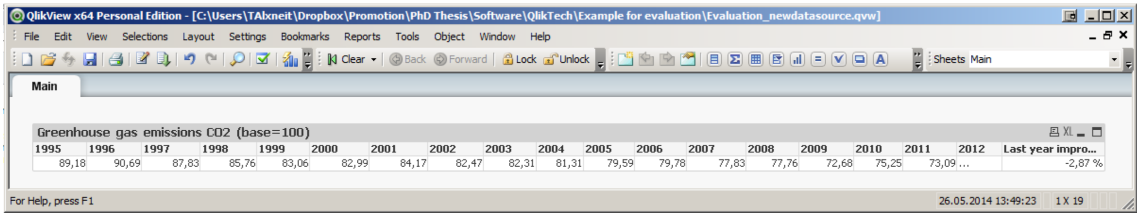
After the download URL is defined, this URL can be added into the loading script of QlikView (see Figure 9.26). Since the resulting data is comma separated value (CSV), only a few further definitions, like designation of column titles, the header size and the characters uses (in this case UTF-8) must be made. Furthermore, an additional where-clause limits the results to the indicator greenhouse gas emissions.


```
Envelope:
LOAD
    [Body/TabellenExportResponse/TabellenExportReturn/tabellen/tabellen/tabellenDaten] as tabledata
FROM [https://www-genesis.destatis.de/genesisWS/web/ExportService_2010?method=TabellenExport&kennung=GK106337&passwort=qP2yW6E6&namen=91111-0001&ber
Results:
FIRST 52 LOAD @1 as Titel,
     @2 as [1995],
     @3 as [1996],
     @4 as [1997],
     @5 as [1998],
     @6 as [1999],
     @7 as [2000],
     @8 as [2001],
     @9 as [2002],
     @10 as [2003],
     @11 as [2004],
     @12 as [2005],
     @13 as [2006],
     @14 as [2007],
     @15 as [2008],
     @16 as [2009],
     @17 as [2010],
     @18 as [2011],
     @19 as [2012]
FROM_FIELD
(Envelope, tabledata)
(txt, utf8, no labels, delimiter is ';', msq, header is 6 lines)
WHERE @1 = 'Treibhausgasemissionen in CO2-Äquiv. (BJ=100)';

Drop Tables Envelope
```

Figure 9.26: QliKView loading script for direct import

After the reload of the data, the data can be displayed in Qlikview, like shown in Figure 9.27.



1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Last year impro...
89,18	90,69	87,83	85,76	83,06	82,99	84,17	82,47	82,31	81,31	79,59	79,78	77,83	77,76	72,68	75,25	73,09	...	-2,87 %

Figure 9.27: Result of new data source connection

The foregoing example aims to clearly outline how to connect to new external data sources. The advantage of this example is that data can be reloaded directly from the German Federal Office of Statistics without downloading new files every year and being required to import them.

Both section 9.3.2 and section 9.3.3 aim to outline possibilities to integrate manual data as well as connect new data sources. Although this is often done in BI reporting projects, the goal of this work is to combine both the IT and business perspective and therefore outlines the creativity needed for a sustainability reporting implementation using BI.

9.4 Evaluation of the Research Question

The research question, defined in section 2.3 were further divided tripartite in theory-based, process-based and case study-based research questions so the overall research question could be derived from these research questions. These research questions and the derived overall research question are evaluated within this section.

1. Theory-based research questions:

1a) Which are the triggers and requirements for the realization of BI reporting projects (from an IT implementation perspective)

Initially, the theoretical BI background was researched in chapter 3, as well as the structure of a BI project and its organizational inclusion in chapter 4.

Derived from this theoretical background, as well as frameworks from literature and consulting companies, a BI reporting process was developed in chapter 5. This reporting process focused on the IT aspects of the reporting process, that is, among others, the set-up of the databases, the ETL process as well as the reporting environment. As described in chapter 4, many BI projects are not conducted from the ground up, so mainly BI projects are conducted in historically grown systems. The initiation of these projects can originate from the IT department but also from finance or controlling departments or through management requirements (see also section 4.2). The requirements for conducting BI reporting are both from IT, described in chapter 3 and from project control, described in chapter 4.

1b) Which are the triggers and requirements for the realization of sustainability projects (from a conceptual / content-based perspective)

Analogous to the development of the BI reporting process, in the case of sustainability the theoretical background was researched in chapter 6 and the first triggers and requirements for the realization of a sustainability reporting project were defined. Compared to the developed BI reporting process, the sustainability reporting process is geared to sustainability guidelines (see section 6.13), since they represent a framework for the mostly voluntary sustainability reporting. Because of a shortage of literature regarding the IT implementation of sustainability reporting as next step a sustainability reporting process was developed, focusing on the content of this reporting and the required project tasks. Triggers for sustainability reporting projects could be both internal or external, where external triggers could be the improvement of the public reputation and internal motivation could be of a monetary manner, for example to reduce energy efforts (see section 6.3). Furthermore, more and more regulatory requirements can arise, forcing companies to report on special sustainability figures (see section 6.4).

1c) What do these triggers and requirements (1a and 1b) have in common and what are the differences?

Through the development of both reporting processes a comparability was ensured as basis for SureBI (see chapter 8). This methodology, describing the implementation of a sustainability reporting with BI, outlines the characteristics of the novel reporting process such as the addressing of new stakeholders or the handling of crucial IT implementation tasks. The comparability of the triggers of both kinds of reporting is ensured by the definition of the BI project (see section 5.1) as well as the sustainability reporting project (see section 7.1). The differences between the requirements for a sustainability reporting project compared to a BI project are that it can be assumed that in case of a sustainability reporting project, much of the data isn't available and has to be connected through the reporting process. This requirement was considered when modelling SureBI.

The process-based research questions were handled simultaneously to the theory-based research questions.

2) Process-based research questions

2a) Which approaches for the IT implementation of sustainability-reporting with BI are currently developed?

Section 1.4 preliminarily discusses the topics of sustainability, sustainability reporting and BI with various perspectives considered providing a somewhat superficial approach due to the lack of literature addressing the topic. From a content perspective, however, there are several consulting companies and NGOs which were used to describe the conceptual implementation of sustainability reporting. These were used for the description of the process in chapter 7.

2b) What does a sustainability -reporting implementation look like?

The lack of literature, as well as the voluntary obligation to report sustainability can be regarded as two main challenges. As described above, several frameworks were used to achieve comparability with the BI reporting process (see chapter 5) and to develop a reporting process (see chapter 7). The objective of the sustainability reporting process was to model a general approach, including several sustainability guidelines (see section 6.13) and how to implement these guidelines. At the same time, methods were derived describing how to choose the appropriate guideline and how to prioritize the reporting content. The answer to that research question is the modelled sustainability reporting process in chapter 7.

3) Case study-based research questions

The case study based research questions describe to what extent a prototype was used to exemplarily implement SureBI.

3a) What challenges does this implementation approach outline?

The particular challenges were mainly worked out through the development of SureBI. One main particularity of the new process model is that new stakeholder have to be addressed throughout the reporting process. Furthermore, the SureBI process emphasizes the few legal requirements and how companies conducting this reporting process can evaluate and prioritize existing sustainability guidelines. Apart from that, these few legal requirements lead to a high amount of estimation figures within the reported KPIs. From this, the distinctive process steps were derived, evaluated and implemented prototypical in section 9.3. From an IT perspective, as already described, one main difference is that many new data sources have to be connected as well as the integration of estimated figures. Both can be integrated using the methods described in section 9.3.2.

3b) To what extent can sustainability -reporting be implemented with this reporting process using QlikTech?

QlikTech was chosen as the solution to implement crucial IT tasks, since QlikView offers an intuitive ease of use as well as a flexible license scheme. The prototypical implementation in this context is done exemplarily to show that the identified distinctive process steps can be conducted with a BI solution. It must be assumed that the described tasks can be conducted with any other BI solution (see Figure 3.23 as well). The exemplary implementation, therefore, cannot be regarded as a unique proposition but aims instead to demonstrate that the implementation of sustainability reporting with BI involves creativity and partly a manual effort. However, it can be assumed, that a sustainability reporting can be implemented using BI instead of dedicated sustainability software solutions.

Overall research question: How to support companies willing to implement sustainability reporting with BI?

Since there is very little literature combining the two topics of sustainability reporting and BI, SureBI aims to help companies to implement sustainability reporting with BI, with a structured process helping to achieve the implementation within a project.

Therefore, as described in the foregoing, the two topics of sustainability reporting and BI were worked up in a structured manner by developing a comparable BI reporting process (see chapter 5) and a conceptual sustainability reporting process (see chapter 7). Based on that, SureBI was developed.

Generally, SureBI targets experts from both the sustainability and BI fields. Furthermore the SureBI chapter is twofold, a short reference using the BPMN notation to provide SureBI at a glance (see section 8.4) as well as a detailed process description (see section 8.5).

Both forms of representation include the project tasks, references to the text and to further literature, as well as useful methods and the transitions of each tasks and their deliverables.

9.5 Conclusion

This chapter provided a conceptual and prototypical evaluation of SureBI in place of a practical implementation of the overall process. Again, the practical implementation of this process isn't possible within the scope of this thesis, as this thesis outlines an ideal process and the real implementation of such a project, like every BI reporting process, involves various employees and high expenditures.

As described in section 9.1, during the modelling phase, the rules on how to model such a business process were observed. Furthermore, section 9.2 described the several methods that were conducted to ensure the quality of the process regarding the syntactic, semantic and pragmatic quality. Section 9.3 outlined several options to steer clear of the difficulties of implementing non-financial data into BI systems. Finally, section 9.4 evaluates the research question defined in section 2.3.

10 CONCLUSION

This chapter provide an overall conclusion by giving an overview and conclusion to this work. Section 10.1 summarizes the aims of the work. Section 10.2 provides an overview of the achievements researched within this thesis. The limitations of SureBI and the context of sustainability reporting with BI are outlined in section 10.3. Section 10.4 describes further possibilities of research within this new field of sustainability reporting with BI. Concluding section 10.5 provides a general outlook on the topic of sustainability reporting with BI.

10.1 Aims of the Research

This thesis represents one of the first examples of sustainability reporting within the context of BI. A reporting process was developed, illustrating a step-by-step guide (see chapter 8) helping companies to implement a reporting project with the objective to report on sustainability indicators. Since this combination of the two topics, including an implementation approach, is new in literature, both topics were developed thoroughly. The aim was to provide a common basis for experts from both disciplines. Therefore, a BI expert can focus more on the topics of sustainability (see chapters 6-7) whereas the sustainability expert with minor IT experience can focus on the BI aspect (see chapters 3-5) of this thesis. In detail, section 1.4 illustrates that there is little literature combining sustainability reporting with BI and therefore Business Intelligence was further investigated in chapter 3, focusing mostly on BI functions, existing BI models, the basic principles every BI system implies, as well as what current BI software providers offer. Furthermore, in section 3.8, an outlook of the future of BI systems was shown in order to further analyze the current state of the art of BI. Unlike chapter 3 which focuses more on the IT aspects of BI, chapter 4 concentrates more on how BI projects are conducted within a company. This was done to establish the basis for the novel reporting process for BI reporting projects in chapter 5. Although there are many BI process models, this new one was developed to make it comparable to the subsequent sustainability reporting process. Current reporting processes for BI projects typically either focus on the new setup of a BI system or are quite superficial, only describing the main process steps, disregarding the single tasks, deliverables etc. Following chapter 6, a thematic shift is done guiding the reader to the sustainability topic. This is done to address each topic adequately to meet the demands of the respective experts as described earlier. Chapter 6 introduces the topic of sustainability beginning from a conceptual point of view and provides the basis for the conceptual sustainability reporting process in chapter 7. As in the case of the novel reporting process for BI (chapter 5), there are already process models which describe a sustainability reporting process. To make the sustainability reporting process (chapter 7) comparable with the BI reporting process (chapter 5), prominent approaches were used, describing the content perspective of a sustainability reporting process on an equally profound level like the BI reporting process (chapter 5). Based on the BI reporting process from chapter 5 and the sustainability reporting process from chapter 7, the main contribution of this thesis, the novel SureBI (chapter 8) was also modeled based on the conceptual preparatory work regarding BI (chapter 3, 4) and sustainability (chapter 6). Since the proposed SureBI represents an ideal process appropriate for a wide range of companies using various BI systems, the proposed reporting process could not be tested entirely within the scope of this thesis. Because of this, chapter 9 outlines various possibilities to evaluate the to-be process model which are also conducted within chapter 9. In addition to qualitative evaluation methods, the most crucial tasks of the implementation of a sustainability reporting using BI solutions was, furthermore, tested in section 9.3.

10.2 Achievements of the Research

New knowledge discovered within this thesis is both from a conceptual as well as an IT perspective. From the conceptual perspective, this thesis reconfirms that the GRI guidelines could be deemed as the de-facto standard for sustainability reporting and that these guidelines serve quite well for a BI implementation since the GRI supports partial implementation of a sustainability reporting and also supports the reader with considerable documentation. As the proposed SureBI is an ideal process, additional guidelines are presented in a methodical approach in section 6.13. Furthermore, as outlined in section 8.5.5 and described in section 7.3.3, validation plays an important role for the nonobligatory sustainability reporting. This was considered while modeling the novel SureBI within section 8.4.4 and described in 8.5.5. Furthermore, it is stated within the named process steps that external organizations could support and even attest to the validation.

From an IT perspective derived from the methodic parts of this thesis, two major novelties were discovered. The first novelty is that the actual guidelines themselves refer to a high quantity of indicators which have to be estimated – a factor also confirmed by the author's project experience. Therefore, section 9.2.2 illustrates several ways to include manual data entries not normally used in BI systems. The second is that there are a number of new data sources which have to be connected in order to be able to implement sustainability reporting with BI. While not being able to test all possible data sources regarding sustainability data sources, section 9.3.3 describes data source connectors, BI provider's supply, additional data source connectors which can be bought by specialized providers, as well as an example of how to implement an automatic data source connection using QlikView.

10.3 Limitations of the Research

One limitation of this research was that the investment in capital and manpower a company has to invest was not regarded. This is due to that the ideal process cannot be implemented totally in the context of this thesis, however process steps, distinctive to traditional BI projects (see chapter 4) are implemented (see section 9.3). Furthermore there are no concrete requirements given regarding company size, company sector or BI solution. The only limitation is that the company is running a BI system based on the basic principles of BI and therefore it can be assumed that the companies which the process targets are of a certain size.

In addition, the sustainability guidelines are analyzed but not questioned in regard to sustainability reporting. From the BI perspective it has to be said that many companies running a BI system face problems due to the growth structures. If a company faces problems due to this factor, this must be addressed utilizing special BI projects and, therefore, this limitation is mentioned but not addressed within this thesis.

10.4 Suggestions and Scope for Future work

The field of sustainability reporting from an IT implementation perspective is relatively new to research and there are interesting research questions which are not addressed by this thesis. It is the author’s belief that the relevance of sustainability reporting, in general, will increase and, therefore, various research areas described in the following are offered. Therefore, more publications have to focus on the need to implement sustainability reporting with BI from an IT perspective and not only from a financial perspective, as seen with the SBSC (see section 6.7) and with integrated reporting.

From a research perspective, the empirical evaluation, e.g. based on the five levels proposed by Fettke, Houy et al. (2010, pp. 353–354), could be used to evaluate SureBI. Furthermore, the research could include comparing the effort of implementing sustainability reporting to the implementation using dedicated sustainability software (see section 6.14). Therefore, concrete use cases have to be defined and implemented. Furthermore, it could be analyzed whether special sustainability reporting tools have advantages compared to the integration of these indicators within BI systems. The development of a process for the automatic integration of manual and estimation data could support the holistic use of the BI environment for sustainability reporting. Therefore, publications should not only focus on BI, but also on sustainability in general, to further strengthen the importance of the IT implementation in an economic context. To enhance visibility within the scientific environment it is further planned to publish a summary of SureBI in a BI journal.

Besides the scientific-methodic development of SureBI, research regarding the practical feasibility appears appropriate. From a company perspective, it would therefore be interesting to measure the sustainability performance after having implemented sustainability reporting using SureBI. The author will use the presented thesis as a framework for implementation projects of sustainability reporting within companies to further bring the results achieved to real world.

10.5 Outlook

Due to the tendency toward integrated reporting (including sustainability indicators into financial reporting), SBSC approaches, the BI basic principle "one point of truth", as well as several consultancy studies illustrated in the text which refer to integrated reporting as the highest maturity level in sustainability reporting, the author maintains that it is vital that companies begin to move toward integration within BI systems now! The transition from today's BI systems which are often overloaded with data, will demand that companies declare their commitment as well as their creativity to this vital process. The IT implementation examples given in section 9.3 should encourage this endeavor and ease the undertaking for companies.

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