MASTER'S THESIS

Information integrity

A proposal to improve the integration of knowledge management and business intelligence for better decision-making

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Abstract

How do organizations know that they use the right information for their decision-making? Nowadays, organizations support their decision-making through adopting business intelligence (BI) techniques. These solutions can only be applied if the information is available, reliable and reusable. BI, therefore, depends on the integrity of information, but businesses often suffer from poor information integrity. The purpose of this thesis report is to find out how information integrity can be improved. Scholars propose to integrate BI with knowledge management (KM) to assure the right information for decision-making, but they do not discuss the aspect of information integrity. Therefore, a proposal has been designed to close the loop toward information integrity. Decision-makers should share their insights about possible data errors to initiate information transfer, which enriches source data. The exploratory qualitative research took place to identify reasons and motivations for information integrity and how organizations enrich source data. Findings show that people share their insights on data errors to enrich source data because data errors affect decision-making. To be concluded, the organization uses the right information for her decision-making by assuring information integrity.

Key Terms

Information integrity, Integration of Knowledge Management and Business Intelligence, Knowledge Sharing, Information Transfer, Data Enrichment/Enhancement

Summary

This section of the report, gives you, as a reader the chance to quickly see the main contents of this thesis report. The report has been conducted as a graduation thesis at the Open University of the Netherlands for the master's degree program Business Process Management and IT (BPMIT). The graduation program for this thesis was organized in two parts between November 2016 and December 2017. The first part was about the literature and the second part of the thesis was about the empirical research, which has been conducted at Florensis BV. This graduation thesis' aim is to explore the three-dimensional problem of information integrity and how it can be improved for better decision-making.

The introductory chapter defines the three-dimensional problem of information integrity, of which business often suffers. Information needs to be available, reliable and reusable to support efficient decision making. Mostly not all source data is integrated into data warehouses, and the source data itself can be missing or incorrect. Information is often not reusable because the outcome of business intelligence (BI) is made for one specific purpose and not for multiple purposes. BI, often sold for efficient decision making, depends on information integrity. Scholars' advice to integrate knowledge management (KM) and BI because KM can link information. To find out if KM and BI integration also affects information integrity, the following problem statement was formulated: *"How does the integration of KM and BI help to improve information integrity for better decision-making?"* Sub-questions for literature review and empirical research have been defined in the problem statement as well.

Chapter 2 covers the literature review. Based on how the problem of information integrity occurs an integrated research approach has been chosen. Literature was reviewed to find out how the integration of KM and BI works and how it can support information integrity. Literature review shows that KM and BI integration provides the right information at the right time for better decision-making (Shehzad & Khan, 2013), but scholars do not explain how information integrity can be improved. A proposal has been written to add knowledge sharing and information transfer to existing KM and BI integration models. The combination of both as addition to existing integration models closes the loop toward information integrity and should be researched in real business.

The third chapter describes the empirical research design. This chapter defines the starting points, circumstances, and arrangements; wherein empirical research has been conducted. The chosen research method and techniques should lead to insights about reasons and motivations for information integrity, and how organizations enrich source data to close the loop toward information integrity. An exploratory qualitative research approach has been chosen as the research method of empirical research, to answer these questions and to find out how information integrity could benefit from source data enrichment. Data were collected through semi-structured interviews at Florensis BV and analysed with data coding. The validity, reliability, and ethics of empirical research have been discussed at the end of the chapter, to ensure that research is consistent, meaningful, relevant and transferable.

Chapter 4 focusses on empirical research findings. The findings of data analysis were illustrated in such a way that they can be integrated into the process of information integrity in the discussion section. The flow of the process is influenced by the KM perspective and the information system (IS) architecture. Findings show that people share their insights about data errors because the want to initiate source data enrichment to limit inaccurate outcome of BI. The way of how people detect data errors and share their insights to initiate data enrichment depends on the KM perspective and the IS architecture of the organization.

The concluding chapter gives in first case an answer to the main research question. The chapter also discusses the results of research and it gives recommendations for further research and a reflection about the research process and the quality of the results. It has been concluded that the integration of KM and BI supports decision-making, but it doesn't refer to information integrity. To close the loop toward information integrity estimated insights about data errors need to be shared to initiate information transfer to enrich source data. Based on this answer the process of information integrity was illustrated (Figure 4). The research results needed to be discussed because methodological bias was experienced during research in the use of BI techniques and the terms of data enrichment and data enhancement left questions for further research as well. At the end of this chapter, the reader gets practice recommendations and ideas for further research. Practical recommendations are for instance the standardization of data enrichment through updating source databases because it seems more efficient than manual data entry or import via EDI (electronic data interchange). Ideas for further research that has been recommended are for example to research on the interaction of text mining and data mining, because and literature doesn't explain how it really works.

Content

1. Introduction

Efficient decision-making in businesses depends on the right information at the right time (Shehzad & Khan, 2013). Only when the information is complete, correct, up to date, accessible and usable for multiple purposes, then investments in Business Intelligence (BI) solutions become an effective strategy to support decision-making (Herschel & Jones, 2005). Nowadays BI techniques, such as data mining are applied in business to support decisions about complex situations. Decision-making becomes efficient when organizations improve information integrity. In other words, it needs to be available, reliable and reusable (Sharda, Delen, & Turban, 2014). However, organizations often suffer from poor information integrity.

First, information is not always available as required, as it is not integrated into information models and IT services, such as data warehousing. Integration is necessary because it allows the combination of different information from various sources (Gadu & El-Khameesy, 2014). When utilizing the information, a second widespread problem occurs. Source data and information can be missing or inaccurate. This reliability problem of information can be caused by migration, registration, by missing or wrong values. The third dimension of this information integrity problem is that information is often not reusable for multiple purposes without losing its quality. Information will not be reusable, when, for example, reports are made for specific purposes, when it is unclear where the applied information comes from or whether it is valid (Gadu & El-Khameesy, 2014).

Given this three-dimensional information integrity problem, it is not surprising that organizations are often spending 80% of their IT investments on implementing BI solutions to support decision-making (Herschel & Jones, 2005). Usually, information is supported by different IT services that are used by various departments for various purposes. After mergers and reorganizations, many organizations try to create efficiency with major IT integration projects that are often half implemented and result in information migration issues. Moreover, the return of investment (ROI) for BI as sold to the organizations is often less than expected, because the poor integrity of information is affecting the efficient use of BI solutions to support decision-making (Herschel & Jones, 2005).

1.1 Context

The integration of knowledge management (KM) and BI provides strategic and competitive information. It enables organizations to be efficient and productive (Alrumaih & Zemirli, 2014). Therefore, early proponents of KM and BI integration identified "*BI as a set of all technologies that gather and analyse data to improve decision-making*" (Herschel & Jones, 2005, p. 45) and KM as the interaction between people, process, and technology (Rostami, 2014). Nowadays, researchers describe BI as an organization's ability to gather all its capabilities and skills and transform them into knowledge through providing historical, current, and predictive views of business operations (Shehzad & Khan, 2013). According to Gadu and El-Khameesy (2014), BI builds on technologies such as data warehouse, data mining and online analytical processing (OLAP). These technologies need to be integrated into enterprise architecture (Cheng & Cheng, 2011).

When organizations adopt BI solutions for better decision-making, they depend on the individual knowledge and skill (Herschel & Jones, 2005). KM is considered to be a systematic framework to capture, acquire, organize and communicate knowledge and it includes people, process, and technology (Rostami, 2014). In knowledge creation theory, researchers define two kinds of knowledge: explicit and tacit knowledge (Shehzad & Khan, 2013). Whereas explicit knowledge can be captured, shared, analysed and

communicated it takes tacit knowledge to judge or interpret the truth (Roberts, 2015). KM and BI benefit from each other (Herschel & Jones, 2005), because KM is related to tacit and explicit knowledge and BI is related to explicit knowledge only (Cheng & Cheng, 2011; Gadu & El-Khameesy, 2014; Shehzad & Khan, 2013). Therefore, early KM and BI integration models base the integration process of KM and BI on the idea of Nonaka and Takeuchi (1995) knowledge creation model to transform tacit knowledge into explicit knowledge and vice versa.

1.2 Relevance

BI is often sold to enable better decision-making and organizations want to assure that they use the right information for their decision-making. Therefore, BI depends on information integrity because if the information is not reliable, available and reusable, investment in BI does not turn out as expected. Poor information integrity affects the use of BI and data cannot be turned into useful information and actionable knowledge (Sharda et al., 2014). Organizations should invest in information integrity because it supports right information for their decision-making.

Scholars of KM and BI integration propose integration to be supportive for better decision-making and it helps to improve information (Herschel & Jones, 2005). BI is related to explicit knowledge and KM is related to tacit and explicit knowledge. Explicit knowledge is objective, and it can be codified and structured. Tacit knowledge is personal, subjective and inexpressible in codifiable form (Hislop, 2009). More than 80% of the available information in organizations is unstructured, but BI focus only on 20% of the structured information, whereas KM technologies such as text mining can help to bring structure to unstructured textual information and hence help in finding the meaning of that unstructured information (Herschel & Jones, 2005).

1.3 Problem statement

Decision-makers nowadays take their decisions supported by BI solutions. BI supports efficient decision-making when information is integer (Herschel & Jones, 2005). The integration of KM and BI is said to offer the right information at the right time (Shehzad & Khan, 2013). Hence, it should affect information integrity. The problem statement of this research can be defined as followed:

1. How does the integration of KM and BI help to improve information integrity for better decision-making?
2. Sub-questions for the literature review can be defined as followed:
    a. How does the integration of KM and BI works?
    b. How does it support information integrity?

After examining literature review, results show that KM and Bi integration only refers to information availability and its reusability, but not to information reliability. Therefore, a proposal has been designed to close to loop toward information integrity and empirical research must find out how business deals with information reliability.

3. Sub-questions for empirical research can be defined as followed:
    a. What are reasons and motivations for information integrity?
    b. How organizations enrich source data?

1.4 Thesis Outline

This graduate thesis is structured and organized as follows.

The **first** chapter describes the topic of information integrity. Here, the background, context, relevance, and problem statement of information integrity are described. In **chapter two,** existing literature on the integration of KM and BI is discussed. Such integration supports the right information at the right time

(Shehzad & Khan, 2013), hence, it can be assumed that information integrity will be affected by the integration of KM and BI. Through literature review shows how this integration works and how it can support information integrity. The literature review identified a gap in existing literature. KM and BI integration only refers to information availability and reusability. It does not cover information reusability. The third chapter describes why and how explorative qualitative research should take place to close the loop toward information integrity. An explorative search approach has been chosen, to find out how the business deals with information reliability. It allows identifying underlying causes of information integrity because this problem has not been studied before. The fourth chapter includes the results of empirical findings. The identified gap in existing literature defined the scope of this research, which means that explorative research focused on the reliability of information only to close the loop toward information integrity. The chosen empirical research design helped to identify reasons and motivations for information integrity and how organizations enrich their source data. The fifth chapter discussed and concluded the research of information integrity. It also provided practical recommendations and recommendations for further research. Finally, the reflection discussed the quality of the research and the sustainability of the conclusion. Hence, I, the writer of this report takes a step back to reflect if research could have been done better.

2. Integration of Knowledge Management and Business Intelligence

Reviewing existing KM and BI integration literature establishes insights about how integration works and how to improve information integrity. Therefore, a simple search strategy and clear search criteria were defined in search queries (Appendix II, Table 2). Following these search queries, the snowball technique (Saunders, Lewis, & Thronhill, 2012) was applied. With the help of this technique, the most relevant literature was found. The progress of literature review has been illustrated in a structured search process (Appendix III, Figure 5). Searching for literature and studying literature about the integration of KM and BI raised questions about the reliability of information that will be explained in section 2.2 and discussed in section 2.3.

The questions that have been left through studying existing KM and BI integration literature can be seen as a gap in KM and BI integration literature. Therefore, a proposal to close this gap is offered in section 2.2. Search queries were used to find literature to support the proposal (see Table 2) and the progress of proposal search is illustrated in Appendix III, Figure 6. The results of the literature review form a substantial foundation of this thesis. Overall, a review of the literature indicated that the integration of KM and BI helps organizations to get the right information at the right time (Shehzad & Khan, 2013), but such integration does not improve information integrity. Therefore, two additions to the existing integration models were proposed to close the loop toward information integrity. The first addition is about knowledge sharing. According to Roberts (2015, p. 73) knowledge sharing initiates information transfer. The second addition is about information transfer. According to Lambert (2014), information transfer enriches/enhances source data. Both additions could enable the improvement of information integrity. This proposal needs to be confirmed by empirical research.

2.1 Integration of KM and BI

Scholars argue that the integration of KM and BI is relevant for organizations facing issues like an innovation explosion (Sharma, Tan, & Cheng, 2010), data explosion (Alrumaih & Zemirli, 2014), information revolution (Shehzad & Khan, 2013), rapid environmental changes (Rostami, 2014), raising dynamic organizational environment and complexity (Gadu & El-Khameesy, 2014). The integration of KM and BI is relevant for organizations because it helps to get the right information at the right time (Shehzad & Khan, 2013). In fact, it enables organizations to improve decision-making and productivity (Rostami, 2014) and Herschel and Jones (2005) argue *"that there is an interaction effect between KM activities and BI effort*."

Research on KM and BI integration takes mainly an objectivist perspective towards knowledge (Appendix VI). In the objectivist perspective, knowledge is an object that can be transformed and codified (Hislop, 2009). Researchers in KM and BI integration define knowledge in two categories: explicit and tacit knowledge (Shehzad & Khan, 2013). Whereas BI focuses only on explicit knowledge, such as structured data and information, it needs the knowledge to be interpreted and give meanings to patterns. This knowledge should be supported by KM "*to capture, acquire, organize and communicate tacit and explicit knowledge"* (Rostami, 2014, p. 33). A conversation between individuals, for example, is tacit knowledge and contains unstructured information. Stored data in a database can be seen as structured information and therefore explicit knowledge. In addition to the objectivist perspective, recent researchers introduced a people-centric approach. In KM systems, people will apply knowledge and address it to problems (Roberts, 2015). This approach is similar to practice-based perspective towards knowledge (Appendix VI). The practice-based perspective points out that knowledge is inseparable from humans because it is embedded in practice, embodied in people and socially constructed (Hislop, 2009). Scholars argue that KM is not only about transforming data and information into actionable and valuable knowledge but also

about understanding how people work and how employees can share and learn from each other (Alrumaih & Zemirli, 2014; Gadu & El-Khameesy, 2014; Rostami, 2014).

Approaches of KM and BI integration have changed over time (Figure 1). This figure has been designed for literature review to illustrate the development of KM and BI integration. The first KM and BI integration ideas were established as supporting approaches. Herschel and Jones (2005) define BI as a subset of KM, whereas Sharma et al. (2010) argue that KM is a subset of BI. They both focused on the knowledge creation model from Nonaka and Takeuchi (1995). In this model, tacit knowledge can be transformed into explicit knowledge and vice versa. Later in time, KM and BI integration models were designed following the hierarchical design ideas for information system development in a three-layer model (Cheng & Cheng, 2011). In this model, data are stored and collected in the data storage layer (first layer), then loaded via ETL (Extraction, Transformation, and Load) services in the logical layer (second layer) where they are processed, analysed and transformed into valuable information in a data warehouse. This information is presented through OLAP services in the form of reports and graphs in the presentation layer (third layer) and shared as actionable knowledge for decision-making.

Researchers of KM and BI integration adopt the taxonomy of text and data mining (Sharda et al., 2014). They suggest knowledge discovery techniques such as text mining (Herschel & Jones, 2005) to analyse unstructured or semi-structured data and information, like text, multimedia, HTML or XML. They apply data mining techniques for BI activities, wherein structured data and information will be analysed (Sharda et al., 2014). Both techniques can discover knowledge (Sharda et al., 2014) but researchers in KM and BI integration only consider text mining as a knowledge discovery technique. Because it can find existing information in other source databases, that could be used to enrich source data. More recently, integration has developed toward a people-centric KM and BI integration approach. Because people evaluate and feedback (Cheng & Cheng, 2011) and share knowledge for decision-making (Rostami, 2014).

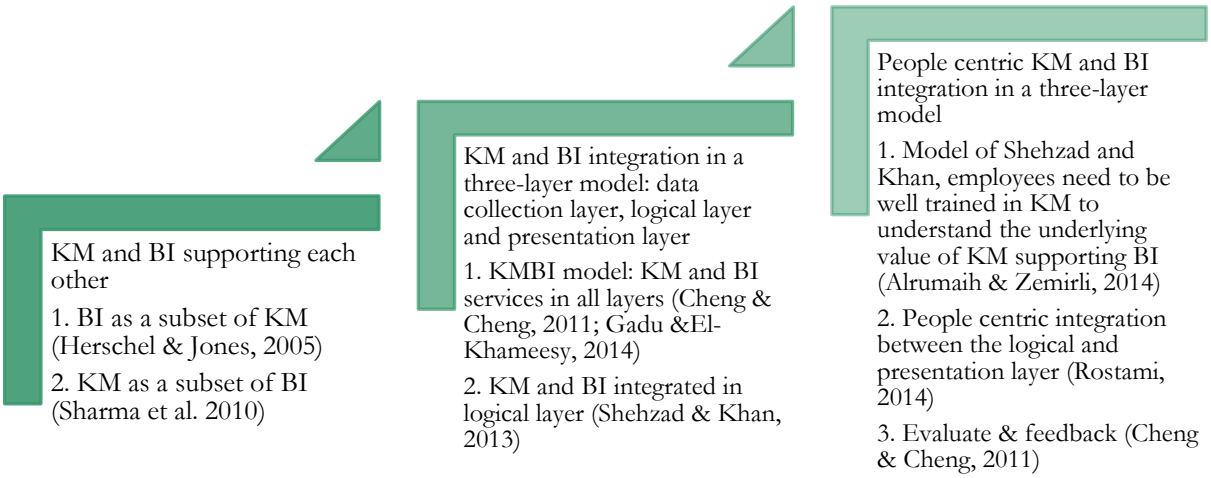

Figure 1 KM and BI integration development

2.2 Proposal of additions knowledge sharing and information transfer

When organizations support their decision-making by integrating KM and BI, they refer to information availability and reusability, but they don't refer to its reliability. Moreover, Cheng and Cheng (2011) argue that evaluation and feedback take place in the presentation layer, but scholars do not explain how does it work. According to the intelligence creation and use process, invented by US military, the use of BI is cyclical. The analysis of BI will not be accurate and reliable if steps such as evaluation would not affect data collection (Sharda et al., 2014). Which means the outcome of BI should be checked if it was correct and if it used the right information. It is unclear; however, if KM and BI integration models use evaluation and feedback to improve the reliability of information. The results of BI analysis can be used not only to support decision-making, but also to improve information integrity. Two additions to the existing integration models create a closed loop that enables improvement of information integrity. Knowledge resulting from BI analysis should be shared with other decision-makers to initiate a process of information transfer that - in turn - enriches source data.

As mentioned above, latest KM and BI integration models are people-centric. People play an important role because they use and share knowledge for decision-making (Rostami, 2014). Hislop (2009) describes knowledge sharing of tacit knowledge as a person-to-person interaction. An example for this could be a conversation, such as when analysts and decision-makers are having a conversation about their insights. Based on this conversation they could, for example, decide together about a possible initiation of the information transfer. That means that through conversation they share their newest insights about the information itself. They could initiate information transfer with the purpose to enrich source data. The information transfer process, distributes explicit knowledge formally, such as structured and unstructured information and need to be initiated by people (Roberts, 2015).

In summary, the improvement on existing integration frameworks combines explicit and tacit knowledge. Tacit knowledge should be shared (Hislop, 2009) and explicit knowledge should be transferred back to source data and information (Roberts, 2015). It needs knowledge sharing to initiate an information transfer because tacit knowledge cannot be transferred formally like explicit information.

Information can be transferred back into source databases (Gadu & El-Khameesy, 2014) through data enrichment techniques. These techniques are used "*to add data from alternate sources as a by-product of knowledge"* (Mosley et al., 2009) to source data and information. By applying data enrichment/enhancement techniques, supported by ETL services, organizations can enrich/enhance the quality (Lambert, 2014) of existing data to make it more reliable. According to Lambert (2014) data enrichment/enhancement techniques such as data matching, data correcting, and data interpolation are used in business nowadays to repair and improve existing source data and information. Through data matching, incoming sets of data will be compared with existing data sets, to match incoming data to the right existing data. Correcting cares about invalid data like time, date, geographic information, through standardization. Interpolation means to give a continuous function to discrete data and to map it. Data and information from other sources can be used to fill missing values (Lambert, 2014) for further analysis.

Taken together, to assure information integrity, supporting decision-making (Shehzad & Khan, 2013), organizations should go through an information integrity evolution process (Figure 2) with three stages. This evaluation process has been drawn in Figure 2 to illustrate how organizations should deal with the three-dimensional problem of information integrity. First, organizations should adopt hierarchical design ideas of information system development (Cheng & Cheng, 2011) to make information available and reusable. Second, by integrating KM and BI (Herschel & Jones, 2005), analysts could identify new patterns and the right information. In the last stage of this information integrity evolution process, organizations could improve information reliability as well. Through sharing knowledge with other

decision-makers, information transfer could be initiated. It contributes to evaluation and feedback processes that close the loop and enrich source data.

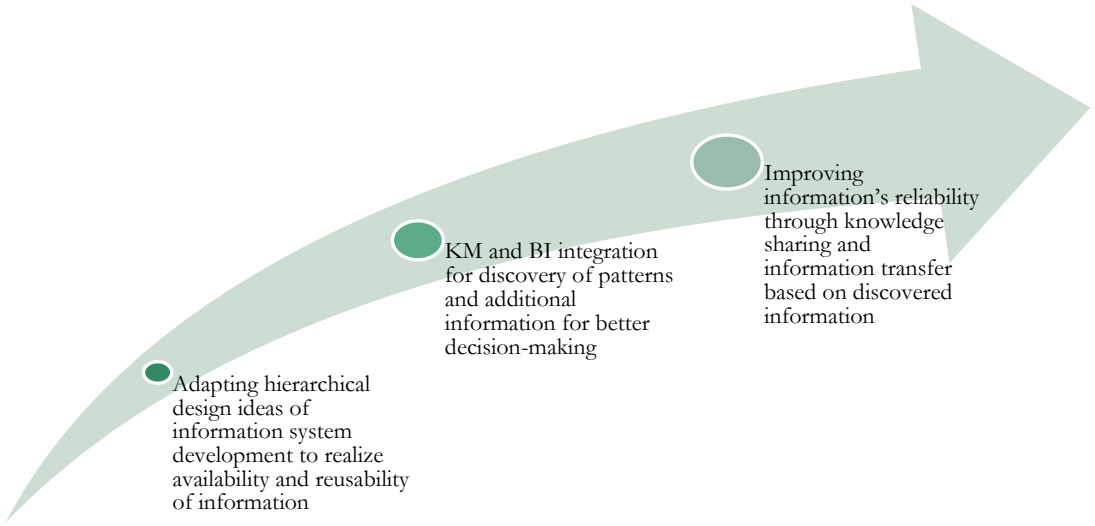

Figure 2 Information's integrity evolution

2.3 Literature review conclusion

Businesses often suffer from poor information integrity. Whereas organizations try to adopt BI for better decision-making, they struggle because information is mostly not available, reusable and reliable, as required for the efficient use of BI. Scholars propose that the integration of KM and BI provides organizations with the right information at the right time for their decision-making (Shehzad & Khan, 2013) because KM helps to link data. Through knowledge, we can make information from data (Hislop, 2009) and BI "*extracts this knowledge from various sources of data*" (Rostami, 2014, p. 34). Reviewed literature divides this knowledge into two categories: tacit and explicit knowledge (Sharma et al., 2010). Whereas BI deals only with explicit knowledge, KM manages tacit and explicit knowledge (Shehzad & Khan, 2013). Through integration, both can benefit from each other (Herschel & Jones, 2005).

In conclusion, the integration of KM and BI supports decision-making based on the integrity of information, but it doesn't improve information integrity itself. It is unclear how the interaction of data and text mining techniques works within the logical layers and how evaluation and feedback in presentation layer will be used (Cheng & Cheng, 2011). Adapting hierarchical design ideas of information system development, such as data storage, including ETL techniques, data warehousing and OLAP (Gadu & El-Khameesy, 2014), enables the availability and reusability of information and prepares its reliability through the interaction of data and text mining techniques (Gadu & El-Khameesy, 2014). Existing integration models suggest stages to evaluate and feedback (Cheng & Cheng, 2011). Others claim that integration of KM and BI should be people-centric because people take decisions (Rostami, 2014). When scholars argue that the integration of KM and BI provides the right information at the right time and therefore improves decision-making (Shehzad & Khan, 2013), then decision-makers should share their insights in a closed loop. They should share their knowledge and transfer the information (Roberts, 2015) to improve and enrich source data. In other words, information transfer should not only take place to load source data into the data warehouse for further analysis, information transfer could be used as well to enrich source data based on the insights that decision makers got through BI output.

Because information integrity has not been studied in detail yet, qualitative exploratory research will help to establish underlying relationships. Hence, reasons for certain decisions can be understood better (Saunders, Lewis, & Thornhill, 2012). By executing explorative research, insights of how organizations

deal with information integrity in practice can help to answer the research question of *how the integration of KM and BI helps to improve information integrity for better decision-making*. Exploratory research, moreover, strives to clarify *what organizations do to enrich source data* because KM and BI integration don't cover information reliability.

3. Empirical research design

The research design defines methods used to organize and carry out empirical research (Saunders, Lewis, & Thornhill, 2012). It includes a description how to collect, analyse and address required data and information to the research objectives. The research design also describes reasons and justifications for empirical research, data collection, operationalization, and data analysis techniques used.

3.1 Research approach

Scholars argue that the integration of KM and BI helps to enable the right information at the right time for better decision-making (Shehzad & Khan, 2013). However, existing literature does not explain how the integration of KM and BI works in practice, and it does not discuss how to deal with information integrity. Therefore, two questions that need to be answered through empirical research have been indicated. First, what are reasons and motivations for information integrity? Second, how organizations enrich source data? Exploratory qualitative research ensures trustworthy data to analyse a phenomenon that has not been well understood yet (Edmondson & McManus, 2007), such as information integrity. This qualitative research method aim is to understand the underlying reasons and motivations to ensure information integrity and to uncover trends in thoughts and opinions (Saunders, Lewis, & Thornhill, 2012) that are interesting and meaningful to answer the research question about information integrity.

Exploratory qualitative research is an interpretive research method. Interpretive means that the explorative phenomenon is socially constructed and multiple (Edmondson & McManus, 2007) just like the three-dimensional problem of information integrity. Exploratory qualitative research generates not only an elevated level of depth, but it generates also valid, trustful and honest primary data to analyse (Saunders, Lewis, & Thornhill, 2012). Exploratory qualitative research allows a research approach wherein the proposal (theory) can be tested in real live (Edmondson & McManus, 2007, p. 1173). In the case of information integrity, a gap was found in the literature. Two add-ons (knowledge sharing and information transfer) were added to existing KM and BI integration frameworks to improve information integrity. Exploratory qualitative research takes place bottom-up, from interviewing to patterns and answering the research questions (Saunders, Lewis, & Thornhill, 2012).

3.2 Data collection

Data were collected through semi-structured interviews. Research can benefit from this interview technique because interviews can be prepared and qualitative data can easily be compared (Saunders, Lewis, & Thornhill, 2012). Interviews have been taken to enter another's person point of view. Semi-structured interviews help to make this point of view explicit. The interviews are structured with an interview guide (Appendix: Interview Guides). This guide includes themes like BI, KM, knowledge sharing and information transfer *"to explore, probe, and ask questions that will elucidate and illuminate that particular subject "* (Patton, 2002, p. 342).

The interviews were held in a company (see research settings), that uses BI solutions for decision-making for more than five years. Together with the manager Information and ICT of the company, two groups of interview candidates were selected: BI-users and IT/data experts. The selection of these two groups ensures that data collection supplies information to answer the research question. Table 8 in Appendix X includes an overview of the twelve interview candidates and their functions.

Research setting

Florensis BV is one of the biggest horticulture producers of the Netherlands and has been founded as a family business in 1941. The company has grown in the second generation to be an innovative, worldwide providing, breeder and supplier with more than 900 million young plants (from seed and cuttings) every year (Florensis, 2016). The company employs more than 2000 people in the Netherlands, Belgium, Germany, Italy, Poland, UK, Ethiopia, Kenya, and Portugal. The core business of Florensis BV is the production of young plants (plugs) like annuals, perennials, pot plants, primulas, pansies, and violas. In addition to the plug production, Florensis BV supplies cut flowers. The company offers more than 4000 different flowers and plant varieties to growers all over the world.

The development and production of a living product include mostly data-driven processes. Time series data, such as product forms, prices, production conditions and transaction orders are entered (mainly) manually and also via EDI (electronic data interchange) into an ERP system. In 2012, the company adopted one of the leading ERP systems in horticultural productions. It helps to manage all organizational transactions of plant productions more efficiently. The ERP system is an open system, meaning that it does not check data characters during data entry. The ERP system does not supply management reports. Therefore, after the ERP implementation, in order to generate management information, the management decided to start a pilot with a BI cube. This pilot was such a success that the organization decided to go ahead developing reports, tools and check queries with the BI cube in MS Visual Basic.

Florensis BV suits as an organization for empirical research because they use BI to support their decision-making. By finding out what this organization does to enrich source data, the research question can be answered. The IT architecture of the organization supports the integration of all source databases into a data warehouse, wherein a cube has been adopted to run BI reports. The company applies a three-layer-model, just like identified in the literature review (Cheng & Cheng, 2011). The only difference is the second layer, wherein the company applies a cube and not data mining as BI solution.

3.3 Operationalization

Semi-structured interviews have been prepared with interview guides (Appendix VIII). These guides provide questions for different themes. Two of the themes are BI and KM. Questions about these themes (Appendix VIII) create insights about the purpose of knowledge sharing and information transfer in this organization. Questions about knowledge sharing and information transfer (Appendix VIII) generate insights about how the interaction of decision-makers in BI can initiate information transfer to enrich source data. The themes questions and probing questions were combined per interview candidate group in two interview guides (Appendix VIII). All interviews were held in Dutch, which is the language that interview candidates felt with most comfortable. Interview candidates were invited to join the interview with an information letter (Appendix VII). The candidates were informed about the research question, the research strategy and the operationalization of it. In addition to general information about the research, candidates were informed about voice recording during the interview, anonymization, the transcription of each interview and the feedback round of the transcript interview, before data was analysed.

3.4 Data analysis

"The interpretation of data cannot be regarded independently of their collection or sample of material" (Flick, 2011, p. 306). Data coding helps to refine and organize the data collection, to evaluate and give meaning to the data, and to draw conclusions about a problem such as information integrity. The analysis of data is

inspired by grounded theory. Coding helps to formulate the answers to the research questions (Flick, 2011).
Data coding can be seen as an iterative process, wherein three types of coding are applied. First, open coding allows reducing the amount of data through concepts. Second, axial coding enables finding categories within the concepts based on open coding. The third form of data coding is selective coding, which allows focusing on the potential core concepts and abstraction (Flick, 2011).

The main goal of **open coding** is to break down and understand the collected data (Flick, 2011). Open codes supposed to be comprehensive to develop a theoretical elaboration and to create a connection between the categories and the data. Open codes were developed relating to the proposal and the research question. **Axial coding** helps to identify core categories and find relations between these categories. According to Flick (2011) approach to data coding, a paradigm model can help to identify relations between core categories. The paradigm model (Flick, 2011) enables relating causes and consequences, strategies, context and intervening conditions to the problem of information integrity. This step of the data analysis is iterative between inductive and deductive thinking. On one the hand, researchers want to know if organizations enrich source data as proposed and on the other hand, researchers want to know how organizations enrich data. The last step of data coding is **selective coding**. Selective coding is meant to focus on potential core concepts that lead to the formulation of the story about information integrity.

3.5 Plan of action

The main goal of the empirical research is to find answers to the two identified research questions. First, what are reasons and second, how organizations do to enrich source data? The research needs to be prepared carefully, to avoid mistakes, misconceptions, and surprises during the research (Saunders, Lewis, & Thornhill, 2012). Therefore, the organization was asked to confirm the conditions under which research took place. We agreed to name the organization with its real name but anonymize the interview candidates only. By examining each research step as already described, rich and trustful data were collected. Each interview was recorded and transcribed. The transcription took place with the help of a transcription program called 'Listen N' Write'. This free software enables easy transcriptions by applying shortcut keys. Before the data analysis, each transcript was sent back to the candidate for feedback. In this way, the correctness of the data collection can be ensured. Data were analysed by coding data in QDA Miner Lite. This free software allows creating cases (per candidate), categories and codes (to give meaning to the data) (Flick, 2011). The narrative report progressed during the data analysis, leading to this final thesis report.

3.6 Validity, Reliability and Ethics of Research

The quality of exploratory qualitative research can be assessed regarding internal and external validity, reliability and ethics (Flick, 2011). The following subsection illustrates the actions taken to ensure the quality of research.

3.6.1 Internal validity

Exploratory qualitative research is valid if the choice of the right interview candidates, tools, processes, and data fits to answer the research questions (Saunders, Lewis, & Thornhill, 2012). The choice of methodology must enable detections of findings in the useful context for it to be valid. Exploratory qualitative research is a qualitative research method, wherein data were collected through semi-structured interviews. The interview-candidates were collected based on their background and experience. All interviews were recorded and transcribed and each transcript was checked by the interview candidate before being analysed. The entire process flow of the analysis has been registered in an Excel file on

Google drive. The supervisor had access to this file to monitor the follow-up. After the data was collected, transcribed and checked for correctness, it was analysed in 'QDA Miner Lite'.

3.6.2 External validity/Generalizability

The external validity can also be called generalizability. It referred to generalizing the conclusion of the scientific research. The term generalizability has been taken over from quantitative research. Qualitative research refers to the transferability to another context or settings (Saunders, Lewis, & Thornhill, 2012). The context of this research has been described in such a way, that it would fit for each other organizations that manage its data and information in comparable settings. Moreover, the transferability of this empirical research will be included in the discussion.

3.6.3 Reliability

Reliability refers to the consistency of qualitative research. Through its consistency, research becomes applicable and repeatable. Using the same interview guide per interview group (Appendix VIII) naming and describing all research steps, and structuring and organizing the report in such a way that it reads with a flow, consistency of research will be guaranteed.

3.6.4 Ethics of research

Two aspects are clarifying the Ethics of research. The first aspect refers to the literature review and the way of writing the report. The APA's Ethics Code is required to be followed as a guide to avoid research misconduct in the thesis, like fabrication, falsification or plagiarism. The second aspect refers to empirical research because researcher must take care of privacy and confidentiality (Saunders, Lewis, & Thornhill, 2012). Interviews were prepared to be managed anonymously. All interview candidates got a fake name. Work experience and BI experience were categorized to avoid traceability to an individual. Each interview candidate has been informed about the interview procedure (Appendix VII). At the beginning of each interview, a candidate needed to permit recording it (Appendix IX). Each interview record was saved digitally and transcribed with the anonymous identity. Before data analysis started, each candidate got the transcript for feedback. The transcripts of the interviews are not included in the appendix.

4. Research Findings

This section presents the findings of exploratory qualitative research closing the loop toward information integrity. Findings show that KM perspective and IS architecture are two aspects that influence information integrity. Therefore, these aspects are illustrated first, before illustrating the way the organization deals with information integrity. Describing the influencers first helps to understand the underlying causes of information integrity better.

4.1 KM perspective

One of the aspects that influence information integrity is the KM perspective. In the studied organization, people share their insights, what they know, whom to talk to. Every interviewee described the organization as having an **open-door policy**. If a colleague needs help, nobody would deny helping "*You can always walk inside, and everyone wants to help you* "(BI-user). When a BI-user detects data errors, he mostly knows who to contact, and people are willing to help. "*Here the responsibilities are quite clear; I often have only two people that I can appeal to"* (IT/data expert). In many departments of the organization, colleagues can be backup of each other and can take over others job if needed "*What you see is always sure that there is a backup. Certainly, in holiday periods. For all tasks. For example, it may be that my entire task package is pulled apart, thus completing different tasks by different people. In case that we're driving into a tree tomorrow, we back up. That knowledge is guaranteed in each case"* (BI-user). This situation enables people to take **responsibility** for source data to be correct and the mentality to go for it. That enables knowledge sharing and information transfer. "*If a BI-user detects data errors, he will go to the person who is responsible. Mostly it's solved within five minutes. There are short lines here"* (IT/data expert).

People developed their knowledge and experience of adopting IT system architecture with the BI cube for better decision-making. The average BI-user had a **learning-on-the-job-training**. Most of them know how BI solutions were developed and how they correctly work because BI solutions are custom made. The BI-user knows all processes that supply data for the BI report or tool they are using. They know what outcome they can expect. If they detect different outcome in BI than expected, they will analyse to find the cause. When people get an automated email of a detected data error from a check query, they know how to solve the data error in the source database. They know at what point in the source database they should correct or fill missing values. When people know how to analyse the causes of data errors in underlying source systems and they themselves or others know how to correct data errors, we can classify these skills as a **high standard of interpretation ability.** The identified KM perspective at Florensis BV can be summarized with an open-door policy, learning by doing mentality and highly skilled employees.

4.2 IS architecture

The second influencer of information integrity is the IS architecture. The ERP system is one of the source databases that are connected via an ODBC (open database connectivity) connection with a data warehouse. ODBC is a standard for ETL platforms and it enables the availability of source data through connecting source databases with the data warehouse. The data warehouse supplies a cube mechanism that runs on Microsoft Visual Studio. This BI environment is developed and hosted by two BI-specialists, who program each BI report, tool and check query with SQL statements. The ERP system includes master data and transaction data, delivering input to other source databases as well. When source data in the ERP system is incorrect or missing, every other source database and BI will result in inaccurate output.

There are three kinds of employees who enter data into the ERP system. The first group of employees works for the MDM department (master data management). They manage the master data in the ERP

system. The second group of employees is the group of ERP users and functional process owners. They manage transaction data in the ERP system. MDM, ERP users and functional process owners enter data manually or via EDI import into the ERP system.
The third group of employees is the group of BI-specialists. They can enrich source data, by updating source data databases like the ERP system.

Figure 3 has been developed based on data analysis. This figure illustrates the situation when source data in the ERP system is incorrect and/or missing.

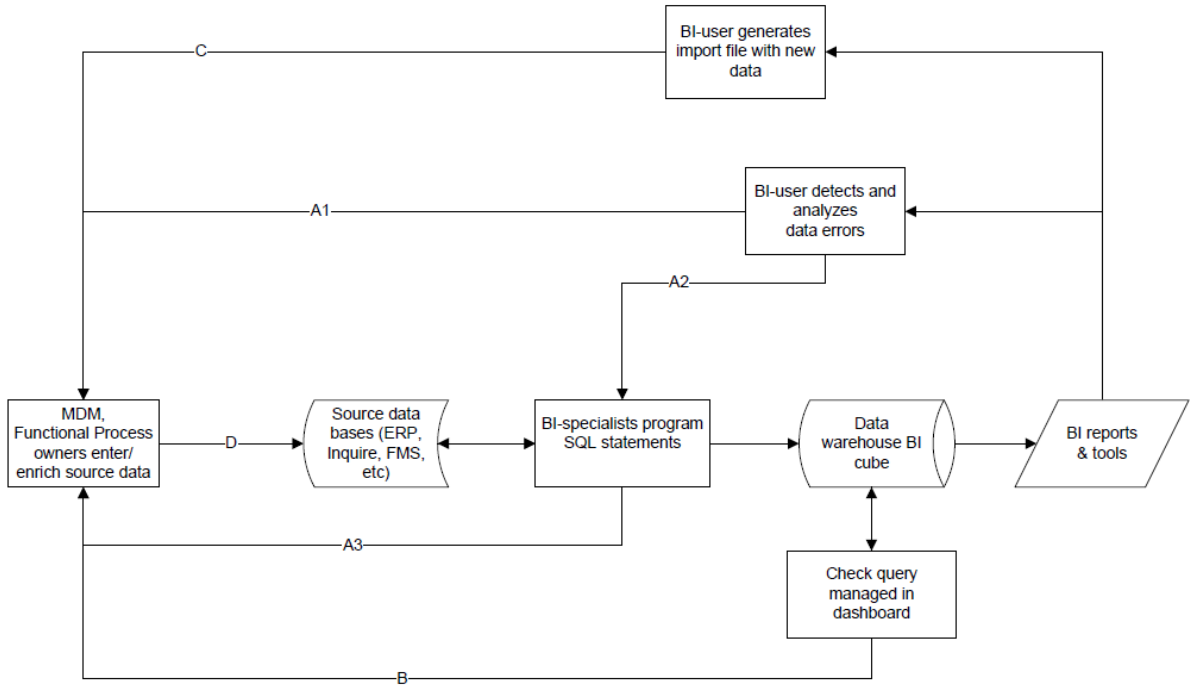

Figure 3 Case findings Knowledge sharing initiates information transfer

Source data gets entered in source databases, such as ERP, File maker and, a financial system. All source data is integrated into the data warehouse and data warehouse provides BI reports, tools and queries. Figure 3 illustrates different scenarios when source data in the ERP system is incorrect and/or missing. Letter A (1-3) indicates personal knowledge sharing after data errors have been detected. Letter B describes automated knowledge sharing, letter C illustrates the generation of new data, which can be seen as a semi-automated process, wherein source data will be generated via BI tooling. Letter D describes information transfer, which enriches source data. Hence, detected data errors will be shared (personal and automated) and new data will be generated to enrich source data.

4.3 Detecting errors, generating new data and insights

In this organization were three processes identified by which new insights are generated: Two processes can be described as data error detection, one personal and the other automated. The third process can be described as the generation of new source data by the BI tool to import into ERP systems.

A) BI-user detects inaccurate output in BI reports and tools. Data errors will always be recognized naturally by the BI-user and decision maker, if he knows what outcome to expect: *"If the BI-user gets results he does not expect, and the report or query is technically good, then they will search in the underlying systems to find data inconsistencies"* (IT/data expert). Three diverse ways of how BI-users detect inaccurate data were identified (see Figure 3, process A1, A2, and A3).

The average BI-user in the organization knows what output they can expect because BI reports, queries and tools are custom made: *"We discuss in advance what it should be, it is customized"* (BI-user). When the BI-user experiences inaccurate information output in BI, he shares his insights to solve the problem. Therefore, he will analyse the causes to decide whom to contact and to inform. Responsible people need to be contacted to solve possible source data or IT related issues, and other BI-users need to be informed if inaccurate information output occurs and influences decision making. When people know whom to contact, they go for it: *"If you can solve it by finding each other, then you are almost there"* (BI-user).
The BI-user analyses the causes for the inaccurate output in BI, to assess whom he should contact to solve the data issue: *"I often look what the cause of the data error is to find out how to prevent the error next time"* (IT/data expert). If the BI-user identifies inaccurate data in source databases, he will contact the functional process owner, a person who enter the data or MDM. (see Figure 3, process line A1)

Logical checks. BI-users do logical data checks on the outcome of the BI tool (see Figure 3, process line A1). If they detect data errors, they will analyse the cause and share their insights to enrich source data. This phenomenon is a proactive form of personal data detection that inquires deep insights of all data transactions and process knowledge "*In that tool, I do some logical checks on data. Like, do I see the same curve within one series of the species? That's my own BI tool"* (BI-user).

Faulty SQL statements. If the BI-users think that SQL statements are faulty, they will contact the BI-specialists (see Figure 3, process line A2). *"The BI-specialist is very strict in that, doing exactly what you ask. So, if your question is not correct, you get something that does not work. You must display your selection as accurately as possible. So, you must be very consistent and indicate what you want to see"* (BI-user).
Inconsistent source data. During development of BI reports and tools, the BI-specialist may detect inaccurate source data. Then he contacts MDM to have a look at it. This type of knowledge discovery is communicated personally (see Figure 3, process line A3).

B) Automated data detection

The automated versions of data error recognition are **check queries.** If they are programmed in SQL, they allow specifying data conditions in any row of a table within a database (Tayler, 2013). When BI solutions are hosted with cube mechanism, they are mostly programmed with SQL constraints: *"...the BI database itself runs on the SQL server of Microsoft and the tool we use is Visual Studio, that allows us to develop processes that run in Microsoft's SSIS environment and run most of the processes"* (IT/data expert). Hence, offering check queries for data error detection becomes a simple and efficient data management utility. "*All check queries are records of all the business rules we have in this company"* (IT/data expert).

Usually, when data errors are detected by a query, the outcome will be sent automated per e-mail to a responsible person and to the functional process owner, to solve the data error in source database "*Everyone who is responsible for a query will get the outcome of the query every morning in the mailbox, and then they take action to solve the data error"* (IT/data expert). MDM manages and monitors the follow up of check query via a dashboard. Therein, MDM can manage the responsible persons, who will receive the outcome of check queries to solve detected data errors. This type of knowledge discovery is automated (see Figure 3, process line B).

C) Generation of new data

The third process can be described as the **generation of new source data** via BI tools. ERP does not offer functions like planning and pricing. These functions were developed in BI tools. With these tools, BI-users can generate new source data that they will import via EDI into the ERP system. "*Yes, a grid comes*

out. An import grid that I import into the ERP system" (BI-user). The import file will be loaded into the ERP system to steer several processes.

The BI-user generates import files with new data for different processes in BI tools like space estimations and prices per product. (See Figure 3, process line C). For example, the pricing tool adds to each article the right price after defining a price relay in the BI tool. The ERP system cannot do this; therefore, BI generated an import file with new prices per article "*For example the pricing tool: Therein, I manage the prizes. So, I make sure the prices come in ERP system.*" (BI-user).

4.4 Knowledge sharing

As a follow-up of detecting data errors and generating new data, three types of knowledge sharing were identified during research. These types can be classified as personal communication, semi-automated and automated knowledge sharing.

Personal communication and knowledge sharing. When people detect data errors while using BI tools for their decision-making (see Figure 3, process line A1, 2 and 3), they need to share these insights because they affect their daily business: *"When data errors are detected in BI outcome, it will be detected quickly by the BI-user. It is because of errors in master data affect productions and daily business"* (BI-user/IT expert). By analysing the cause of the data errors, people know whom to contact. Mostly the person who detects the data error first initiates further actions. If many people are affected, cause analysis and further action will be coordinated in a group of people "*For this, it is relevant to inform people of this is what we see now, this is what we think, but this is not the case, so keep that in mind*" (BI-user).

If the responsible person works close-by, for example in the same building, people will contact each other mainly face to face, and for further information they use e-mail. Otherwise, data errors will be communicated via phone or per e-mail. E-mailing can be used to attach short cuts of the data error to signalize the issue. Face to face or phone communication leads mostly directly to agreements to solve the data error. "*If data errors were detected, they will immediately be promoted for correction. Then we can check immediately if the data has been corrected or not*" (IT/data expert).

Automated knowledge sharing (see Figure 3, process line B). Check queries are programmed to send and an outcome of data errors to specific people. They belong to knowledge sharing because they only indicate data errors. They don't solve them. The organization uses check queries to share insights automated about data errors with responsible people who will correct the data error. "*The outcome of a query will be mailed automatically, once per day, Monday through Friday or one per week. The person, who is responsible for a piece of data, can be specified.*" (IT/data expert). The identification of data errors, confirm business rules, initiates data enrichment "*All check queries are records of all the business rules we have in this company. They check if data complies with what is necessary"* (IT/data expert). Via a dashboard, the MDM department manages the frequency of the e-mails and responsible people. "*And you can specify users, so you specify in the dashboard who should receive the query*" (IT/data expert).

Semi-automated knowledge sharing (see Figure 3, process line C). Newly generated data will be saved first in an import file in an authorized map before it will be imported into the ERP system. The moment that import-files will be saved and shared before import can be defined as semi-automated knowledge sharing. Running the BI tool to generate an import file and save this file on the server can be seen as semi-automated knowledge sharing because people do first a selection of the data that will be generated in BI and then they share the generated data with the person who uploads the data. The BI-user who runs the tool uses the import file in the next step to enrich source data. New source data will be generated by a

manual update of the BI tool. The update generates an import file that will automatically be saved. "*For example, we provide certain CSV (comma separated values) files. This often goes through automatic transfer"* (IT/data expert).

4.5 Information transfer

The transfer of information will always be initiated by people (see Figure 3, process D). When people want to know how to solve data errors and how to prevent them in future, they have to understand first the cause of the data error. "*Sharing data errors and unreliable outcome of BI initiates searching for the cause and try to avoid the same errors in future. If you know the reason for data errors, you try to fix them. The cause could be inaccurate source data or not proper working BI reports*" (IT/data expert). Three types of information transfer have been identified during research. MDM and other responsible people transfer information manually or imported via EDI. The BI-specialist transfers information by updating source databases. In the last case, data will be enriched in the source database directly, by commanding changing through SQL statements in Microsoft Studio. This type of information transfer can enrich values in single columns in source database tables.

Manual data transfer. After people detect single data errors or errors were identified via check queries, people enrich source data manually. They enter missing values or correct faulty values front-end in the source database. "*Data correction must be entered manually by the user in source database*" (IT/data expert). Everyone, who enters data into source databases usually knows how to enter the data and what business rules are in charge. Single or couple values can be entered front-end easily into source database. If people enter too many values or are not careful enough, their data entry could cause unreliable BI outcome "*If I see a turnover of 27 million in BI then I know 100% that BI is good, but that customer service have made a typo*" (BI-user).

Import file via EDI. When a lot of values need to be filled or corrected in the source database, this organization applies import files to mass upload data into source databases "*We upload master data into the ERP system*" (IT/data expert). Usually, the import file exists as a template, so people know how to fill it. The template should be filled not only for the value of the column that needs to be filled or corrected, but it needs to be also filled with all the other values. An import of data will always write over existing values in the source database. If the import does not happen carefully, it can cause a lot of damage in source data in one time "*If we a not careful filling the import file, we can cause a lot of damage because existing data will be changed for all values within one table in one time* (IT/data expert).

Information transfer by updating source data. The BI-specialist can enrich source data by updating source data "*We ask one of our BI-specialists to enrich source data, by updating on databases*" (BI-user). The owner of the source database doesn't support transferring information by uploading the database itself, but it is technically possible "*In agreement with the owner of our ERP system we mostly do not update the database, but yes, it is technically possible".* (IT/data expert). Here single values in only one column of a table in source database can be enriched, without updating the other columns and values in the same table. Not every value can be changed. A unique number, for example, that refers to other tables as well, should not be changed, because it would corrupt the functionality of the source database. "*Basically, we do update the database, but as you saw it yourself it is possible to change values, that do not affect others"* (IT/data expert).

4.6 Influencers of Information integrity

After illustrating what this organization does to enrich source data, it's essential to get the influencers clear first, before findings can be summarized. A systematic analysis compares the different manners of the influencers of information integrity (Table 1). This analysis links and visualizes the influencers per stage. For instance, per stage and category of influencers are a couple of effects listed. If the effects are connected, they have the same underscore. The influencers don't affect each stage of information integrity equally.

Table 1 Systematic analysis

Stages	IS architecture (4.2)	KM perspectieve (4.1)
1. Generating new insights and source data	1.1 Data warehousing support generating new insights and source data. 1.2 BI Reports, tools and queries are custom-made	1.1 The BI-specialist is highly skilled. He owns all the knowledge about BI, BI-users depend on the knowledge and experience of the BI-specialist. 1.2 BI-users know what outcome can be expected in BI cubes, because the BI solution is custom-made. 1.3 BI-user has a high standard of interpretation ability. He can reflect BI outcome to business and is able to analyse causes of data errors.
2. Knowledge sharing (4.4)	2.1 The IS architecture supports automated knowledge sharing.	2.2 People are responsible for processes. An open-door policy, training on the job and backup systems encourages people to share their insights about data errors. People also try to identify causes of data errors to avoid the same errors in the future. 2.3 When people know, they develop an overall responsibility of business processes. 2.4 Sharing data errors with a responsible person initiates data enrichment.
3. Information transfer (4.5)	3.1 IS architecture supports mass data upload via EDI or by updating source databases 3.2 Information transfer in form of an import via EDI writes over all data in one table in source database 3.3 Enriching source by updating source databases, values in one	3.1People who transfer data and information are highly skilled. They need to work as carefully as possible. These people know exactly what to do. 3.2 If people don't work carefully or do not know what they do, data errors could be transferred, they can cause unreliable outcome in BI.

	column of a table can be changed in one time, without writing over the values in other columns of the table.	
4. Information integrity (5.1)	4.1 The organization decided to develop BI solutions instead of ERP modules, because the ERP system doesn't support reporting for decision making. 4.2 Information becomes available, when loaded to process into a data warehouse. 4.3 Information becomes reusable, when processed and visualized in BI reports, tools or check queries. 4.4 Information becomes reliable, when information about data errors will be shared, and information will be transferred to enrich source data.	4.1 BI-users developed a high standard of interpretation ability by learning how to apply BI cube for their decision making. Cube mechanism provide custom made BI reports 4.2 When people know their processes, they can gather the right information for their decision-making through BI solutions. 4.3 When people feel responsible and when they know whom to contact, they will share data errors to enrich source data. 4.4 People who enrich source data are responsible and highly skilled

4.7 Summary of the findings

The history and circumstances of the organization allow the improvement of information integrity. First, the organization enables the availability of all source data. They integrate all source databases into a data warehouse. Here, data is processed in a cube and SQL constraints. Getting confronted with unreliable outcome in BI solutions, the organization has developed check-queries that check source data for correctness to enrich source data. The outcome of a check-query is mailed to a responsible person, who solves the data error in the source database. Employees share insights about data errors because they feel responsible for the business.

Sharing inaccurate outcome of BI mobilizes others to transfer information and enrich source data. They fill missing values or correct wrong ones, either manually, via EDI import or by updating source bases. Every ERP-user and functional process owner can enrich source data manually. Only a few people can import data via EDI. The BI-specialists can enrich source by updating source databases. The last type of data enrichment is quite risky because data errors can corrupt the ERP system itself.

5. Conclusion

Businesses depend on the right information at the right time for efficient decision-making. Only when the information is available, reliable and reusable, then investments in Business Intelligence (BI) solutions become an effective strategy to support decision-making (Herschel & Jones, 2005). This research was meant to explore the three-dimensional problem of information integrity to find out, how organizations can be sure that they use the right information for their decision-making. Therefore, the following research question has been defined: *"How does the integration of KM and BI help to improve information integrity for better decision-making?"*

Scholars argue for integrating KM and BI to support decision-making. It provides organizations with the right information at the right time for their decision-making (Shehzad & Khan, 2013). The integration of KM and BI supports the integration all source databases into the source layer. Here all explicit knowledge, such as data and documents are integrated and will be loaded via ETL into the logical layer, where KM- and BI techniques interact with each other to discover knowledge and support decision-making in the presentation layer (Cheng & Cheng, 2011). By examining the literature on KM and BI integration, it can be concluded that existing KM and BI integration models refer to the availability and reusability of information but not to its reliability. Scholars do not explain if the right information will be used for another purpose than decision making. The identified gap has been tried to close through a proposal: information resulting from KM and BI integration should be used to enrich missing or inaccurate source data to ensure information reliability. Information transfer, such as enriching source data need to be initiated (Roberts, 2015). Therefore, decision-makers should share their insights about data errors in a closed loop because data errors affect their decision making. In other words, organizations must adopt first hierarchical design ideas of information system development (Cheng & Cheng, 2011) to ensure information availability and reusability. Then, they should use a KM process, like sharing their knowledge (Hislop, 2009) and transfer the information (Roberts, 2015) to enrich source data.

The exploratory qualitative research helped to establish underlying relationships of information integrity. Semi-structured interviews have been conducted to explore reasons and motivations for information integrity and what organizations do to enrich source data. The collected data from the interviews have been analysed with data coding (Appendix XI). Findings indicate that missing or inaccurate source data cause unpredictable outcomes from BI. When BI-users detect data errors, they analyse them to find out the cause. They try to find out how data errors have happened, to decide what kind of actions are required to solve the data issues and prevent them in the future because data errors affect their decision-making. Therefore, BI-users share their insights with other decision-makers, such as IT/data specialists or with functional process owners to assure that data errors will be solved. The researched organization also applied data correctness checks, like automated check queries, made with SQL constraints; that specify the conditions of single rows in source databases according to existing data business rules. Sharing insights, personal or automated, about data errors initiates information transfer. This transfer can be seen as a systematic distribution of information to enrich source data because data errors in source data affect BI outcome and decision-making. To conclude, the researched organization guarantees the right information for their decision making because its ensures information integrity. The organization integrates all source data in data warehouse and IS architecture supports reporting and tooling for multiple purposes. People share their insights about data errors to initiate source data enrichment.

5.1 Discussion

Four aspects of the research findings will be discussed below. First, reasons and motivations for information integrity and why knowledge sharing and information transfer should be added to existing KM and BI integration models. Second, the influence of different KM perspectives on KM and BI

integration. Third, the relation of BI solutions and people's ability of interpretation. The last aspect that should be discussed is about updating source databases to enrich source data. Together, these aspects form a relation that can be called the process of information integrity (Figure 4).

The first aspect that needs to be discussed is about reasons and motivations for information integrity. Reasons and motivations for information integrity were not discussed in existing KM and BI literature, but they were explored during empirical research. Scholars argue that integration of KM and BI enables the right information at the right time (Shehzad & Khan, 2013), but they don't discuss, where else this information is useful. Cheng and Cheng (2011) mention feedback and evaluation and Rostami (2014) introduced a people-centric approach. It is not clear, how the 'right' information can be used for continued improvement (Sharda et al., 2014) of BI. As explored in empirical research, decision-makers share their insights about data errors because they want to limit inaccuracy of BI outcome. When they detect data error's they want to share this information because faulty source data affects BI outcomes and decision-makers would use inaccurate information for their decision-making. Sharing insights about inaccurate source data initiates information transfer for source data enrichment. These insights about knowledge sharing and information transfer can be useful in addition to existing KM and BI integration literature.

The fact that decision makers want to share their insights about data errors refers to the KM perspective wherein they operate. The identified KM perspective in the literature review differs from the identified KM perspective in empirical research. Both perspectives need to be analysed and compared in their effect on information integrity. KM and BI integration take mainly an objectivist perspective towards knowledge because explicit knowledge will be transferred to support decision making (Appendix VI). Current research introduced in addition to the objectivist perspective of knowledge a people-centric approach. In KM systems, people will apply knowledge and address it to problems (Roberts, 2015). This approach is like a practice-based perspective towards knowledge (Appendix VI), pointing out that knowledge is inseparable from humans because it is embedded in practice, embodied in people and socially constructed (Hislop, 2009). Qualitative research at Florensis BV reminds of the Rostami (2014) people-centric approach. This organization was described as an open-dynamic company where people share their insights to continue to improve their business. The objectivist perspective toward knowledge could not be found in this organization because people rather prefer to talk with each other than to document their procedures. In summary, KM and BI integration scholars propose a people-centric KM approach that mainly takes an objectivist perspective toward knowledge and empirical research identified a practice-based perspective toward knowledge that is similar to the people-centric KM approach of Rostami (2014). It seems that an objectivist perspective toward knowledge is required to enable knowledge discovery and a practice-based perspective toward knowledge mostly supports knowledge sharing and the initiation of information transfer.

The third aspect deals with the discussed and identified BI solutions. This aspect is important because it caused the possible influence of methodological biases and errors on data validity. The transferability of research could be in danger. The BI mechanism that has been described in KM and BI literature differs from the findings of empirical research. Scholars argue the use of data mining as BI mechanism (Cheng & Cheng, 2011; Herschel & Jones, 2005). In empirical research the situation was different. The organization runs a cube mechanism to generate custom-made BI reports, queries and tooling. The average BI-user knows what outcome to expect because in most cases he was involved in developing the BI report. When the BI-user knows what outcome he can expect, he can detect data errors. Through developing the use of BI solutions, the BI-user developed a high level of interpretation ability. In other words, he can judge, whether the outcome of BI is correct or not. Scholars of KM and BI integration don't discuss if this

interpretation ability is possible to develop with data mining techniques and if should be required to feedback and evaluate (Cheng & Cheng, 2011).

The last aspect that should be discussed is about the effectiveness of all identified data enrichment techniques versus the risk, applying these techniques. It is interesting that the most efficient enrichment techniques are mainly forbidden, because of the implied risk. In Chapter 4 Findings, three types of data enrichment methods were described. Data can either be enriched manually, via EDI import or by updating source databases. Manual data enrichment takes place value by the value frond-end in the source database. The second type of data enrichment imports files into source databases. These files are single tables in source databases, wherein all values within a row will be imported into source database. All existing values in the source database will be updated through import via EDI. The third identified method is data enrichment by updating source databases to change single columns within a table in the database. This method is the most effective method because it can enrich only the value that needs to be filled or corrected. This method is known for its risk of database corruption. Enriching source data by updating source database requires the insights of database setups, like data models. To avoid these kinds of conflicts, database owners, mostly try to forbid these data enrichment methods in contracts.

All identified aspects should be shown in their relation to each other, to understand the underlying reasons better for information integrity. This relation can be illustrated in a relation model, also called paradigm model (Flick, 2011). This model has been shown in Figure 4, and it is the result of data analysis, illustrating the relationships of each step of this data enrichment process and its influences.

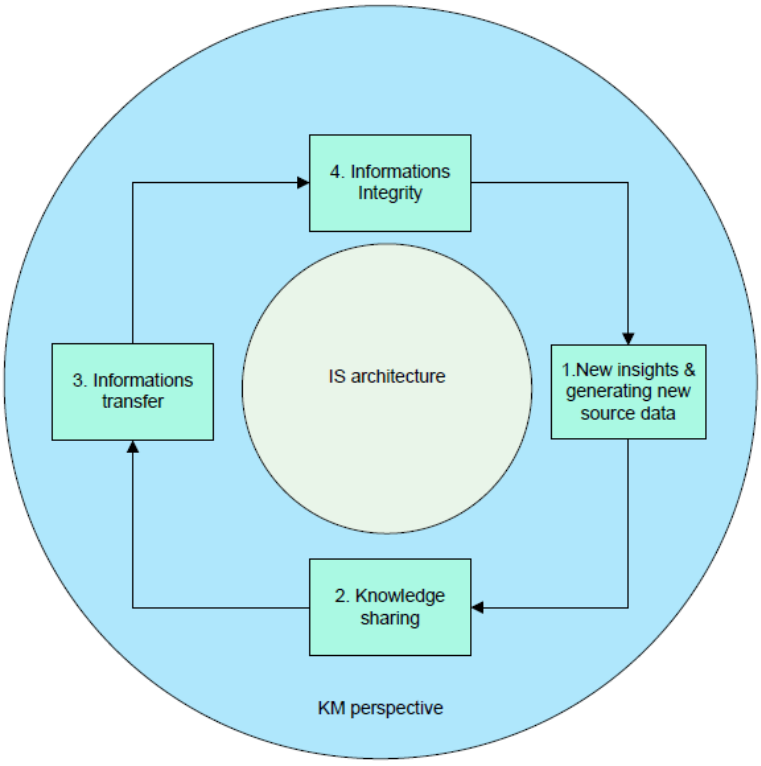

Figure 4 Information integrity process

The process of information integrity (Figure 4) can be seen as a continuous improvement process of decision-making (Sharda et al., 2014) that is influenced by two organizational conditions. The first condition is about the IT function. How does it support the business in decision-making? The second condition, the KM perspective, integrates and influences all steps. Knowing how people in organizations

deal with each other helps to understand how knowledge sharing and information transfer takes place and how these, in turn, benefit information integrity.

At this point of research, underlying relationships of information integrity that have been researched where supported by the organizational conditions, in which research took place. In other words, a practice-based perspective toward knowledge and the situation of IS architecture and data processes support to close the loop toward information integrity. Information integrity benefits from identified circumstances at Florensis BV. This organization assures the right information for their decision-making.

5.2 Practice recommendations

Data enrichment by updating source databases is efficient and reliable if system requirements of the source database will be respected. Given that this method is mostly forbidden and unwanted, source database owners and business owners should innovate together, for example by developing best practice guides for data enrichment/enhancement methods involving updating source databases. These guides could generate insights and understanding of business processes in combination with system requirements through identifying patterns and context in functional requirements (Mosley, Brackett, Earley, & Henderson, 2009).

Based on the evidence from my empirical research, I recommend a combination of objectivist and practice-based perspective toward knowledge supportive for continuous improvement of BI (Sharda et al., 2014). Scholars of KM and BI integration mention feedback and evaluation (Cheng & Cheng, 2011) and a people-centric approach (Rostami, 2014). Nevertheless, it's unclear, whether the results of BI analysis could be used to improve information integrity. The two additions to the existing integration models that I am proposing create a closed loop that enables improved information integrity. Therefore, knowledge resulting from BI analysis should be shared with other decision-makers to initiate a process of information transfer that in turn enriches source data.

5.3 Recommendations for further research

Business is interested in the accuracy of knowledge discovery through interaction of text and data mining and how this information could be used to enrich source data. Given, that literature review of KM and BI integration literature fails to describe how the interaction of text mining and data mining works, and this was also not the objective of my empirical research, further research should be done on this topic.

During the review of the literature, the terms 'data enrichment' (Lambert, 2014) and 'data enhancement' (Mosley et al., 2009) has been discussed. 'Data enrichment' was found in business language and 'data enhancement' was found in science. It is unclear, whether they are defined the same or not. Scholars should clarify both terms and apply one. Moreover, data enrichment by updating source databases affects Metadata, also known as information about information and logging data in source databases. Further research should take place about the effects of data enrichment by updating source databases on Metadata.

Methodological biases and errors on data validity of applying cubes mechanism instead of data mining as BI solution is possible and leaves an interesting question: "*Does people's interpretation ability differ by using different BI solutions?"* In other words, are people able to detect data errors in BI output, if they apply data mining techniques? Scholars should do further research on people's interpretation ability detecting data errors, when they apply different BI solutions.

5.4 Reflection

This section demonstrates my ability to identify the strengths and weaknesses of the methodology used and to refer them to the quality of the outcomes achieved. I have classified four strengths and three weaknesses of methodological use.

The thesis topic, information integrity was researched in two parts. First, I reviewed the relevant literature. Second, I conducted empirical research at Florensis BV to examine how they close the gap that was identified during literature review. I enjoyed researching the topic information integrity a lot. I found this topic during a job interview. I asked my interview partner what kind of knowledge management challenge he has in his position. He answered that he would like to know how he can be sure of using the right information for decision-making. This question was fascinating to me as an upcoming data management expert. For me, it was clear why this topic needed to be researched. Nevertheless, identifying reasons to research and logically organize them was quite iterative. In other words, I struggled with the iteration of revising my argumentations. I classify these circumstances as a weakness of the methodological use because I didn't understand back then, how to use iteration to improve. If I could start this research again, I would clarify the problem of information integrity more effectively to avoid taking more time than needed to define relevant reasons to research.

After outlining the steps of the literature review, I started searching for literature. The literature review was meant to find out how the integration of KM and BI works can and how it supports information integrity. Searching for the chosen key terms did not turn up any results. As I could not find any literature, I started searching the World Wide Web (internet) to find other key terms or at least an explanation of KM and BI integration. Surprisingly, I found a website of Richard Herschel, who is one of the pioneers of KM and BI integration. I classify the decision to search on the internet as a methodological strength. Searching the internet, helped me to find literature in science. Through applying the snowball search technique, I found reliable literature about KM and BI integration. Real problems in business processes and IT, such as information integrity are often not researched in detail yet. Hence, searching for key-words on the internet should be part of the literature review.

After a gap was identified in existing literature, I wrote a proposal for two additions to existing KM and BI integration models. Searching for literature that supports my proposal was difficult yet again. Because the problem of information integrity has not been studied yet, almost no literature was found in academic search machines. I searched again on WWW and found blogs of Bob Lambert (2014), who wrote about data enrichment. The definitions he gave for this term was similar to the definition of (Mosley et al., 2009) 'data enhancement'. Business uses the term 'data enrichment' and science applies to the same definition the term 'data enhancement'. To enable the reader to follow my story of information integrity, I applied a combination of both terms: 'data enrichment/enhancement' during the proposal section. I applied the term 'data enrichment' during summary, empirical research findings, conclusion and discussion, I applied the term 'data enrichment' because it was found in business. I also recommend for further research to clarify both terms. Discussing both terms was needed because science needs to be clear and business needs to be able to follow and to adapt. I classify the chosen terminology as a strength of methodological use because it helps to address recommendations for further research.

The proposal led to two questions for empirical research: what are reasons and motivations for information integrity and how organizations enrich source data. An exploratory qualitative research approach was chosen because the three-dimensional problem of information integrity has not been studied before. I started working at Florensis BV as a data specialist, two months before I started with empirical research. The organization was also interested in the topic, thus what needs to be done to know that decision-making will be supported by the right information. Florensis BV also supports the

development of their employees, that's why they allowed me to do the research. I decided to take semi-structured interviews because this interview technique allows me to prepare the interviews and to compare qualitative data (Saunders, Lewis, & Thornhill, 2012). Together with one of the managers, I collected 12 interview candidates, and all of them joined the interviews. I had planned the interviews during the summer. This period was ideal because all my interview partners had time and enjoyed the interviews. The different perspectives of all candidates enabled a broad data collection that has been transcribed first before I started data coding. I'm realizing that the organizational conditions in combination with the research question for empirical research influencing recommendations for further research. For instance, if the organization wouldn't enrich their source data by updating source databases, even if it is forbidden, I wouldn't recommend standardizing data enrichment by updating source databases to avoid source database corruption. I classify the choice of research design for empirical research as a strength of methodological use because it enables insights on source data enrichment, which can be used for further recommendations.

Another aspect of research that should be named for reflection is the methodological bias of the identified BI solutions, which could be relevant for the transferability of research. Data mining was mentioned in existing KM and BI integration literature and a cube as BI solution was found during empirical research. The cube mechanism supports a high standard of interpretation ability of the BI-users because reports are most likely custom made. It is not clear of data mining reports support the same interpretation ability of BI-users. The outcome of empirical research would have been different if the organization would have applied data mining as BI mechanism. I discussed my findings and I recommended further research on the interpretation ability to use different BI solutions.
I mentioned in my conclusion that the IS architecture affects information integrity. The BI solution is part of this architecture and affects information integrity. (Figure 4). The choice of organization for empirical research causes possible methodological bias. These circumstances can be classified as a weakness of methodological use. If I could do research again, I would search for an organization that uses data mining as BI solution to avoid methodological bias.

The iterative process of open, axial and selective coding has taught me a lesson. The story of information integrity was based on my proposal, and empirical research illustrates that this organization shares their insights of data errors in BI to enrich source data. I applied first open codes that were mostly related to my proposal and the questions I asked during the interviews. In the end, I can say that coding helped me to tell the story of information integrity. I also entered the amount of all quotes per code to each code in the codebook. Here we see, that certain codes, such as 'BI solutions' were coded more often than for example 'Logical data checks in BI tools'. When a code has been quoted twice as others, different codes have been summarized to one code. If I could do data analysis again, I would try to be specific in coding directly, and I would ask myself how a code could help to answer the research question.
I realized too late that a lot of my codes meant the same. Just like at the beginning of research, I still struggled with iteration. These circumstances have been classified as a weakness of methodological use already.

Writing a research paper takes a lot of time, effort, and organization. It was a fantastic opportunity to explore information integrity because the insights I got can be applied in the job and probably for further research. The frequent correspondence with my supervisor helped to progress and kept me focused on the research process and the research question. After all, chapters were written, I got the advice to start revising the report. I reviewed the entire report according to Simons (2012) checklist. This checklist was helpful also for my English skills because an explanation was given to each aspect that should have been checked during revision. Applying the checklist of Simson (2012) for review can be seen as a methodological strength because it helps to be consistent and to improve writings.

With this thesis, I transformed a simple question into a thoroughly researched and well-written paper. Reading the paper repeatedly for revision reminded me of the exciting time investigating the three-dimensional problem of information integrity. I hope that I will have the chance to continue researching information systems topics.

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Appendix

I. Literature research execution
II. Search queries
III. Summary of literature research
IV. Summary of proposal research
V. Literature review results
VI. Comparing KM approaches
VII. Introduction and inviting for interviews
VIII. Interview guide lines
IX. Permission to record
X. Data collection Summary
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I. Literature research execution

After getting familiar with KM and BI background (query 1, Table 2), the keywords *knowledge management*, *business intelligence* and *integration* were identified. In a Boolean search with AND operator, literature about the integration of KM and BI could not be identified (query 2, Table 2). Searching for the integration of KM and BI on the World Wide Web (query 3, Table 2) led to the identification of one of the founders of integration of KM and BI, Richard T. Herschel. A validity check about this source (query 4, Table 2) helped to identify the first KM and BI framework of Herschel and Jones (2005). Considering this paper as relevant because the integration of KM and BI was the main topic, snowball search was applied. That means, to search for cited papers (query 5 and 6, Table 2). With these technique papers of Sharma (2010), Cheng & Peng (2011), Shehzad and Khan (2013) were identified. Continuing snowballing (query 7 and 8, Table 2) led to the identification of the papers of Gadu and El-Khameesy (2014) and Rostami (2014). In total, 14 literature sources were identified for further research, and 12 sources were selected (**Fout! Verwijzingsbron niet gevonden.**).

As already been said, existing KM and BI integration literature could not answer all questions how information integrity can be supported. Therefore, a proposal was made as an addition to existing KM and BI integration literature. For this proposal, literature was searched to ground the ideas in theory.

After defining a new research question for the proposal, keywords, such as *knowledge sharing, information transfer, and data enrichment/enhancement* were deduced (query 9, Table 2). During searching for relevant literature, it has been noticed that science uses the phrase 'data enhancement' and real business adopts the phrase 'data enrichment' (query 10 and 11 Table 2). It is not clear if science means something else with 'enhancement', then business, when it's using 'enrichment' (query 12, Table 2).
Therefore, the decision was made to apply a combination of both phrases 'data enrichment/enhancement'. In total, three literature sources were identified all were selected for further research (**Fout! Verwijzingsbron niet gevonden.**).

Different analysing techniques were applied, to assure a consequent content analysis of identified literature helps to answer the research questions. Like comparing quality aspects, summarizing frameworks, and compare frameworks in selected literature. These analysing techniques enabled a consistent quality of literature review and a steady base for the documented results.

II. Search queries

Table 2 Search queries

Query	Description	Source	Results	Selected
Literature review				
No 1	Advice supervisor content search within KM field	Google Scholar	5	3
No 2	AB "knowledge management" AND AB "business intelligence" AND AB integration imiters - Published Date: 20070101-20161231 Search modes - Boolean/Phrase	EBSCO	10	0
No 3	Knowledge Management & Business Intelligence	Google	∞	1
No 4	AU Richard Herschel	EBSCO	7	1
No 5	Herschel and Jones, 2005 Cited Crossref Cited Scopus	ournal of Knowledge Management	 50 61	 2 3
No 6	Herschel and Jones, 2005 Cited	Google Scholar	187	2
No 7	Shehzad, 2013 Cited	Google Scholar	31	1
No 8	Gadu, 2014 Cited	Google Scholar	1	0
Proposal				
No 9	Advice supervisor content search	Google Scholar	2	1
No 10	AB “data enrichment”	EBSCO	0	0
No 11	AB “data enhancement”	EBSCO	139	1
No 12	Data enrichment	Google	∞	1

III. Summary of literature search results

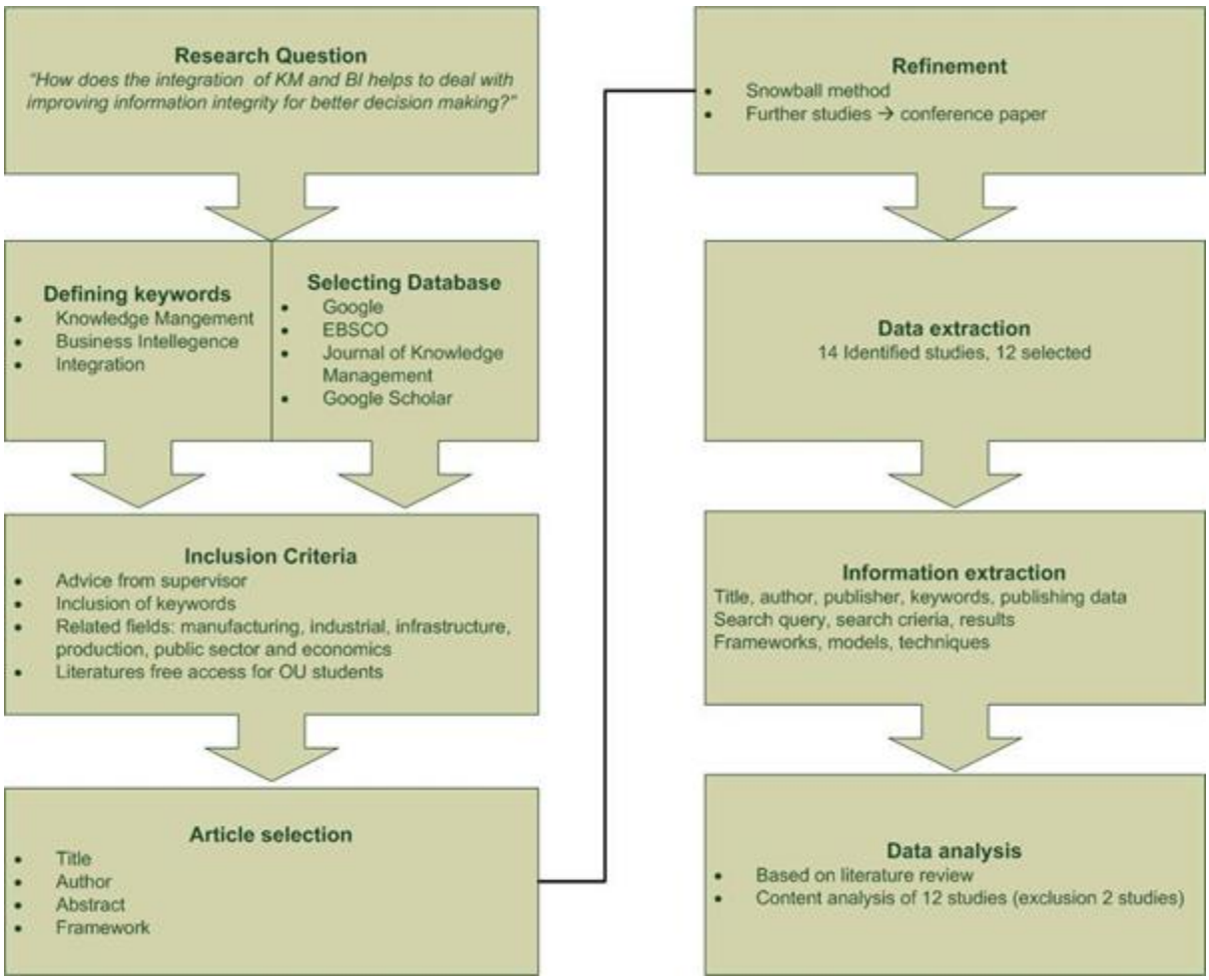

Figure 5 Structure review process literature search results

IV. Summary of proposal search results

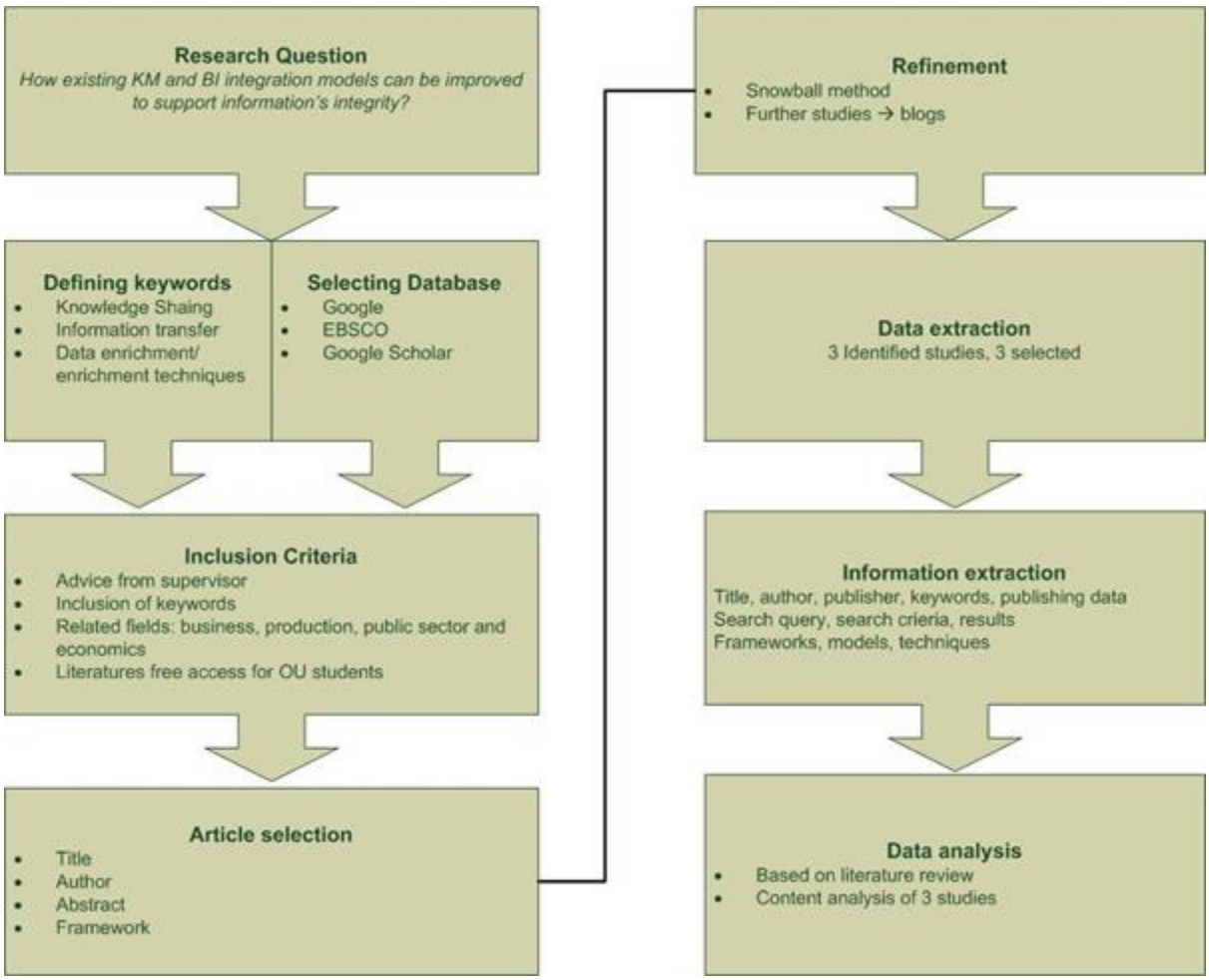

Figure 6 Structured process proposal search results

V. Literature review results

Table 3 Literature review results - identified studies

Query	Literature	Author	Source	Selected (Yes/No)	Not selected - reason
2	Knowledge management and business intelligence: the importance integration Journal of Knowledge Management, Vol. 9 Iss 4 pp. 45 - 55	Herschel & Jones (2005)	EBCSO	Yes	
4	Two Heads Are Better Than One. International Journal of Systems and Service-Oriented Engineering 1:2	Sharma et al. (2010)	Journal of Knowledge Management – Crossref	Yes	
4	Integration: Knowledge Management and Business Intelligence.2011 Fourth International Conference on Business Intelligence and Financial Engineering	Cheng & Cheng (2011)	Journal of Knowledge Management – Crossref and Scopus	Yes	As a student of Open University, I have no free access to this paper, because three others refer to their model, seemed relevant and I got it via my supervisor
4	The relationship of business intelligence and knowledge management.2010 2nd IEEE International Conference on Information Management and Engineering	Weidong et al. (2010)	Journal of Knowledge Management – Crossref and Scopus	No	No free access

4	Rationalising Business Intelligence Systems and Explicit Knowledge Objects: Improving Evidence-Based Management in Government Programs Info. Know. Mgmt. 13, 1450018 (2014) [18 pages]	Carlton et al. (2014)	urnal of Knowledge Management – Scopus	No	No free access
4	Integration of Business Intelligence and Knowledge Management –A literature review Journal of Intelligence Studies in Business, 2014	Rostami (2014)	urnal of Knowledge Management - Crossref	Yes	
5	Integrating Knowledge Management with Business Intelligence Processes for Enhanced Organizational Learning International Journal of Software Engineering and Its Applications, Vol. 7, No. 2, March, 2013	Shehzad & Khan (2013)	Google Scholar	Yes	
5	A Knowledge Management Framework Using Business Intelligence Solutions International Journal of Computer Science Issues	Gadu & El-Khameesy (2014)	Google Scholar	Yes	
6	Investigation of Knowledge Management support for Business Intelligence in Saudi Arabic Sector Proceeding of the 15th European Conference of Knowledge	Alrumaih & Zemirli (2014)	Google Scholar		

	Management, Portugal, 2014 p. 39-46				
Proposal					
	Single-Loop and Double-Loop Models in Research on Decision-making	Argyris (1976)	Google Scholar	Yes	
	The DAMA Guide The Data Management Body of Knowledge (DAMA-DMBOK Guide)	Mosley et al. (2009)	EBSCO	Yes	
	ps://www.captechconsulting.com/blogs/guiding-principles-for-data-enrichment	Lambert (2014)	Google	Yes	

VI. Comparing KM approaches

According to Hislop (2009), KM is an 'umbrella-term', wherein two perspectives of KM are possible. Hislop (2009) describes how objectivist perspective and practice- based perspective differ from each other (Table 5). By analysing selected literature, I found out, KM and BI integration is mainly an objectivist perspective approach but over time researchers add a practice-based perspective (Table 6). In Table 6, I present most significant statements of selected literature and their KM approaches. Based on Table 5, I will give an interpretation of the chosen statement, if it is either an objectivist perspective KM approach or a practice-based KM approach.

Table 4 KM approaches according to Hislop (2009)

Objectivist perspective (Hislop, 2009 p. 19 and 27)	Practice-based perspective (Hislop, 2009 p. 35 and 45)
- knowledge is an entity/object	- knowledge sharing/acquisition requires 'perspective making' and 'perspective taking' developing an understanding of tacit assumptions
- based on a positivistic philosophy: knowledge regarded as objective 'facts'	- knowledge sharing/acquisition through rich social interaction and immersion in practice (watching and/or doing)
- explicit knowledge (objective) privileged over tacit knowledge (subjective) - convert tacit knowledge into explicit knowledge (codification)	- managing role to facilitate social interaction
- knowledge is derived from intellectual processes	- tacit and explicit knowledge are inseparable and mutually constituted
- technology plays a key role	- knowledge is multidimensional

Table 5 Analysis KM-approaches

Article	Objectivist perspective	Practice- based perspective
Herschel & Jones (2005): "*Text mining, seen primarily as a KM technology"* (p. 47) KM is about tacit and explicit knowledge and enables transformation and interaction between both.	Knowledge is an object and technology play a key role Knowledge can be converted.	
Sharma et al. (2010): introduces Web 2.0 tools as knowledge creation systems according to Nonaka and Takeuchi (1995) knowledge creation spiral, to support decision-making with BI. "*Web 2.0 supports the interplay between tacit and explicit knowledge"* (p. 3)	Authors privilege objective knowledge that can be captured in Web 2.0 tools. Technology plays a key role	
Cheng & Cheng (2011): *"KM stressed that knowledge is the most valuable resource and strategic capital, the corporate competitive advantage depends on knowledge creation, dissemination and utilization."* (p. 308)	Knowledge is an object, that can be derived from intellectual processes	
Shehzad & Khan (2013):" Knowledge *is categorized into two types: tacit and explicit knowledge. 'Explicit or codified knowledge is communicable in an official or organized language. Whereas, tacit knowledge corresponds to the personal traits and qualities present within an individual".* (p. 84) *"KM helps to extract knowledge from unstructured information, that is mostly textual".* (p.84)	Authors see tacit and explicit knowledge as two distinct categories. Knowledge is derived from intellectual processes	
Rostami (2014): *"KM refers to a systematic framework to capture, acquire, organize, and communicate both tacit and explicit knowledge of employees"* (p.33) *"KM is not always about technology, but it's also about understanding how the people work."* (p.33)	Knowledge is derived from intellectual processes, wherein technology plays a key role	Knowledge is embedded in practice and culture. KM in the managing role to facilitate

"KM systems are people centric. People create, share, disseminate, use and apply knowledge." (p.33)		social interaction
Gadu & El- Khameesy (2014): *"Knowledge is a group fact, etc."* (p. 102) *"Knowledge is integrated into the products and processes of a company"* (p. 102) *"KM transforms data and/or information into actionable knowledge."* (p.102) "KM is about making sure that an organization can learn." (p. 102)	Knowledge is an object Knowledge is derived from intellectual processes Explicit knowledge (objective) privileged over tacit knowledge (subjective)	Knowledge sharing through rich social interaction and immersion in practice.
Alrumaih & Zemirli (2014): *"KM captures, stores, organizes and distributes organizational knowledge and resources".* (p.41) *"KM is multileveled in organizations."* (p.41) "KM enables collaboration and learning" (p.41)	Knowledge is derived from intellectual processes	Knowledge is multidimensional Knowledge sharing requires 'perspective making' and 'perspective taking' developing an understanding of tacit assumptions

VII. Introduction & inviting for interviews

Beste …,

Mijn naam is Catrin Niesel en ik werk sinds mei 2017 als Master Data Specialist bij Florensis BV. Ik ben naast mijn werk sinds 2015 bezig de Masteropleiding Business Process Management and IT aan de Open Universiteit. De studie omvat 60 ECT's, welke zich naar een studielast van 10-15 uur per week laten vertalen.
Voor mijn afstudeerproject heb ik het vak Business Intelligence (BI) gekozen in combinatie met Kennismanagement. In 2016 ben ik begonnen bij verschillende bedrijven op zoek gegaan naar een uitdaging op het gebied van kennismanagement (KM) gegaan. Een vraag die me heel erg aansprak heb ik uiteindelijk opgepakt voor nader onderzoek.
De vraag die ik meekrijg was: *"Hoe kan ik zeker zijn van de juiste informatie voor mijn besluitvorming?"* Uit mijn ervaring als bedrijfskundige weet ik dat informatie in complexe organisaties nog wel onbetrouwbaar, niet altijd beschikbaar en al te vaak niet herbruikbaar is. Dit driedimensionaal fenomeen heb ik als 'informatie integriteit' samengevat en gesteld dat door verbetering van de informatie integriteit de besluitnemer vanzelfsprekend zijn besluit op basis van de juiste informatie neemt. Ik wil nu met behulp van empirisch onderzoek nagaan hoe de business met het fenomeen 'informatie integriteit' omgaat.
Voor het onderzoek heb ik een exploratief aanpak gekozen, omdat het probleem rond de informatie integriteit nog niet tot de diepte is onderzocht. Exploratief onderzoek is kwalitatief, waardoor ik de mogelijkheid heb kleinschalig diepgaand onderzoek te doen om de problematiek nog beter te kunnen duiden. Voor dit onderzoek pas ik semigestructureerde interviews toe, waarbij ik tijdens een gesprek vragen over een aantal onderwerpen stel.
In overleg met de manager IM heb ik een selectie van mogelijk interviewkandidaten gemaakt waar jij er een van bent. De interviewkandidaten zijn ingedeeld in twee groepen: BI-gebruikers en IT/data experts. Jij bent een van IT-experts en daarom wil ik graag met je spreken omdat je kennis en ervaring mij inzicht kunnen geven over onderwerpen rondom BI ten behoeve van besluitvorming en informatie integriteit.
De interviews vinden plaats tussen week 28 en 35 (excl. week 30). De deelname aan de interviews is vrijwillig maar ik zal je bijdrage erg op prijs stellen. **Graag hoor ik vóór 11 juli of je mee wilt doen met deze interviews.**
Voordat het interview plaatsvindt, zal ik je schriftelijk toestemming vragen voor de stemopname van het interview. Ieder interview wordt geanonimiseerd. Na de opname ga ik het interview overtikken en aan jou ter inzage en zo nodig correctie voorleggen. Het definitieve interview document ga ik m.b.v. open coding software analyseren. Door open coding kunnen patronen worden ontdekt, die helpen een conclusie te vormen.
Het interview zal ongeveer één uur duren maar ik zal 90 minuten inplannen, voor mogelijke uitloop.

Alvast bedankt voor je deelname!
Graag tot kijk

Met vriendelijke groet
Catrin Niesel

VIII. Interview guideline BI-user, IT expert

Table 6 Interview guide BI-users

	Theme	Question NL	Probing
1	Business Intelligence	Graag wil ik dit interview beginnen met het onderwerp Business Intelligence. Kun jij mij vertellen voor welk doel Business Intelligence binnen deze organisatie wordt toegepast?	- Binnen welke processen gebruik je BI? - Gebruik je BI voor meerdere doeleinden? - Zou je een voorbeeld kunnen geven? - Ik begreep uit eerdere gesprekken dat BI ook wordt toegepast om de tekortkomingen van ERP te verhelpen. - Kun je hier iets meer over vertellen? - Welke tabellen kunnen in ERP bv niet worden gecombineerd? - Waarom heb je het inzicht door de combinatie van de tabellen nodig?
2	Business Intelligence	Vertel mij aub hoe je BI in je dagelijks werk toepast!	Kun je een voorbeeld geven?
3	Business Intelligence	Kun je mij vertellen wat ik zeker moet weten om BI in deze organisatie te gebruiken?	- Welk soort kennis heb je nodig om BI te kunnen gebruiken? - Hebt u een extra training ontvangen voordat u BI gebruikt - Volg je een protocol om BI te gebruiken Heeft u een beschrijving hoe u BI kunt gebruiken - Hebt u een helpdesk of een andere ondersteuning? - Indien proceskennis nodig, welke processen bedoel je precies? - Waarom is proces kennis volgens jou nodig?
4	Business Intelligence	Hoe heeft het gebruik van BI over de jaren heen zich ontwikkeld?	- Zie je tegenwoordig meer informatie? - Win je nu meer inzichten? - Weet jij of er ontwikkelingstrajecten gaande zijn?
5	Business Intelligence	Om verder te gaan, zou ik graag meer willen weten over de voor- en nadelen van het gebruik van BI die je ervaren hebt.	- Kun je een voorbeeld van een voordeel noemen? - Wat zijn voordelen en waarom? - Wat valt tegen in het gebruik? - Waarom vind je dat tegenvallen? - Wat vind je van de informatie uit BI? - Kun je dit beschrijven
6	Business Intelligence	Indien nog niet verteld: Kom je ook weleens inaccurate informatie in BI tegen? Of, je hebt net verteld dat een van de nadelen inaccurate informatie output is. Hoe ga je hiermee om?	- Ga je altijd ervan uit, dat je van de juiste informatie gebruik kan maken? - Kun je een voorbeeld van inaccurate data output noemen?

7	Business Intelligence	Hoe kom je erachter dat je te maken hebt met inaccurate informatie in BI? Kun je een voorbeeld geven?	- Hoe merk je dat de output niet klopt? - Kun je een voorbeeld noemen?
8	Knowledge Management	Ik zou het interview graag voort willen zetten met vragen over kennismanagement. Kun je mij vertellen hoe in deze organisatie met kennis wordt omgegaan? a. Hoe wordt kennis geborgd? b. Hoe wordt kennis gedeeld? c. Zijn er vaste momenten waarbij kennis wordt gedeeld?	- Krijg je een buddy als je nieuw binnen komt? - Special inwerkprogramma, trainingen etc? - Wordt alles opgeschreven? - Spreek je met elkaar af om kennis te delen? - Schrijf je e-mails? - Gebruik je blogs of wiki's
9	Knowledge Management	Vertel mij aub welke applicaties gebruik je om: a. kennis op te slaan en te organiseren? b. nieuwe kennis op te doen? c. kennis te verifiëren? d. kennis te delen?	
10	Knowledge Management	Wanneer KM-applicaties worden toegepast: a. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI op te slaan of organiseren? b. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI te delen? c. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI te verifiëren?	
11	Knowledge Sharing	Ik zou het interview graag voor willen zetten met meer specifieke vragen over het delen van de inzichten, die je wint door de inzet van BI. Vertel mij aub, hoe deel jij de nieuwe inzichten, die je behulp van BI wint?	- Kan iedereen bij het rapport, waaruit je je inzichten wint? - Met wie spreek je hierover? - Maak je een nieuw rapport/overzicht van, wat je kunt delen? - Hoe deel je het rapport? - Waarom doe je dit op deze wijze?
12	Knowledge Sharing	Kun je aangeven of je collega's die ook BI gebruiken op dezelfde wijze hun kennis delen?	- Maken je collega's ook een nieuw rapport/overzicht? - Kun je een voorbeeld geven?
13	Knowledge Sharing	Dat is interessant. Je hebt eerder vertelt dat je soms inaccurate informatie in BI tegenkomt, hoe deel jij deze inzichten?	- Wat doe je, als je inaccurate informatie in Bi tegen komt? - Deel je direct je inzicht? - Verifieer je eerst de correctheid van jouw inzicht?
14	Knowledge Sharing	Met welk doel, deel je inzichten over inaccurate informatie?	- Wens je dat de informatie wordt hersteld? - Waar zou je informatie naar jouw mening worden hersteld?

15	Knowledge Sharing	Indien als doel het verhelpen van de inaccurate informatie wordt genoemd: Op basis van je eerdere antwoorden zou ik tot slot graag meer over het proces willen weten, waarmee je het verhelpen van inaccurate informatie initieert. Kun je aangegeven hoe het proces verloopt?	- Zorgt het proces voor herstel? - Zorgt het proces voor voorkomen van inaccurate informatie? - Wie zijn de stakeholders?

Table 7 Interview guide IT/data experts

	Theme	Question NL	Probing
1	Business Intelligence	Graag wil ik dit interview beginnen met het onderwerp Business Intelligence. Kun jij mij vertellen voor welk doel Business Intelligence binnen deze organisatie wordt toegepast?	Binnen welke processen gebruik je BI? Gebruik je BI voor meerdere doeleinden? Zou je een voorbeeld kunnen geven? Ik begreep uit eerdere gesprekken dat BI ook wordt toegepast om de tekortkomingen van ERP te verhelpen. Kun je hier iets meer over vertellen? Welke tabellen kunnen in ERP bv niet worden gecombineerd? en waarom heb je het inzicht door de combinatie van de tabellen nodig?
2	Business Intelligence	Vertel me wat je weet over de BI-structuur!	Hoe is het opgebouwd? Wat voor soort diensten gebruikt u? Welke bron databases zijn geïntegreerd? Zijn alle bron databases geïntegreerd? Waarom integreer je alles/ niet alles?
3	Business Intelligence	Kun je mij vertellen wat ik zeker moet weten om BI in deze organisatie te gebruiken?	Welk soort kennis heb je nodig om BI te kunnen gebruiken? Hebt u een extra training ontvangen voordat u BI gebruikt Volg je een protocol om BI te gebruiken Heeft u een beschrijving hoe u BI kunt gebruiken Heeft u een helpdesk of een andere ondersteuning? Indien proceskennis nodig, welke processen bedoel je precies? Waarom is proces kennis volgens jou nodig?
4	Business Intelligence	Hoe heeft het gebruik van BI over de jaren heen zich ontwikkeld?	Zie je tegenwoordig meer informatie? Win je nu meer inzichten? Weet jij of er ontwikkelingstrajecten gaande zijn?
5	Business Intelligence	Om verder te gaan, zou ik graag meer willen weten over de voor- en nadelen van het gebruik van BI die je ervaren hebt.	Kun je een voorbeeld van een voordeel noemen? Wat zijn voordelen en waarom?

			Wat valt tegen in het gebruik? Waarom vind je dat tegenvallen? Wat vind je van de informatie uit BI? Kun je dit beschrijven
6	Business Intelligence	Indien nog niet verteld: Kom je ook weleens inaccurate informatie in BI tegen? Of, je hebt net verteld dat een van de nadelen inaccurate informatie output is. Hoe ga je hiermee om?	Ga je altijd ervan uit, dat je van de juiste informatie gebruik kan maken? Kun je een voorbeeld van inaccurate data output noemen?
7	Business Intelligence	Hoe kom je erachter dat je te maken hebt met inaccurate informatie in BI? Kun je een voorbeeld geven?	Hoe merk je dat de output niet klopt? Kun je een voorbeeld noemen?
8	Knowledge Management	Ik zou het interview graag voort willen zetten met vragen over kennismanagement. Kun je mij vertellen hoe in deze organisatie met kennis wordt omgegaan? a. Hoe wordt kennis geborgd? b. Hoe wordt kennis gedeeld? c. Zijn er vaste momenten waarbij kennis wordt gedeeld?	Krijg je een buddy als je nieuw binnen komt? Special inwerkprogramma, trainingen etc.? Wordt alles opgeschreven? Spreek je met elkaar af om kennis te delen? Schrijf je e-mails? Gebruik je blogs of wiki's
9	Knowledge Management	Vertel mij a.u.b. welke applicaties gebruik je om: a. kennis op te slaan en te organiseren? b. nieuwe kennis op te doen? c. kennis te verifiëren? d. kennis te delen?	
10	Knowledge Management	Wanneer KM-applicaties worden toegepast: a. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI op te slaan of organiseren? b. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI te delen? c. Hoe gebruik je [naam applicatie] om je bevindingen of kennis van BI te verifiëren?	
11	Knowledge Sparing	Ik zou het interview graag voor willen zetten met meer specifieke vragen over het delen van de inzichten, die je wint door de inzet van BI. Vertel mij a.u.b., hoe deel jij de nieuwe inzichten, die je behulp van BI wint?	Kan iedereen bij het rapport, waaruit je je inzichten wint? Met wie spreek je hierover? Maak je een nieuw rapport/overzicht van, wat je kunt delen? Hoe deel je het rapport?
12	Knowledge Sharing	Kun je aangeven of je collega's die ook BI gebruiken op dezelfde wijze hun kennis delen?	Maken je collega's ook een nieuw rapport/overzicht? Kun je een voorbeeld geven?
13	Knowledge Sharing	Dat is interessant. Je hebt eerder vertelt dat je soms inaccurate informatie in BI tegenkomt, hoe deel jij deze inzichten?	Wat doe je, als je inaccurate informatie in Bi tegen komt? Deel je direct je inzicht? Verifieer je eerst de correctheid van jouw inzicht?
14	Knowledge Sharing	Met welk doel, deel je inzichten over inaccurate informatie?	Wens je dat de informatie wordt hersteld? Waar zou je informatie naar jouw mening worden hersteld?

15	Knowledge Sharing	Indien als doel het verhelpen van de inaccurate informatie wordt genoemd: Op basis van je eerdere antwoorden zou ik tot slot graag meer over het proces willen weten, waarmee je het verhelpen van inaccurate informatie initieert. Kun je aangegeven hoe het proces verloopt? Wie zijn de stakeholders?	Zorgt het proces voor herstel? Zorgt het proces voor voorkomen van inaccurate informatie?
16	Information Transfer	Laten we verder gaan met het onderwerp informatie transfer. Deze wordt in de literatuur beschreven als een distributieproces van informatie. Kun je een voorbeeld geven van data/informatie transfer binnen deze organisatie.	Kunt u een voorbeeld geven? Welke diensten worden toegepast? Wat is het voordeel/ nadeel van welke dienst? Zijn er plannen om te ontwikkelen, hoe? Waarom moet je upgraden?
17	Information Transfer	Welke stromen van data/informatie transfer bestaan binnen BI? a. Kun je de transfer beschrijven die wordt toegepast om brondata te kunnen analyseren? b. Kun je de transfer beschrijven die wordt toegepast ten behoeve van reporting? c. Kun je aangeven of er ook binnen BI een data/informatie transfer bestaat, waarmee brondata/informatie wordt verrijkt? d. Indien van toepassing!!! Worden voor de verrijking van brondata/informatie dezelfde IT-services voor de transfer ingezet als voor het transfer om te kunnen analyseren en te presenteren? Welke zijn dat?	
18	Information Transfer	De ener laatste vraag gaat over het herkennen van data/informatie fouten. Wat doe je om te voorkomen dat je inaccurate informatie output in je BI-omgeving krijgt? Vertel mij a.u.b. hoe fouten worden opgespoord	U hebt eerder gezegd dat u ze herkent tijdens het gebruik van BI Zijn er triggers en check query's? Zijn ze BI gerelateerd/ ondersteund Wat zijn de voor- en nadelen van deze aanpak
19	Information Transfer	Hoe ziet het proces eruit waarmee data/informatie structureel wordt verrijkt.	Wie zijn de stakeholders Hoe wordt dit proces door IT ondersteunt? Zijn er KPI's

IX. Permission to record

Ik wil u bedanken voor de tijd om vandaag met mij te praten.
Mijn naam is Catrin Niesel en ik zou graag een interview willen af willen nemen over uw ervaringen in de omgang met BI en welke rol de integriteit van informatie hierbij speelt.

Het interview kan tot 75 minuten duren. Ik zou het interview graag willen opnemen omdat ik geen van uw reacties wil missen. Graag vraag ik u bij deze om toestemming van de stemopname tijdens het interview.
Het interview wordt geanonimiseerd en alle antwoorden worden vertrouwelijk behandeld.
Dit betekent dat uw antwoorden alleen binnen het onderzoeksteam (supervisor en ik) gedeeld worden. In mijn scriptie rapport wordt u niet geïdentificeerd. We spreken hierbij af dat u alleen over dingen tijdens het interview spreek, waarbij u zelf comfortabel voelt.
Het interview kan op elk gewenst moment worden beëindigen.

Zijn er vragen over wat ik net heb uitgelegd?

Bent u bereid om deel te nemen aan dit interview?

_____	_____	_____
Interview kandidaat	Interviewer	Datum

X. Data Collection Summary

Table 8 Data Collection Summary

Data Source	Information Items	Quantity	Contribution to empirical findings, (quotes that support findings)
Semi structured Interview	BI KM Knowledge Sharing Information Transfer	total 12 (average 60 minutes) Member of direction (BI-user) Member of MT (BI-user) Member of MT (IT/data expert) Member of MT (BI-user) Business process engineer 1 (IT/data expert) Business process engineer 2 (IT/data expert) Business process engineer 3 (IT/data expert) Supply chain Planner 1 (BI-user)	When people know who to contact and when they know how to find each other, they share their insights about data errors. Before we generate new data via BI, we do logical checks on the data. This ensures correct generated new data. This work mentality enables 100% connection between BI and ERP system When I see an extreme turnover, I know that BI works fine, but manual data entry causes data errors. We get a lot of requests from BI-users, to analyse data errors. I can read SQL statements. I can analyse quick if data or BI is wrong. We share knowledge within our department, to be able to back up each other. When we detect data errors, we ask a responsible person to correct it imminently. Than we can check if the data was corrected. BI-users need to be analytical strong. They need to be able to make information from data.

		Supply chain Planner 2 (BI-user)	Sometimes I take data from different BI tools and add them together because I cannot see the entire story with existing reports and tools.
		Member of IT experts (IT/data expert)	Check queries detect data errors based on existing business rules.
		Member of Sales office (IT/data expert)	When I detect data errors I always analyse the cause to see how I can prevent the business doing from more data errors like the identified once.
		Member of Sales office (IT/data expert)	The organizational culture allows to share knowledge. I always share knowledge, with everyone, who is interested.

XI. Code book

Table 9 Code book IT processes

	Quote	Code	Category
	IT/data expert: we gebruiken software van Microsoft, de Bi database zelf draait op de SQL-server van Microsoft en de tool die we gebruiken is Visual studio, waarmee wij processen ontwikkelen die gedraaid worden in de SSIS-omgeving van Microsoft en daar draaien de meeste processen in. De rapportages vinden vaak plaats door middel van Excel. Dus de data vanuit BI wordt geïmporteerd in Excel en daar worden dan rapporten aan de gebruikers manier gemaakt.	BI-solutions (coded 108 times)	Information system architecture and data processes
	IT/data expert: in principe en wat we hier natuurlijk doen, wordt de rapportage door degene die zij programmeert opgeleverd en dan hebben de gebruikers zoals jij en ik dan alleen een kant-en-klaar rapport. Waar je eventueel nog wat data in kan zetten, maar eigenlijk kan je niet een rapport op gaan bouwen, zeg maar...		
	BI-user: hoe je evenwicht tussen de BI-tools en het niveau van de gebruikers. En daarmee bedoel ik als je al dan niet met intelligentie, maar op moment dat je de systemen zo intelligent maakt dat de gebruikers dommer kunnen zijn, snap je dat. Wat doe je dan als er veranderingen gaan komen in je omgeving		
	BI-user: Wat je vaak ziet of dat idee krijg ik erbij met het ontwikkelen van een tool dat er enorm veel gepingpongd wordt, continue, er wordt iets gemaakt, iets opgeleverd, dan vindt achteraf nog veel correctie plaats, door feedback verwerking, zo gaat het dus vaak heen en weer. De aanvrager moet van tevoren al goed nagedacht hebben, want je kunt je natuurlijk ook afvragen: kun je van een programmeur verwachten of hij wel al de administratieve stromingen zelf al over ziet of moet je als gebruiker hier het inzicht hebben.		
	BI-user: Dit gaat vrij snel en de BI-specialist is daar heel strikt in, die doet precies wat je vraagt. Dus als je vraagstelling niet goed is, krijg je iets wat niet werkt. Die specialist doet ook niet allemaal aannames, zodat je tegen hem kan zeggen, ik wil dit en dit en dan gaat die kijken hoe hij dat kan opleveren. Het detail zou je altijd mee moeten vertellen. Je moet je eigen selectie zo precies mogelijk weergeven. Dus je moet heel	BI-specialist programs and maintains BI environment (coded 10 times)	

	consequent zijn en aangeven wat je wilt zien. En dan zie je dat de BI-specialist binnen een half uur een check query gebouwd.		
	BI-user & IT/data expert: Je bent afhankelijk van de ontwikkelaars intern, maar als ik onze softwarepartner bel en de juiste tarieven betaal, staan er een paar ontwikkelaars op de stoep. Wat wel uniek is van onze BI-specialisten is dat zij beide nog langer dan ik zelf hier werken, is hun vertaalslag naar bedrijfsprocessen naar systeem en dat ga je nooit terugkrijgen met een externe. Het enige nadeel wat ik zie is als je uit een keer een vervanging discussie gaat hebben of een back-up discussie dat je altijd key users en business owners samen met een ontwikkelaar moet plaatsen, want die unieke samensmelting van bedrijfsproces kennis en systeemkennis ligt echt bij de twee mannen.		

Table 10 Code book KM perspective

	Quote	Code	Category
	IT/data expert: Ik heb een werkinstructie gemaakt. Dit is het openingsscherm, hier moet je inloggen, hier moet je dit doen en dan dat. En alles stapsgewijs gewoon door de schermen heen	Work instructions as explicit knowledge (coded 25 times)	KM perspective
	BI-user: ik denk dat de meest voorkomende toch een word document is. Een procesbeschrijving. Maar daar liggen er plenty van op de plank en er wordt weinig mee gedaan		
	BI-user: ik denk dat deze organisatie een beetje een boeren filosofie heeft kwab kennisoverdracht. Dit is dan met name een mondelinge kennisoverdracht, zoals dit al eeuwen gebeurd, zeker geen schriftelijke, sterker nog, bijna niet. Op de administratieve functies zal daar nog meer zijn aan schriftelijke kennisoverdracht, dat daar procedures worden vastgelegd, dat weet ik wel zeker, als je meer naar de hbo (+) functies kijkt dan is daar niets vastgelegd, denk ik. Ik weet niet hoe jij dat hebt ervaren, toen je hier kwam.	Practice based knowledge management (coded 20 times)	
	IT/data expert: Daar zijn bepaalde mensen of afdelingen, die zijn goed of gedreven in het overdragen van kennis of het uitleggen van processen en is er bijvoorbeeld ook ruimte om dit te doen, terwijl daar zijn ook afdeling van welkom ga zitten en als je vragen hebt dan horen we het wel. Dus ja, dat is dan veel meer zo, van zoek het zelf maar uit, doe je het zou willen doen en als je niet uitkomt dan horen we dit wel. Zo is het bij toen ook gegaan, toen ik hier kwam. Daar wordt in de basis uitgelegd, zo kom je hier, zo kom je daar en dit moet je doen en hoe je het doet, dat mag je zelf weten. En dat was heel veel vrijheid. Toen ik de afdeling verliet is daar heel veel ook niet overgedragen omdat daar niet naar gevraagd werd of naja.		
	BI-user & IT/data expert: Ik denk dat we daar best nog wat te winnen hebben.		
	IT/data expert: ik vind eigenlijk dat dit een heel open organisatie is en dat iedereen bereid is om elkaar te helpen. Ik denk dat dit wel echt gedeeld wordt, zo ervaar ik het in iedere geval vanuit mijn eigen functie		
	IT/data expert: van learning by doing gaat tot het nemen van tijd voor overdracht en inwerktrajecten.		

	BI-user & IT/data expert: Bij teelt bijvoorbeeld zijn ze een initiatief gestart om met een soort media wiki	KM infancies (coded 15 times)	
	BI-user: dat is heel erg afhankelijk van het individu. De een individu weet dat kennis macht is... misschien heeft dit ook te maken hoe BI in deze organisatie is ingericht en hoe het hier werkt. Zorg maar ervoor dat de betrouwbaarheid van de informatie wordt gegeven door mensen die hiervan verstand hebben, maar verwacht niet van mensen, die dat nog zouden moeten leren, dat zij de moeite nemen om dat ook te kunnen begrijpen. Daardoor wordt heel veel kennis, macht en posities centraal gehouden. Terwijl als kennis verspreid wordt door de organisatie, ja dan wordt de meerwaarde van het individu wordt kleiner. Kennis deling in een organisatie waar informatie niet altijd vrij toegankelijk is, ja daar kan je dan nog wel tegen aan lopen dat individuen de hele boel in een keer gaan dwarsbomen. Dit is gebeurd en het gebeurd nog steeds. In verschillende lagen		
	BI-user: Ik heb hier een mooi voorbeeld bij vandaag. We hebben een nieuwe partner in onze database toegevoegd en een deel van hun klanten opgenomen. De check query kijkt of bij een bepaalde klantgroep een bepaald rapport zit en dan wordt een e-mail naar de BI-specialist gestuurd met sluit a.u.b. deze nieuwe situatie uit. Deze is niet terecht. De nieuwe situatie heeft haar eigen policy, maar daar zitten dan ook weer andere klanten bij, die ook onder een ander policy vallen. Dus die moet je wel blijven checken. Dus je moet gewoon blijven checken op bepaalde omstandigheden omdat een deel van de klanten wel de oorspronkelijke settings moet hebben.	BI-user's interpretation capability (coded 32 times	
	BI-user: zoals wij hier BI ontsluiten zeg maar dan is een behoorlijke basiskennis van Excel is al een pre, nee dat is alleen wat je aan applicatie kennis moet hebben. Je moet ook nog een aantal competenties hebben, je moet analytisch heel sterk zijn. Je moet in staat zijn van data informatie te maken		

Table 11 Code book Detecting errors, generating new data and insights

	Quote	Code	Category
1	IT/data expert: dan is het aan de gebruiker zelf om na te gaan of de gegevens kloppen	BI-user detects data errors (codes 15 times)	Detecting errors, generating new data and insights
2	BI-user: Als je echt over rapporten praat dan is het door wat de mens ziet in consistenties		
3	BI-user: als wij bijvoorbeeld een nieuwe tool ontwikkelen en we zien vreemde data. Dan is dat eerste wat ik zit te doen, even in het ERP-systeem kijken wat staat daar nu precies op orderregel niveau en kijken of ik het kan verklaren. Kijken we nu naar hetzelfde dan dat komt dit en waar komt dit vandaan. Dat is eigenlijk altijd in het ERP-systeem kijken.	People analysing causes of data errors (coded 27 times)	
4	BI-user: Als je dat aan mij vraagt, ik kan SQL lezen. Ik ga het statement nakijken, die werd gebouwd en ik ga kijken waar de data vandaan wordt gehaald en ga ik zelf berekenen. Ik weet andere mensen maken zelf een rekensom om te kijken of de presentatie die ze zien wel klopt.		
5	BI-user: je moet continu blijven denken, waarom ontstaat daar nou een afwijking.		
6	IT/data expert: Er wordt een check op de correctheid van brondata in het ERP-systeem gedaan	Check queries detect data errors (coded 44 times)	
7	IT/data expert: we hebben een dashboard voor de check query's. Daar staan alle check query's in. Daarin staat overzichtelijk hoeveel meldingen per check query zijn per dag. je kan ook nog de geschiedenis zien, de check query heeft iedere dag zoveel uitslag of zoveel uitkomsten moet ik zeggen. En je kan gebruikers opgeven, dus je geeft in het dashboard op, wie het dashboard moet ontvangen.		
8	IT/data expert: ja dat is in feite ook een soort kennis. Die administratieve kennis, de kennis over de data wordt vastgelegd in de check query's.		

9	BI-user: de check query's worden in principe een keer in de nacht ververst. Dan heeft de BI-server gedraaid. Hebben we een probleem met de BI-server, dan hebben we een probleem met de check query's.		
	BI-user: Bijvoorbeeld de pricing tool. Ik ben de beheerder van de prijzen. Dus ik zorg dat de prijzen in ERP SYSTEM komen te staan. Daar ben ik operationeel bezig. Ja daar komt een grid uit. Een import grid, die ik in het ERP-systeem importeer.	Generating new data via BI to enrich source data (coded 17 times)	
	BI-user: Hierin wordt het vullen van lege trays bepaald en de trays worden dan vervolgens gebruikt voor het zaaien van zaad den stek en voor het proces. Ik had hier ook een eigen file voor gemaakt. Hiervoor dumpte ik wekelijks data uit BI en dat was gewoon betrouwbaar of zo werd het beschouwd en dat stopte ik in een file, wat verder in productie werd gebruikt om hun interpretatie erop te doen.		
	BI-user: tools zijn vaak wat complexer. Maar eigenlijk zou ik een heel aantal check query's willen vervangen door dashboards. Want de oorsprong van een check query is er gaat iets fout. Ojee, dit moeten we voortaan checken. Terwijl je in een dashboard bijvoorbeeld een tabel kan pakken bepaalde logica checks op doen. We checken nu dingen waar we van weten dat die fout kunnen zijn. Maar dingen die we nog niet mee hebben gemaakt, dat die fout gaan, die checken we niet. In een dashboard kun je gewoon logica checks maken. If than, if this - than else.	Logical data checks in BI tools (coded 9 times)	
	BI-user: ja en op die tool heb ik dan weer een check bestand gemaakt, waar ik dan weer een aantal logica checks ga doen. Dat ik binnen een serie altijd dezelfde curve heb, dat een serie dezelfde ic, royalty enz. Dat is mijn eigen BI tooltje		

Table 12 Knowledge sharing

	Quote	Code	Category
	BI-user: als je op kan lossen, door elkaar op dit moment te vinden, dan ben je al een heel eind.	Interaction between people (coded 15 times)	Communication & knowledge sharing
	BI-user & IT/data expert: ja bij ons is dat wat kleinschaliger. Als een gebruiker wat geks ziet dan belt die de BI-specialist of hij loopt zelf langs en dan is het vaak vijf minuten later opgelost. Daar zijn hier gelukkig hele korte lijntjes.		
	BI-user: Maar zeker waar dit ook goed geautomatiseerd is zijn de check query's. Maar zo zijn er meerdere. Dan zijn dat de mailtjes die elke dag uitgespuugd worden	Automated knowledge sharing (coded 15times)	
	BI-user: de normale instelling is om een check query waar uitkomst wordt gestuurd naar de betreffende gebruiker die ermee iets moet doen. Er zijn ook check query's die output geven als er geen afwijking is. Je kunt dan instellen of je dit dagelijks of werkdagen of eens per week verstuurt.		
	BI-user: Je kunt een probleem alleen maar oplossen door het met elkaar te bespreken. Je gaat dan de vervuiler opzoeken en kijkt hoe dit kon gebeuren. Alleen de vervuiler kan er iets van leren als die iets verkeerd gedaan heeft.	Personal communication (coded 29 times)	
	BI-user: Die bespreek ik meestal met de betreffende persoon en zij kijkt dan. Ik filter even op de oude openstaande posten en op grote posten. Op klanten die het niet zelf volgen.		
	BI-user: vaak wel, vaak is dat een bijlage in een e-mail en een agenda topic voor ERM, CPM. (meetings)		

Table 13 Code book Information transfer

	Quote	Code	Category
	IT/data expert: Iedereen die hiermee te maken heeft, krijgt elke ochtend de uitkomst van de query in de mailbox en dan moet die actie ondernemen	Responsible person takes action to enrich sources data (coded 18 times)	Information transfer
	BI-user: mijn intentie is het nooit om het zelf op te lossen. Nee, je moet ervoor zorgen dat de verantwoordelijke voor het proces en degene die het heeft gedaan worden geïnformeerd om het zelf te corrigeren. Want die kan dat veel beter dan ik. En ik wil niet in zijn basisprocessen gaan werken. Ik heb de rechten om alles te doen en als dit gedaan moet worden, dan zou ik daar gebruik van kunnen maken, maar ik ga het niet doen, omdat ik niet wil dat ik in het systeem ga.		
	IT/data expert: In principe gaat alles via de voordeur in het ERP-systeem zelf.	Manual data entry front- end source data enrichment (coded 8 times)	
	BI-user: En dan wordt het in het ERP-systeem opgelost. In dat geval zorgt diegene wel ervoor dat de stap wordt afgemeld.		
	IT/data expert: wat je kunt doen is BI-tool die je hebt, zou je kunnen zeggen ik maak een extra tabblad aan en dat is mijn inlees formaat	Import file to enrich source data (coded 7 times)	
	BI-user: ja dat zou dan gepaard gaan met een upload naar bv in het ERP-systeem en daar hebben we wel tabellen. Alleen de masterdata		
	BI-user: we schrijven niet op de source database. We gaan niet direct op de database in het ERP-systeem schrijven vanuit BI. Hij stopt in feite in de BI-omgeving en dat ophalen van informatie uit de presentatielaag doet die alleen om berekeningen te kunnen maken. Maar er wordt niet geschreven op de database in ERP SYSTEM zelf. In zoverre het nodig is voor planning of check query's laten we op de SQL-database dingen bijschrijven, maar we gaan niet naar het ERP-systeem door de gebruiker laten	Writing on database data enrichment (coded 8 times)	

	doen. Dan zou de gebruiker in ERP SYSTEM zelf actie moeten ondernemen en data aanpassen.		
	IT/data expert: Wat jammer is en ik weet niet of dat een negatief punt is en daar is in mijn ogen op dit moment ook geen ander alternatieve. Het is jammer dat je wel data kan onttrekken, maar dat je niet makkelijk data terug kan sturen.		
	IT/data expert: het is efficiënt en betrouwbaar. Je moet je voorstellen, we hebben regelmatig grote wijzigingen, grote aantallen, als je eist handmatig gaat doen dan heb je altijd met de menselijke foutmarge te maken. Ik wel ergens uit gelezen, dat een nauwkeurig iemand 1% aan fouten maakt en iemand die minder nauwkeurig is, daar ligt het iets hoger en gemiddeld rond de 3,5%. Dus als je dan een paar honderd regels moet aanpassen, dan zit daar altijd een foutmarge in. Terwijl als je iets in een programma zoals Excel iets kan wijzigen, dan kun je in een keer een hele selectie wijzigen. De kans op fouten is een stuk kleiner. We hebben ons dan wel ook aangeleerd, om jezelf te controleren, als het dan fout gaat, dat je het dan zelf gelijk eruit gaat halen.		
	BI-user: BI heeft hieraan wel meer betrouwbaarheid gegeven.		

Table 14 Information's integrity

	Quote	Code	Category
	BI-user: En overal waar redunde informatie is, heb je een beheersingsvraagstuk. Eerste lijn is efficiency, tweede lijn is data integriteit ook door reductie van redundantie en derde lijn onze reductie van redundantie op de data gedaan hebben, dan is er geen andere bron.	Apply BI solutions instead of developing ERP (coded 22 times)	Information integrity
	BI-user: We kwamen uit de situatie van ERP-implementatie en we hadden toen iets nodig om de bestaande rapportage landschap in stand te houden. Die kon het ERP-systeem niet bieden. Toen is voor Visual studio gekozen. Omdat we wel zagen dat iets gingen missen.		
	IT/data expert: Wij gebruiken BI omdat we operationele systemen deze gegevens niet kunnen aanleveren	ERP's inconsistency, disability to estimate and present management information (coded 29 times)	
	BI-user: het ERP-systeem is geen wonder pakket. Er zaten zeker in de eerste paar jaar veel inconsequenties in het ERP-systeem		
	BI-user: De omzet van 27mln i.p.v. 2.7 mln. die leidt tot enorm bedrag in de omzet die wil ik helemaal niet hebben. Dus ik ga direct na de bron en geef aan dat ik dit heb gezien en of ze kan helpen. En dan is het opgelost met een credit nota en dan controleren we alles en dan is het opgelost. Ik kan niet verder als de cijfers niet goed zijn. Ik ben afhankelijk van degene die de brondata aanlevert en corrigeert, voordat ik weer verder kan.	Wrong BI input – wrong decision (coded 19 times)	
	BI-user: Ik denk dat BI hieraan heel erg bijdraagt om de organisatie de juiste beslissingen te laten nemen. Het is een centrale omgeving. Het is de moeder van alle data. Zou de kennis gaan decentraliseren omdat het eigenaarschap is gedecentraliseerd dan zou je chaos krijgen, hier komen we echter vandaan		
	BI-user: Ik vind het heel moei dat onze BI-systemen ons gaan ondersteunen en daar moet je zeker ook op kunnen vertrouwen, maar je moet ook af en toe even zelf kunne nadenken van ik neem een BI-tool en doe		

	daar een interpretatie op vanuit de kennis die ik heb en als we alleen maar mensen hebben, die geen kennis hebben en alleen maar met BI kunnen werken. Daar heb ik een beetje moeite mee.		
	BI-user: Maar waar dit vandaan kwam of dat compleet was, kon je niet achterhalen. Bij stek en bij de kas ruimte planning hadden we dit en nu weten we zeker dat alle data in de bi omgeving geborgd is, die heeft 100% aansluiting met ons ERP-systeem. Dat wordt ook gecheckt door de accountants. Die doen daar ook steekproeven daarop. Die gaan letterlijk orderbevestiging en factuur uit de kast halen en laat maar zien van A-Z en de gaan zelf in de kas, om te kijken hoe staat de voorraad er wel volgens het ERP-systeem. Die betrouwbaarheid wordt echt gecontroleerd	Information becomes reliable (coded 9 times)	