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Information Systems are only as Good as the People behind Them

Information systems and their impact on logistics performance in a multinational manufacturing company

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Abstract

Over the past years, information and information systems (IS) have become increasingly important for manufacturing companies' overall logistics performance. Information and value-added data runs throughout the company and with IS as an enabler, the company's efficiency increases. IS has received its expected share of rewarding critique, although its presence may not always be solely advantageous. This study therefore aims to investigate under which conditions the concept of IS has a negative impact on a manufacturing company's logistics performance, a context that previously has been somewhat neglected. In this research, a multiple case study has been carried out where 17 semi-structured interviews in Europe and Latin America have been conducted as well as observations. The result indicates that IS is a resource that cannot contribute to enhanced logistics performance without the complementing aspects of high system quality, high information quality, internal communication and adequate human behaviour. Moreover, the study shows that system quality is in fact not the most severe influencer to poor logistics performance, but rather the impact from information quality, communication, and human behaviour.

Key words: information system (IS), system quality, information quality, internal communication, human behaviour, manufacturing company, logistics performance

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1 Introduction

1.1 Background

Information has in the recent decades come to be seen as a potential value creator rather than a cost for organisations (Sampler, 1998; Tippins & Sohi, 2003). Ravichandran & Rai (2000) also mention that the reason for organisations to be attentive to information system (IS) quality improvement is the increased dependence organisations face towards IS, and the losses that are faced due to insufficient information quality. Information spans throughout the entire company and it has as a result of this changed viewpoint become the invisible asset that can be used to leverage other resources when properly managed (Tippins & Sohi, 2003). The need for leveraging resources is also one of the reasons why the logistics function has increased in importance, especially in multinational manufacturing firms. Information can be argued to be the heart of the logistics function as it enables goods to flow efficiently both within and outside the company, which moreover implies sensitivity to the quality of information. Concurrent with the changed viewpoint mentioned above, and the ability to handle the massive amount of information that organisations are facing on a daily basis, computer based information systems have come to be the main provider of information. It is therefore not very surprising that many companies have shifted its focus towards IS and begun to see it as an asset to aid efficient use of information (e.g. Mata et al., 1995; Nault & Dexter, 1995; Powell & Dent-Micallef, 1997; Bharadwaj, 2000; Tippins & Sohi, 2003).

Following the increased IS dependence that organisations are facing, management vigilance is focused towards improving IS quality. Due to the importance of IS, and due to the various academic results of information systems' determinant success factor, many researchers are still attempting to fill the void of the impact of IS on organisational success. One of the most acknowledged models for explaining the main categories for IS is DeLone & McLean's (1992) D&M IS Success Model and it denotes IS impact as a multifaceted concept that contains three levels of potential success; technical, semantic, and effectiveness. This model has been used as a foundation by numerous scholars for further research within the field of information

system research. One of the main conclusions made by the authors, which still holds true in their 10-year update (DeLone & McLean, 2003), is that more field study research should investigate and incorporate organisational impact measures.

1.2 Problem Discussion

IS have received its fair share of honouring critique and it has doubtlessly increased the overall efficiency of organisations, and thus the tributes are immensely valid. The concern however is that, in previous studies, the underlying assumption when investigating IS and business performance appears to be that it solely enhances it (e.g. DeLone & McLean, 1992). There are however various drawbacks with information systems and its impact on business performance, such as software development, information quality, internal communication and information systems' impact on human behaviour.

Although software development has been an important task for companies for decades, the software quality is according to many researchers no better today than it was 50 years ago (Parnas & Lawford, 2003; Whittaker & Voas, 2006; Gorla et al., 2010). The main issue, as Slaughter et al. (1998) suggest, is that IS managers puts too much emphasis on implementing new IS in a quick manner rather than emphasising system quality, which is more important as it entails more sustainable cost savings.

Already five decades ago, Ackoff (1967) mentioned that the most significant deficiency for managers regarding information is the abundance of irrelevant information. Researchers have further elaborated on this in terms of today's business environments and conclude that information quality problems are equally, if not more, relevant today and that information overload is disruptive to the quality of information (Strong et al., 1997; Eppler, 2015). Although information quality can severely impact decisions made on operational and managerial level, there has been little awareness related to this issue and consequently this has resulted in increased costs from an organisational point of view (Eppler, 2015).

Another acknowledged negative aspect of IS is that users are 'losing the art of conversation', since users are more biased towards trusting IS more than any other source of information, especially when other sources carry contradictory information (Cubbage, 2005; Cornelissen, 2014). It has been established by many researchers that internal communication is critical for business success, and that both virtual and non-virtual communication is needed in order to achieve this success (e.g. Cubbage, 2005; White et al., 2010; Eppler, 2015; Jacobs et al., 2016). Jacobs et al. (2016) also mention that internal communication has been somewhat neglected by scholars, especially in combination with the IS field. Furthermore, despite the fact that good internal communication has been acknowledged as critical for business success, companies are neither prioritising nor focusing on this part of communication to the required extent. As a result, researchers argue that companies might forgo business opportunities that would entail value creation, cost reductions, reduction in inventory levels and better forecasts (Kembro & Näslund, 2014).

Many of the issues and potential negative aspects of IS is correlated with human behaviour and cognitive prerequisites. This is one of the underlying reasons for the scarce studies of information systems' negative impact(s) on organisational performance (Bhattacherjee, 2001). DeLone & McLean (1992, 2003) further state that the difficulty of investigating individuals' direct impact on organisational performance is one of the underlying reasons why there is a gap in the literature and as earlier mentioned, the authors call for further research to fill the void.

The objective of this research is therefore to shed light upon the situations when IS is inferior to logistics performance, and the underlying reasons for that. After having scanned the literature, we found that this viewpoint has been somewhat neglected. Consequently, this research is looking to provide the opposite perspective of the general view that information systems are always enhancing business performance. This will be done by investigating IS impact on the logistics function in a multinational manufacturing company. However, as opposed to the D&M IS Success Model and the studies that have been conducted in a similar manner, this study will rather investigate the potential negative impacts IS have on the logistics function, which in turn may or may not affect logistics performance.

1.3 Purpose & Research Question

The purpose and contribution of this study to the field of IS is the investigation of information systems' negative impact on logistics performance. More specifically, this study aims to identify the dominating influencers to poor utilisation of IS, which in turn results in inferior logistics performance. The aim of this study is moreover to provide suggestions of amendments and actions that a company can take in order to counteract these negative influencers. With this in mind, the following research questions have been constructed:

1. *In which situations do IS have negative impact on logistics performance?*
2. *What tools can organisations use to counteract the potential negative impact(s)?*

1.4 Study delimitations

In this research, it was chosen to exclusively do an investigation of one company rather than simultaneously studying multiple companies. This because it in general allows for a more comprehensive understanding of the company, its context with regards to information systems, and thus also the underlying factors that may or may not affect the performance of a company.

It was furthermore established that a multinational company is better suited for this research since it has to take additional contexts and prerequisites from several countries into consideration when developing and using information systems. This requires more complex systems to be implemented and therefore the drawbacks of IS is assumed to be easier to identify.

1.5 Research Outline

Including this chapter, the research is divided into six chapters and it is structured according to the following:

LITERTURE REVIEW

This chapter outlines previous research on the determining influencers for IS usage and the organisational impact. It moreover covers various researchers' studies within the field in order to serve as a framework for later comparison with the empirical findings.

METHODOLOGY

This chapter presents the methodological approach to execute the study. It explains the processes and techniques applied to gather, analyse, and present the empirical data.

EMPIRICAL FINDINGS

This chapter presents critical incidents from the empirical data that was collected from interviews and observations. This includes respondents' perspectives on various incidents that have highlighted the challenges related to working with and in information systems.

ANALYSIS

This chapter merges the empirical findings with the theoretical framework presented in the literature review. The various findings are compared to previous literature and discussed.

CONCLUSION

This chapter illuminates and concludes the essential findings of this research. The conclusion provides answers to the research questions, present contributions of this research to the field of IS and logistics performance, and suggests potential topics for future research.

2 Literature Review

This section aims to provide an overview of previous research that have been conducted within the field of IS. Providing potential tools to resolve the issues at hand is moreover an objective of this section. Therefore, factors that are considered influencers to elevated utilisation of information systems are presented.

2.1 Information Systems

Information systems are according to O'Brien & Marakas (2007, p. 4) "*any organized combination of people, hardware, software, communications network, data resources, and policies and procedures that stores, retrieves, transforms, disseminates information in an organization*." In other words, IS can be any organised means to provide information. However, when referring to information systems throughout this research, computer-based information systems are considered.

DeLone & McLean (1992, 2003) conclude in their studies that there is not only one dependent variable that measures information system success, but rather (too) many variables. These variables therefore require to be categorised depending on their primary impact and therefore, the authors have developed the DeLone & McLean Information System Success Model (D&M IS Success Model). The model has been developed in order to bring clarity to the confusion that is a result from the various viewpoints on what constitutes as success factors.

DeLone & McLean (1992, 2003) have as earlier mentioned presented three different levels of success in terms of IS usage; the technical success level, the semantic success level, and the effectiveness success level. Mason (1978) underlines that since the technical success level affects the other two levels, a fully developed theory ought to deal with all three levels. Hence, similar to D&M IS Success Model this study will also be categorised into these three different levels influencing IS.

2.2 The Technical Impact Level

2.2.1 System Quality Indirectly Impacts Organisational Performance

System quality measures the extent to which the system is user friendly, easy to learn, error-free, flexible, and technically sound (DeLone & McLean, 1992, 2003; Gorla et al., 2010). Gorla et al. (2010) have conducted a study that investigates whether system quality, service quality, and information quality impact organisational performance measures and to what extent. They conclude that system quality does in fact not impact organisational performance directly, but rather indirectly through information quality (that consequently impacts business performance) which entails a non-existing direct link. This is opposing the D&M IS Success Model, which claims that there is a significant link between system quality and organisational impact (DeLone & McLean, 1992). The relationship between system quality and information quality has however according to Gorla et al. (2010) been proved to be significant. Hence, a poor system (i.e. hardware or software) will thus most likely provide poor information, and vice versa.

System quality has been the most investigated aspect of IS since Delone & McLean (1992) identified it as one of the main aspects of IS success and many of the researchers have found the relation between system quality and individual impact to be statistically significant (Goodhue & Thompson, 1995; Etezadi-Amoli & Farhoomand, 1996; Seddon & Kiew, 1996; Teo & Wong, 1998; Wixom & Watson, 2001; DeLone & McLean, 2003). DeLone & McLean (1992, 2003) moreover mention that individual impact influences organisational performance. By following the logic of these authors, system quality will by extension influence organisational performance, which is in line with the conclusions made by Gorla et al. (2010).

Improving system quality by employing well-developed IT, formal development methods, and appropriate system features, organisations will with high probability moreover improve information quality, and thus by extension also improve business performance, as proposed by Gorla et al. (2010). The system quality aspect of IS is highly related to IT and in a study made by Bharadwaj (2000), it is concluded that companies with extensive IT capability usually outperform companies with lower capability. The author however argues that investments *per se* do not provide any

sustained advantage, as according to a resource-based view, since competitors easily imitate them. The competitive advantage in IT is rather regarding how a company leverages the investments in IT resources, skills, and organisational learning that determine a firm's overall efficiency and IT success (Clemons, 1986, 1991; Clemons & Row, 1991; Mata et al., 1995; Bharadwaj, 2000; Tippins & Sohi, 2003). This is in line with Gorla et al. (2010) who state that improving decision-making by providing accurate and timely information will enhance the ability to identify profitable projects and avoid forging business opportunities.

Despite the importance of IS quality, issues of system quality have not been given satisfactory attention by IS scholars, as according to Nelson et al. (2005). Parnas & Lawford (2003) and Whittaker & Voas (2006) further state that regardless of the fact that IS software is continuously under development, quality is no better today than over 50 years ago. Various authors add on to this criticism by stating that heterogeneous software modules are not easily integrated (O'Brien & Marakas, 2007), and that software is usually not very user-friendly (Davis et al., 1989; Jackson et al., 1997; Slaughter et al., 1998).

In order for data and information to flow freely throughout the company O'Brien & Marakas (2007) suggest that companies should strive towards linking differently designated systems (e.g. management information systems and decision supporting systems). Companies should thus make an effort to link differently designated systems in order to achieve flexibility and beneficial synergies in integrating the various types of systems for the business as a whole. Park & Ram (2004) adds to this argument and state that system interoperability is the most critical issue of the technical success level, especially for organisations that need to access information from several, fragmented information systems. Reaching a solid level of interaction between different types of systems is however complex (O'Brien & Marakas, 2007).

As a solution to user-unfriendliness, as highlighted by for example Slaughter et al. (1998), several authors have discussed the possibility of users being a part of system development. While some of the studies have proven to result in IS success (e.g. Robey & Farrow, 1982; Ives & Olson, 1984; Barki & Hartwick, 1989), other studies show contradictory results; that there exist a correlation between user involvement

and IS success (e.g. Baroudi et al., 1986; Newman & Noble, 1990; Hartwick & Barki, 1994). In the latter case, the authors found that a conflict easily arises between system developers and users as they might have different semantic views and objectives.

2.3 The Semantic Impact Level

2.3.1 Information Overload Causes Information Quality to Decrease

Eppler (2015) argues that information overload and information quality are two aspects that characterise the difficulties of today's corporate environments and IS. Employees are constantly subjects to information exposure from various sources and they consequently struggle to filter and process what is relevant to their context. Although there are several benefits to information being more accessible, the excess of irrelevant information is resulting in two main problems. Firstly, information stress is caused due to the fact that the received information is challenging our capability to process information efficiently. Secondly, the author mentions that for example decision making, problem solving, and gaining new knowledge becomes increasingly difficult as the growing amount of available information makes it hard to be attentive to the information that we demand and is of high quality.

As mentioned in the previous chapter, O'Brien & Marakas (2007) suggest that companies should strive towards integration between different systems in order to allow more accessible information. To manage the increased risk of information overload this entails, the abovementioned authors suggest *exception reporting* as a solution. Exception reporting means that the system reports exceptions rather than a large amount of information about normal systematic behaviour.

Information quality can be defined as the difference between the required information determined by a goal and the obtained information (Gerkes, 1997). A qualitative measure for information quality is thus expressed by the following premise: the smaller the difference, the greater the quality of information. A more specific definition is however provided by O'Brien & Marakas (2007, p. 511), as they define information quality to be "*the degree to which information has content, form, and time characteristics that give it value to specific end users*."

By increasing information quality, information overload will eventually be discouraged (Eppler, 2015). This has also been elaborated on by White et al. (2010) who suggest that information overload causes employees to create their personal filtering system and screen e-mails for example in contrast to actually reading them, since this would be impossible due to time constraints. This, the authors continue, causes important information to be left unnoticed as the information recipient may be prioritising incoming information inefficiently.

Eppler (2015) stresses the fact that the basic premise behind any information quality framework is that one cannot correct the faults that one does not specify. Hence, if the traits that lead to high quality information are not made explicit in a systematic manner, there will be no way to coordinate the efforts to improve the quality of the information. Following the logic of Eppler, Strong et al. (1997) have established a systematic framework where they identify ten information quality issues from a database and data warehouse context. These will be presented below, and a compiled summary is presented in Appendix C as well.

The 1st issue of information quality is by Strong et al. (1997 p. 40) called "*multiple sources of the same information produce different value*". This problem often arises due to the fact that systems are designed for different purposes but nevertheless call for similar information. The authors mean that storing similar data in several places entails increased risks, as the information may not be updated coherently. Furthermore, the value of the information output might be of big difference in sundry systems since the processes are varying depending on the system. Hence, decreasing the level of consistency and credibility are threats that follow this issue.

The 2nd problem refers to the events where there is space for subjectivity when collecting data. Using this data as 'facts' when producing information is explained by the authors as the parable of constructing a road using thoughtless procedures and poor material. The consumer of the information will consequently become reluctant to use the information, similar to the fact that people might avoid using defective roads. Key problem number 3, "*Systematic errors in information production lead to lost information*" concerns for example receiving incorrect or missing information due to

problems with edit check that is supposed to validate the input data. This issue refers to systematic problems and not errors (i.e. mistakes). For instance, if the edit check does not function properly, either wrong information may be entered into the systems, or the information may go missing, as according to Strong et al. (1997).

Issue number 4 concerns the fact that it is increasingly difficult to access information in a timely manner as larger volumes of information are stored in the systems. This impacts the added value of information and on the accessibility of the task that needs to be carried out. Hence, it is not necessarily better with more information, since problems might occur for IS users. The nature of issue number 5 is similar to that of the first issue, since it is caused because the distributed systems are heterogeneous and the accessibility level is therefore low, which also leads to inconsistent definitions, formats, and values.

In terms of the 6th issue, companies need to decide on whether it is relevant to store all information, especially the information that is non-numeric and of little or no importance to users. The reason behind this is that, although it is easy to store information, it is difficult to enter and access it easily, as already mentioned in the 4th issue. Following the non-numeric information-logic, issue number 7 builds on the fact that non-numeric information is not enough to create value. If the information is to be of any kind of value the possibility to combine, work and use information should exist in order to calculate trends. Therefore, a combination of non-numeric and numeric information is required.

In the 8th problem, Strong et al. (1997) problematize the abovementioned definition of information quality made by Gerkes (1997). The authors mean that the contextual aspect of information quality can only be satisfied when the information provided is equal to the demanded information. In the 9th aspect of information quality, easy access to information may interfere with security, privacy, and confidentiality requirements. To guarantee information security, privacy, confidentiality, barriers to access must therefore be demanded. An insufficient computing resource, which in turn limits access, is the 10th and final issue that may disable high quality in information. It regards communication channels in IS that are not trustworthy which

consequently results in incomplete information. Ultimately, resources that contain a high level of flaws can thus cost more money than returned by the investment of IS.

2.3.2 Non-Virtual Communication Is Not Prioritised

Communication is included in the semantic level since it is an important aspect and supporter to efficient use of IS considering the fact that it is difficult to provide high-quality information without communication (Jacobs et al., 2016). Information exchange and communication have been acknowledged as two of the most important factors for business success. In spite of this acknowledgement, external communication has however only been thoroughly studied and a lot of emphasis has been put on achieving seamless interorganisational communication throughout the supply chain, as according to Jacobs et al., 2016. The other fundamental part of communication, internal communication, has however been rather neglected – especially in relation to IS.

Information systems enable and ease the information flow and thus also the possibility to communicate more efficiently. However, all these virtual possibilities have been acknowledged to cause people to be more willing to communicate virtually rather than taking part in a face-to-face conversation (Cubbage, 2005; Cornelissen, 2014). In line with this, people are in general more biased towards trusting IS to a wider extent than any other source of information, especially if other sources carry contradictory information (ibid). This is a problem since face-to-face communication is considered a richer mode of communication as it allows non-verbal communication to take place (Daft & Lengel, 1986). Eppler (2015) states that both virtual and non-virtual communication is needed to guarantee that internal communication is highly utilised throughout the organisation. These two areas of internal communication complement each other and when not utilising both of them, the overall effort that the company puts on corporate communication will be ineffective, which in turn can cause employees to become demotivated.

As an attempt to counteract the negligence in internal, two-way communication, Welch & Jackson (2007) have established an internal communication matrix that aim to improve internal corporate communication and strategic planning. This matrix,

which is illustrated in figure 2.1, allows all involved parties in different arrangements to communicate with each other in order to reach a common corporate vision and goal. The most important conclusion is that two-way communication has been identified as a success factor in internal communication (Grunig & Hunt, 1984; Dozier et al., 1995; Grunig & Dozier, 2003; Welch & Jackson, 2007). Although two-way, non-virtual communication in most cases is optimal, it would however be naive to say that internal communication should only be conducted in a two-way manner. It is impossible to apply two-way communication via for example face-to-face interaction with every single employee in a large company and therefore one-way, and virtual, communication is both needed and inevitable. One-way communication is however suitable when, for example, a message must be received by several people at the same time (Welch & Jackson, 2007).

Dimension	Level	Direction	Participants	Content
1. Internal line management communication	Line managers/ supervisors	Predominantly two-way	Line managers-employees	Employees' roles Personal impact, e.g. appraisal discussions, team briefings
2. Internal team peer communication	Team colleagues	Two-way	Employee-employee	Team information, e.g. team task discussions
3. Internal project peer communication	Project group colleagues	Two-way	Employee-employee	Project information, e.g. project issues
4. Internal corporate communication	Strategic managers/top management	Predominantly one-way	Strategic managers-all employees	Organisational/corporate issues, e.g. goals, objectives, new developments, activities and achievements

Figure 2.1 (Welch & Jackson, 2007 p. 185)

2.4 The Effectiveness Impact Level

This section will focus on the influence that IS have on the users of information systems. The main reason for this is, as earlier mentioned, due to the fact that organisational performance is indirectly affected by individual performance (as DeLone & McLean, 1992, 2003). For example, the information system output is communicated to the user or recipient who in turn is influenced, either positively or negatively, by the information. Hence, in order to reach organisational performance, individual performance (or non-performance) must first be achieved.

2.4.1 Human Behaviour is Determined by the Level of Satisfaction and Perceived Usefulness of IS

According to DeLone & McLean (1992, 2003), information systems' impact on individual behaviour is rather challenging to define since it is difficult to grasp how information systems actually impact the individual in any given situation. The individual could be affected positively by for example receiving a better understanding of a context which would result in elevated decision-making productivity, or the user could be affected negatively in a way that the impact would plausibly result in inferior business performance. Nevertheless, the main conclusion that can be drawn is that a lot of emphasis was put on understanding users' attitude towards information systems and the value of them. Other researchers (e.g. Ajzen & Fishbein, 1977; Davis et al., 1989; Hogarth, 1991; Jackson et al., 1997; Bhattacherjee, 2001) have also investigated information systems' impact on individual behaviour, and Hogarth (1991, p. 80) defines it as a "*strategy for developing a theoretical base for understanding the constructs and processes involved in a user's acceptance or rejection of information technologies in the work environment is to focus attention on user attitudes*".

Depending on how information systems influence individuals, they are more or less willing to continue using IS, as argued by Ajzen & Fishbein (1977) and Bhattacherjee (2001). The authors have moreover concluded that attitudes, influences and behaviours keep a close link to each other concerning how an object (i.e. a system) is used. Davis et al. (1989) have also specified that behavioural intention is a major catalyst to system usage and that intention is associated to user behaviour while other factors influence user behaviour indirectly through behavioural intention.

In light of the behavioural studies made by Ajzen & Fishbein (1977) and Davis et al. (1989), Bhattacherjee (2001) developed the Expectation-Confirmation Theory (ECT), where cognitive persuasions and influences impinges a user's intention to continue the use of IS. Bhattacherjee suggests that the intended continuance of using IS is determined by two main aspects; the level of satisfaction of previous IS usage, and the perceived usefulness of it. The level of satisfaction, the author means, is determined

by the confirmation of their expectations, hence the name Expectation-Confirmation Theory.

The level of satisfaction may be an ambiguous factor to study due to its subjective nature. Nevertheless, Locke (1976, p. 1300) was the one to primarily define satisfaction in a work environment as "*a pleasurable or positive emotional state resulting from the appraisal of one's job*", which later on was by Oliver (1981, p. 29) modified to "*the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience.*" Both Locke and Oliver emphasise the psychological state resulting from a cognitive assessment of expectation and confirmation. For example, if IS users would have low expectations and/or experience high performance from IS, user would appraise increased confirmation. Hence, positive influence would follow and the intention of continued usage is more probable. Notable is also that a reverse course of event would cause the level of disconfirmation to be high. This would in turn also cause the level of dissatisfaction to increase which ultimately would affect the appraisal of a system's usefulness, as argued by Bhattacherjee (2001).

In their study, Jackson et al. (1997) confirm Davis et al.'s (1989) theory that a system's accessibility becomes more vital when the system is rather complex and assist a large amount of users. The authors moreover found that there is a vital link between a system's accessibility and a user's attitude and intention to use the system. Moreover, the more manoeuvrable of a system is, the more elevated is the attitude towards a system (Lepper, 1985).

3 Methodology

This chapter will present the methodological approach that has been applied to execute the study. It explains the processes and techniques related to gathering, analysing, and presenting the data.

3.1 Research Approach

This study aims to investigate in which situations the usage of information systems contribute to poor logistics performance. The IS field of research and its drawbacks is as of today relatively scarce and the difficulty of theorising it in a decent manner therefore increases.

3.1.1 Inductive Approach

The main approach in this research is inductive. When embracing the inductive approach, one will move from observations towards wide generalisations and theories (Jacobsen et al., 2002). Inductive reasoning implies that the researcher(s) initiate the investigation with specific measures and observations. Consequently, researcher(s) become aware of patterns and reoccurring events, formulate hypotheses that can be explored and finally develops general theories or implications (Jacobsen et al., 2002; Bernard, 2011). The inductive approach allows the researcher(s) to gather the data from interviews in a quite individual and open way. Subsequently after gathering the data, the approach is in turn used to establish new theory instead of testing already existing theories. When using an inductive approach, it is common that the study that is conducted also is exploratory. This is in order to contribute to this research field and provide new insights and findings due to the fact that it might be problematic finding information about a particular topic beforehand (Collis & Hussey, 2013).

Since the observations were made at a multinational manufacturing company, we gained wisdom about the topic that we were looking in to. The observations were made before establishing which theory to use and when the observations were completed suitable and relevant theory was applied which argues for the use of an inductive approach. This process was used in order for us to optimistically establish new theory instead of testing already existing, since we aim to make a contribution within this field of research.

3.1.2 Qualitative Research

Qualitative research methods are observant to the unexpected and new information, and they are often associated with inductive approaches. These research methods are generally appropriate for studies that seek to thoroughly understand the underlying objectives of an action (i.e. questions usually starting with ‘how’ and ‘why’). In a qualitative approach, low structured data, such as interviews with open responses, is analysed. This type of study makes it possible for the respondents as well as the researcher(s) to clarify and re-ask questions with the intention to secure correct elucidation and understanding of the question (Ghauri, 2004).

The purpose of a qualitative approach is to create an understanding of the ideas and attitudes that cause human actions and decision-making, rather than trying to identify what is decided, said and done (Holme & Solvagn, 1997). When answering complex matters, a qualitative research approach is more appropriate than using a quantitative method as the researcher(s) can gain details of the studied matter to a greater extent. Moreover, the researcher(s) can get hold of significant outcomes and gain a better understanding for how core factors are connected (Marschan-Piekkari & Welch, 2004).

As IS manages complex matters, we established that a qualitative approach would be the most suitable method to use as it would allow us to seize details to an extent that would not be possible using any other approach. Moreover, by using a qualitative research method we gained understanding for what the actual problem was at the company in combination to what we wanted to investigate. Once the problem was identified and correctly understood we had the possibility to re-ask questions in order to get an even deeper and detailed understanding of the whole picture. This was possible through our semi-structured interviews with open-ended questions that started with ‘how’ or ‘why’ (which will be more thoroughly described below).

3.1.3 Multiple Case Study

Jacobsen et al. (2002) argues that one of the main reasons for why researcher(s) use case studies in their investigations is because data can be collected relatively quickly. Bryman & Bell (2015) further state that multiple case studies are an expansion from a

regular single case study. In multiple case studies a comparison between all observed cases is made. By using this method, the researcher(s) are allowed to reflect upon what is common and what is distinctively unusual throughout the cases, and it also encourages the researcher(s) to frequently reflect upon the findings. For some reason, many refer to a case study as a method. However, as soon as cases have been carefully chosen, research methods are required in order to gather the data. By simply selecting and deciding on a company to study will not provide any kind of data; observations must thus be made, interviews conducted, and finally the documents must be examined and administrated. In other words, more work than simply choosing a company is required in order for the researcher(s) to collect any data and thereby be able to refer to a method (Bryman & Bell, 2015). To use a case study as an approach is a popular and broadly used business research design (Eisenhardt & Graebner, 2007). It has been stated by Stake (1995) that this kind of research is implicated with the specific nature and complexity of a case. The case study, in its own right, is an object of interest and the aim is to withdraw an in-depth clarification of it (Bryman & Bell, 2015).

The empirical findings in this paper have been gained through observations and interviews that were conducted by a multiple case study at the company. This means that the company that we chose to investigate provided us with information regarding several cases (or incidents) that have occurred at the company over the past few years.

3.2 Research Design

The research design is aimed to frame the data collection and analysis with the intention of answering our research questions. According to Bryman & Bell (2015), the study's design plays a major part and is important to attain reliability and validity, which measures the study's quality.

3.2.1 Research Unit

The empirical data was gathered at a large multinational manufacturing company. The reasons for choosing this particular company are many. Firstly, as the company is large, with over 42.000 employees internationally, we found it interesting to

investigate how they are managing, for example, the internal communication in combination to IS. This because we assume that the larger the company is, the more difficult it is to manage the usage of IS as it becomes more complex with increasing company size, as also mentioned in the delimitations of the study. Sharing information within the company on a global scale is rather difficult due to for example language barriers, different cultures and different working hours which make it increasingly crucial to have efficient supporting complements in situations where, for example, IS provide poor or incorrect information. Secondly, the company applies job rotation which results in difficulties to anchor and spread the routines to new employees. It is therefore in our interest to observe how processes like these are working as they provide a good example of how the link between IS and the supporting complements work. Thirdly, as the majority of the employments at the company are individual (i.e. a low percentage is employed for a specific project) it is important to communicate with colleagues. By doing so, employees would gain more knowledge and thus become more efficient in their decision-making.

Since the manufacturing company have provided us with sensitive and sometimes confidential information, we made an agreement to keep the name of the company, the respondents, and their respective working area anonymous throughout the paper. According to us, this is a small sacrifice considering the information and material the company provided us with and the overall generosity while at the company as well as after visiting the company.

3.2.2 Data Collection Method

3.2.2.1 Observations

When at the company, we started our empirical data collection by doing observations. By being assigned a project regarding a IS usage-related issue that was completed while visiting the company, we got a good insight of how employees at the company communicate with each other and use the information systems. In agreement with Bryman & Bell (2015) continuous dialogues with the involved people were held in order for us to evade overlooking valuable data and to avoid memory inadequacies.

The observations we conducted were of basic form, meaning that we did our observations during a shorter period of time (two weeks). Observation studies allowed us to identify norms and values and the method gave us an opportunity to give the reader a better picture of daily circumstances. Important to highlight is that knowledge that is not easily obtained when conducting interviews can be gathered through observations (Marschan-Piekkari & Welch, 2004).

We did a 'direct observation' (i.e. studied the company in its natural setting), as suggested by Yin (2014), and in order to make the observations as reliable as possible we were both observing at each occurrence. It is, however, significant to illuminate and clarify that this does not make the study objective as the environment is influenced by our own perceptions when doing the observations which is in line with Marschan-Piekkari & Welch (2004).

3.2.2.2 Interviews: Semi-structured and Critical Incident Technique

It is in our interest and aim to gain a comprehensive understanding regarding IS and if they are really just enhancing a company's logistics performance or if there exist significant drawbacks. Therefore, primary data was collected in terms of semi-structured interviews as this approach is considered to be the most suitable method for collecting qualitative data (Cannie & Daniels, 2004). Semi-structured interview questions cover an extensive variety of examples which gives the interviewer a good insight of the subject (Yin, 2014; Bryman & Bell, 2015). This permits us to directly focus on the most important topics within the subject and brings a clear and deep perception to the bigger picture as we had the opportunity to understand respondents' personal views and opinions.

The critical incident technique involves requesting the respondents to identify critical incidents, which Flanagan (1954, p. 226) outlines very generally as "*any observable human activities where the consequences are sufficiently clear as to leave the observer with a definite idea as to their likely effects.*" The term originates from the analysis of 'near-disaster situations', where the aim is to give a general impression of the event(s) that has led to a possible disaster and to develop a plan for how to handle them in the future. The most common way of using this method implicates

interviewing respondents regarding specific behaviour(s) or event(s) with the aim to develop an understanding of their arrangement and their importance to the individual (Bryman & Bell, 2015).

During the interviews, we asked the respondents to describe two to three critical incidents that had occurred at the company. We asked for incidents that regarded issues that originate from the usage of information systems. After conducting all the interviews, we had eight distinctive critical incidents where the use of information systems was the major contributing factor to why the incidents occurred. We gathered our primary data through 12 face-to-face interviews with respondents based in Latin America and 5 telephone interviews were held with respondents from the headquarter (HQ) in Europe. Moreover, additional telephone interviews were conducted with the majority of the respondents from Latin America. All 17 respondents are managers at various departments within the logistics department at the company, either in Europe or in Latin America. The number of respondents that we conducted face-to-face interviews with were set by one of the contact persons at the company, although this was based on our wishes of how many we approximately wanted to interview. In line with what Andersen & Skaates (2004) are arguing for, we continued to collect empirical data until we saw a pattern in the information provided by the respondents during the interviews (i.e. when the respondents started to mention the same incidents for example). The validity of our empirical findings is according to the authors strengthened by this procedure.

3.2.2.3 Interview Protocol and Interview Process

In order to conduct the interviews in the best possible manner, we did a careful review of the literature with the aim to gather initial understanding of the subject and as a result ask questions that were relevant. The literature review formed the base for our interview guide to make sure to cover all relevant topics. We did this to guarantee that the conversations were led in compliance to the interview framework (Bryman & Bell, 2015; Cannie & Daniels, 2004).

The set-up of the interview guide contained the following steps; initially, questions regarding information systems and how the respondents are using them on a daily

basis were asked. Secondly, we asked questions concerning corporate internal communication and how they perceive that the communication is working at the company. Thirdly, questions highlighting the connection between internal communication, human behaviour and logistics performance were asked. At last, we asked the respondents to describe incidents (i.e. critical incident technique) where poor internal information systems have resulted in poor logistics performance at the company. In Appendix A, a full list of the interview questions can be found.

As all our questions were open-ended, it allowed the respondents to enlighten us with unexpected information and understandings that otherwise would have been inaccessible. Due to this, and because we wanted to be compliant to the respondent, we did not necessarily follow the interview guide but we were instead attentive to the subjects that the respondents brought up themselves during the interviews. The interviews in Latin America took place between 15th and 22rd of February, where two of those were conducted by telephone with HQ. Moreover, the telephone interviews took place between March 23rd and the 7th of April. 17 respondents were interviewed in total, although additional interviews with concerned respondents were requested when needed, which resulted in 27 interviews in total. Full disclosure of dates and times for the interviews can be found in Appendix B. The interviews were subsequently transcribed and the findings were discussed in order to ensure that we were heading in the right direction. All interviews in Latin America were held in quiet meeting rooms in order to avoid interruption by externalities. The interviews lasted between 30 to 60 minutes, and we were both participating in all interviews in order to decrease the risk of unexpected information to be overlooked. The interviews were mainly held in English since that is the corporate language and since the main part of the respondents were Latin American. However, when possible, the interviews were held in our mother tongue.

It is necessary to highlight that semi-structured interviews entail some disadvantages, even though this method was decided to be the best suited for our research. For example, poorly verbalised questions may result in subjective answers from the respondents and the results from this kind of interview method may be subjective. Moreover, the interviews may also be inadequate if the respondent answer what s/he

believes is socially or politically accepted in order to hide realities, or what s/he believes the interviewer(s) want to hear (Collis & Hussey, 2013; Yin, 2014).

3.3 Data Analysis

The interviews were transcribed with the aim to make the subsequent examination as thorough as possible and in order for the data transfer to go as well as possible (Bryman & Bell, 2015). We collected data and analysed it simultaneously with the first interview as a starting point and Ghauri (2004) argue that following this process strengthens the data. Furthermore, in practice, the data analysis procedure is hardly a straight line from the first data collection point to conclusions. During the research, the qualitative data analysis can be viewed as a series of spirals. This because the researcher(s) usually loop back and forth through various phases where endless discussions regarding the analysis progress are held (Dey & Boomgaarden, 1993). Therefore, daily discussions regarding the theoretical framework and empirical findings were conducted where thoughts and ideas were challenged in order to make the collected data analysis as good as possible.

Loop representation of analysis (Dey & Boomgaarden, 1993).

In total, there are 176 pages of transcribed interviews. As Cannie & Daniels (2004); Welch & Welch (2008) and Piekkari et al. (2014) suggests, all interviews were transcribed and coded separately so we could compare and discuss the interpreted information later on and make sure that both of us have understood the collected data the same way. In order to avoid misinterpretation of the transcribed data, potential question marks were in retrospective clarified with the respondents.

The qualitative analysis tool NVivo was used with the aim to code and classify the findings from the transcribed interviews. By coding and classifying, data can easier be interpreted with the theoretical framework and the research questions in mind

(Ghauri, 2004). In order for us to detect themes and trends every step of the interviews were studied. Based on the respondents' individual responses, we established categories; for example the category 'information overload' was used every time a respondent mentioned that they had to deal with too much information in their systems. At a later phase of the analysis, the categories that had been established were gathered into larger main themes (Tenzer & Pudelko, 2014). For instance, when someone expressed its feelings regarding information overload the grouped category was coded to 'The semantic impact level' etc.

3.4 Reliability and Validity

According to Andersen & Skaates (2004), one can validate the results of a study in several ways. External validity refers to how generalisable the results of a study are in other contexts (Tsang, 2014; Yin, 2014). With regards to this and considering the fact that case studies have been argued to be weak in that sense, generalisability is difficult to achieve. However, we are aware about this limitation and Tsang (2014) states that due to the capability to establish observed patterns, case studies can occasionally be more generalisable than quantitative studies. This is especially true when conducting a multiple case study. This statement is moreover valid on the subject of theoretical generalisation that refers to the ability to provide clarifications to the observed relationships between different aspects in a study, in order to apply it to other populations (Tsang, 2014). The purpose with theoretical generalisation is to modify, refine or build new theory, for example by focusing on new cases. To guarantee this, our empirical findings and analysis consists of different examples of when IS is inferior to good logistics performance. The method is referred to as 'analytical generalisation' and in order for this method to be valid, researchers illustrate how their findings from the case studies appears upon a theory or various events which in turn should be applicable to other events that are similar (Yin, 2014).

An alternative framework, presented by Lincoln & Guba (1985), highlights trustworthiness as an important factor in this framework. Except the already mentioned parts in this chapter, trustworthiness has been highly prioritised throughout the entire paper. This was possible by allowing open discussions with the respondents

where they were given the freedom to share their experiences and how they had interpreted them. Our respondents have different managerial positions within the logistics department of the company, which gave us a rich overview of the studied situation. As previously mentioned, observations and interviews have complemented each other throughout the entire data collection phase. All collected data is accessible for usage in future studies which makes this research replicable and this indicates that the level of reliability is high, as suggested by Bryman & Bell (2015). Furthermore, the level of reliability is also measured in terms of how trustworthy the collected data is, both primary and secondary data collections (ibid). Concerning the primary data, it was gained through several interviews where many of the respondents strengthened each other's statements and opinions regarding the incidents. Furthermore, since the respondents possess knowledge, experiences and since the majority also have a long career at the company we consider their answers to be reliable. Regarding the secondary data, we have used several sources in terms of known researchers and authors within their respective area. Databases that have been presented by University of Gothenburg have been frequently used (e.g. EBSCO) which are known to be trustworthy.

3.5 Study limitation

This study is specific to the manufacturing industry and to the particular company that has been investigated since the interviews and observations were done there. Two sites of the company were investigated and the respondents are presumably influenced by their backgrounds and experiences. Consequently, this entails that the result could have been different if the study were to be conducted in another setting and with other respondents. Since this was a conscious and strategic decision prior to conducting the study, the findings should thus be interpreted in the context of a multiple case study approach in one single company, where the findings can serve as a basis for further trails of discussion and research of future studies in fields related to IS and logistics performance.

4 Empirical Findings

Based on the assembled primary data, eight critical incidents will be presented. Firstly, the incident's course of action will be presented and thereafter an analysis of each incident, in order to highlight the most distinctive issues for the incident. The aim is to provide a multifaceted viewpoint of how the use of information systems affects logistics performance at the company. A compiled summary of the incidents will be provided at the end of the chapter.

In light of the theoretical framework that has been presented chapter 2, the following figure (figure 4.1) will be used throughout the thesis in order to illustrate the influence that the various aspects have on each other, and the impact they have on logistics performance.

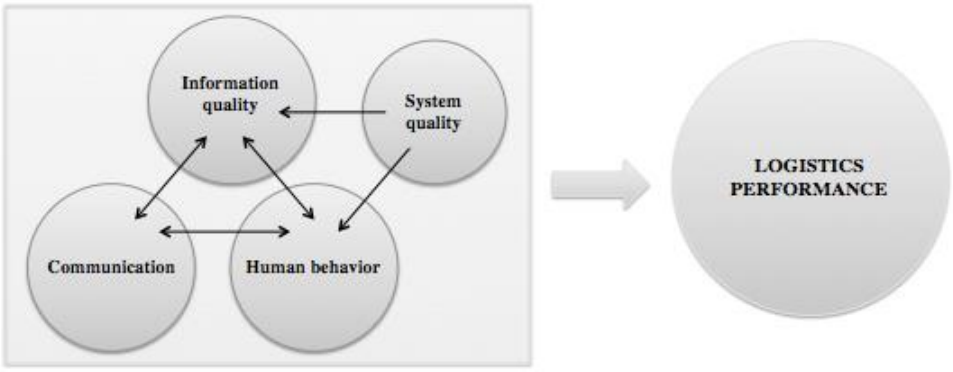

Figure 4.1

4.1 Incident 1: Weight Deviations Causing Order Cancellations

4.1.1 The Course of Events

The inefficiencies in the first incident were identified as we were solving a practical problem at the company, which concerned weight deviations for manufactured goods. The problem that required a solution was revealed when the customs related to a certain customer established stricter rules for imported goods and weight deviations are consequently no longer accepted, as explained by several respondents (R1, R5, R11, R12). It was further explained that the underlying weight information for individual parts is incorrect, and at times even non-existing, which by extension result in an increasing cumulative weight deviation for the finalised manufactured product. The underlying reason for wrong information to exist is because the weight information in the systems is calculated rather than physical. It was moreover

explained that they have been aware about the issue for several years, but that it has not been considered an urgent issue until customs recently tightened the rules (R11).

The prevailing process for sharing weight information was as follows: From the information system at the manufacturing site, weight information was extracted and sent to the HQ, which in turn verify the information in their system (which is provided from the same source as for the manufacturing site), and subsequently the information is sent to the customer and the accompanying customs (see figure 4.2) (R1, R5, R11, R12).

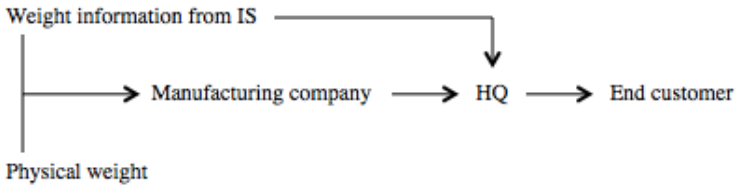

Figure 4.2

Occasionally, the outbound department at the manufacturing site realise that it is impossible for the weights to be correct. In these occasions the outbound department makes a request to the final assembly to physically weigh the product. The result is thus that deviating weight information will be sent to HQ. When verifying the information, employees at HQ will nevertheless change the weight information according to IS. Hence, since the weight information from IS is incorrect for both the manufacturing site and HQ, theoretical and physical weight will not coincide when the product reaches customs and consequently, due to the tightened rules, the goods cannot reach the customer until the deviation in the paperwork is amended. When asking about the trustworthiness of the information in IS, two of the respondents replied:

"In the events where the information provided by the manufacturing site and the information provided by IS deviates we at HQ always choose the information provided by IS." [R12, translated]

"Yes, we trust the information in IS." [R5, translated]

In addition to the underlying problem explained above, the information concerning this specific flow requires a detour through the company HQ, which adds one dimension to the problem. Since the applied IS are not linked to one another, HQ cannot see what the manufacturing site changes in their information system. Hence, as a result from the inefficiencies in the various information systems, increased pressure is put on internal communication as an external linkage, which should be used as a complement to the missing linkage between the information systems (see Figure 4.1). Respondent 10 commented on this and stated:

"It does not matter how good the internal communication is if you communicate the wrong information." [R10]

The established short-term solution was a routine for how to make sure that the correct total weight for the manufactured goods is entered into both information systems in order or the correct information to be sent to the end customer, and hence also the accompanying customs. Although this short-term solution is only implemented for the manufactured goods leaving for this specific market, it should be noted that the weight deviations concern all markets since the weights are calculated and not physical for *all* parts (R5, R8, R13).

The information deviations result in inferior logistics performance in terms of increased lead time when the goods are withheld at customs, additional and unnecessary work for the company, dissatisfied customers, and order cancellations have occurred as a result (R5, R11). Respondent 5 realises the issues regarding this problem and comments:

"We work in a global system for production together with various production sites and delivers all over the world. If this information is incorrect, then yes, we take decisions based on incomplete information… In these situations it is vital that we find routines to work around the systems and communicate cross-functionally." [R5]

The planned long-term solution is thus according to R1 and R5 to physically weigh all parts and enter the correct information in the systems.

4.1.2 Analysis, Incident 1 (I1)

Technical Impact Level

If the manufacturing site changes the weight information in their systems, the changes will not go through in the systems that are being used at HQ since they are not linked to each other. This thus entails that HQ will choose the information provided in the information system that they are using (i.e. the wrong information). Hence, once the long-term solution has been implemented (as mentioned by R1 and R5), the company may want to strive towards linking the systems in order for potential information change to reach more departments throughout the company, which was agreed upon by several respondents (R1:R4, R10, R13, R17). In a situation like this, increased pressure is put on internal communication to serve as an external linkage and a complement to the lack of interoperability between the information systems.

Semantic Impact Level

When analysing Incident 1, it can clearly be stated that the semantic level is the most outstanding from the three levels presented in chapter two. More specifically, the quality of information is the main issue, as it does not fulfil the demands of neither the users nor the customer. Since wrong information is entered into IS it affects both the manufacturing site and the HQ as their system is provided with information from the same source (see figure 4.1). When reflecting on the ten identified key problems of information quality suggested by Strong et al. (1997), issue number 1, 3 and 10 are most suitable to Incident 1. The first issue entail decreased information quality because information is stored in several places and therefore the risk for it not being updated coherently increases. Issue number 3 is appropriate since it highlights the problems of receiving incorrect information as a result of reoccurring system problems. When using communication channels where the encompassing information is not trustworthy, in this case the information systems, it may consequently lead to documents containing incorrect information.

For this incident, the logistics performance was affected by the prolonged lead time and order cancellations which entail lost revenues, as earlier mentioned by R5 and R11. These order cancellations were a result from the fact that the company did not

deliver according to the order specifications. Also, order cancellations do not only entail revenue losses, but it also carries impaired brand image, which in a long-term perspective implies significant costs.

Furthermore, in line with the abovementioned, the semantic level continues to be a problem throughout the events as internal communication is not serving as a complement to inadequate information in IS. This since the involved parties rather rely on IS than co-workers. The bias towards relying on IS is taken based on two distinct reasons. On the one hand it is because the change in weight information is not communicated, as the manufacturing site does not explain why they are sending information that is deviating from IS (R1, R12). On the other hand, the decision is taken because it is easier to trace the information back to IS than to a co-worker (R1, R5, R9, R12). The lack of communication is not contributing to the disappearance of existing problems and the involved parties are instead facing unnecessary and prolonged difficulties in terms of additional costs, extra workload and friction among colleagues. If internal communication would have been utilised to a greater extent, the company could avoid placing themselves in such a disadvantageous position.

Effectiveness Impact Level

Due to insufficient systems, additional workload is added to employees and thus attitudes towards the systems are evidently becoming increasingly negative (R1, R12). Respondent 1 also mentions that evidence of incorrect information in the system causes a suspicion towards the overall reliance on IS. However, since it is not possible to verify all information provided from IS, information provided by the systems is nevertheless used. Since the suspicion towards IS is present, the overall expectation when using it decreases and employees' level of disconfirmation thus increases. This may, as a result, affect the way they use IS in the future.

4.2 Incident 2: Order Allocations

4.2.1 The Course of Events

The second critical incident concerns allocation of customer orders between the various manufacturing sites. The company is striving to balance the utilisation rate throughout the sites in order to maximise the efficiency of each plant. This entails

reallocating orders if, for example, one (or several) of the four manufacturing sites is experiencing over- or under production.

Normally there are monthly meetings regarding next month's potential reallocations that serve as the main arena for decision-making (R5, R15). By the time a decision of reallocation has been made in these meetings, the procedure of reallocating the orders in IS is well defined, which renders the process to be carried out without conflict or friction. However, communication has occasionally shown to be insufficient prior to the decisions and this insufficiency may involve which market the order is destined to, lack of verifications, as well as lacking consent from at least one of the involved parties.

The problem that consequently occurs is that one of the decision makers enters the new (supposedly agreed upon) reallocation decision and notifies the customer about it. This happens without full consent from the manufacturing plant, and a conflict consequently arises. Although all decision makers have access to the same linked systems, no other user than the one initiating the reallocation order can change the information once it is entered into the information system. Hence, if the receiving party of the reallocation wish to cancel it, they are not able to do so without verification from the party that changed the order in the system in the first place. As a result, if the receiving plant does not accept the order and the user that changed the order does not change it again, the order is resultantly pending in the system. According to Respondent 5, the company must therefore make sure that the employees understand the importance of increased communication beforehand as well as the restrictions that follow when decisions about reallocations are being made. Respondent 5 moreover state that these events occur quite frequently and it is affecting the performance of the organisation to a great extent, which brings him to suggest a successful approach that has been used lately when developing new systems:

"We have enhanced and modified a whole lot the last few years in terms of IS. A few years ago we developed a system using the methodology Barashi, which is a methodology where all parties in the chain are involved and allowed to express their desires, concerns and feared risks." [R5, translated]

R5 thus means that a new system should be developed, alternatively redevelop the current system, where all decision-makers are involved in the process.

4.2.2 Analysis, Incident 2 (I2)

Technical Impact Level

Although all decision makers involved in this incident have access to the same systems, no other party than the initiator can make changes in IS once they are reallocated. This indicates that the system is not flexible to changes in decision-making and it therefore has a distinct negative effect on logistics performance and thus the company's performance. Poor system quality will thus most likely result in poor information, since the order (i.e. valuable information for the company) is pending in the system instead of providing information to a designated manufacturing site, as that would lead to action and bring value to the company in terms of being able to initiate the production process. Therefore, the company would have benefited from investing in enhanced system quality in order to achieve a more efficient reallocating process.

Semantic Impact Level

Similar to Incident 1, Incident 2 also holds the major issue in the semantic level. Notable in this incident is however that the communication between employees is insufficient and therefore causing the largest setbacks. For example, even though a decision had (evidently) not been established, information regarding reallocation reached the customer before the internal decision-making process was complete. Unfortunately, this triggered minor conflicts among the employees that could have been avoided if the communication had been better, which is compatible to Kembro & Näslund (2014) and Jacobs et al. (2016). With regards to previous researchers, poor internal communication also affects the manufacturing company's way of managing the forthcoming planning. Since customer orders are pending in the system, the order department do not receive information about how much and what is supposed to be ordered from suppliers. Additionally, in order to keep a sufficient level of information quality, changes in the order allocation requires a correlation between available information and the reallocation to be synchronised, which is compatible to issue 8

mentioned by Strong et al., (1997). This synchronisation was not evident in this case and the quality of information decreased.

The uncertainty about the orders may result in unnecessary logistics costs for the company, e.g. due to the increased risk of being forced to deliver material by air due to reduced time, and waste of resources since employees at both manufacturing sites are planning for the order to be allocated to their plant. Also, there is a risk that lead times will be prolonged, and if so, the customers may be affected. In addition, considering the fact that customers are notified about the changed manufacturing site before the finalised decision has been made, the trust towards the company may decrease and therefore also the brand image.

Effectiveness Impact Level

The affected system in Incident 2 serves numerous users and in this situation it would have been helpful if the system was easily reached and operated. It can moreover be stated that the users of this information system may become dissatisfied with its function and therefore a negative attitude towards the system takes place (R5). In order to avoid the dissatisfaction, there is a possibility to involve end users in the developing phase of new systems, as suggested by R5. In relation to this, Respondent 5 mentions that the company has involved end users in the development of another new system and admitted that it is the most appreciated and efficient system in the company. Implicit from this involvement, end users became satisfied with the result and the usage turned out to be easier to operate which in turn resulted in a positive attitude (R2:R3, R6, R11, R13).

4.3 Incident 3: Providing Goods to an Overseas Market

4.3.1 The Course of Events

The company experienced another critical incident when a shipment was to be made to one of the overseas markets. To this market, the company is not shipping fully assembled products, since the overseas market will manage final assembly themselves. This incident took place in the beginning of 2016 and the manufacturing company was for various reasons forced to ship one batch although all parts were not

included. This would entail the overseas market to be unable to finalise the assembly. The underlying reason why the company was forced to ship the incomplete batch was due to the fact that the quantities for two parts were incorrect in IS, which was discovered too late and thus additional material had to be ordered from the supplier, as according to Respondent 8. Hence, as mentioned above, the manufacturing plant made the decision to send the available parts with the planned delivery and send the residual parts by air upon arrival at the manufacturing site. This decision was subsequently communicated via email to the overseas market.

Since the parts that were sent by air to the overseas market, they arrived prior to the original batch to the overseas market. However, when the airfreight arrived to the overseas market, they had no idea what the purpose for the received parts was. Despite this incomprehension, the overseas market did not contact the company to be enlightened about what the purpose for those parts was.

By the time the sea freight arrived with the rest of the batch (six weeks later), the overseas market complained to the manufacturing site that some parts were missing; the parts that had arrived by air six weeks earlier. Following this, the overseas market notified the company of the missing parts and mentioned that they had not been notified of the change in delivery plans regarding the missing parts. It later stood clear that the manufacturing company had not contacted the correct person and no confirmation that the email had been received and understood (or not understood) was provided by the overseas market. Since the parts that were sent by air were missing at this moment, new parts had to be sent once more as a short-term solution. As Respondent 8 mentions, the decision that was made in the initial stage to send the missing parts by air was a good decision although the communication was not properly managed. The main issue, the respondent continues, was that the people at the manufacturing company did not know that information about different modes of freight should be sent to different departments, resulting in the manufacturing site contacting the wrong department. Given the information overload that emails entail, it would thus have been better to solve this issue, or at least notify the receiving party, by using telephone as the channel of communication (R8, R12, R14, R17). This statement about information overload, especially in terms of emails, have moreover been verified by all the respondents and Respondent 8 also mentions that he usually

uses approximately 20 per cent of the emails received during a day. As a result to this, the company is striving towards having a single point-contact at all the overseas markets, which would be the ultimate solution to these kinds of problems (R8). Respondent 4 stresses the issue regarding information overload as well by stating:

"In the systems, there are a lot of unnecessary information as well as a lot of information that is necessary, but that kind of information is sometimes difficult to find due to all the irrelevant information. The vital information is thus difficult to access." [R4]

There were other circumstances as well that resulted in this communication mistake to become larger than it could have. Firstly, the overseas market received the original batch at the time when many of the regular employees were not present at the manufacturing company due to vacation, which entailed the temporary employees to act without all the facts about previous events at hand (for example information about the need to initially send missing part by air). Hence, when the overseas market complained about the 'missing' parts, the instant reaction was to send new parts, which was once more delivered by air. Secondly, while the issue of the missing parts was being solved, the next planned delivery was received in the overseas market and parts were missing once again. At this point, the supplier did not have the possibility to send the parts that was needed and thus the company had to engage a partner in Europe to assist and thus the parts were shipped by airfreight again.

As a summary, it can be stated that the company had to involve ten times as many people, pay for two additional air freights and the parts it brought, as well as being exposed to a negative atmosphere in general (R8, R12, R17). Respondent 5 highlights the importance of internal communication in order to avoid the consequences that Incident 3 resulted in by saying:

"If I were to conclude, I would say that problems in communicating and cooperating is not dependant on the systems. It is rather the attitudes that constitute the source of the issues, since it affects how the information systems, and thus information, are used. This is where communication is vital; to inform about the importance of

communication prior to making a decision to change something in IS all concerned parties." [R5, translated]

4.3.2 Analysis, Incident 3 (I3)

Technical Impact Level

The technical impact in this incident was not distinct and to initiate an analysis is therefore needless.

Semantic Impact Level

As a consequence to poor information quality the manufacturing company had to spend unnecessary monetary means in order to correct the problems that arose. In Incident 3, we can establish that three of Strong et al.'s (1997) key problems were applicable. Firstly, problem 3 that has been mentioned in Incident 1 is also evident in this incident. Due to the systematic problems that the manufacturing company faced, it was forced to add deliveries to the overseas market, which entailed increased costs. The second applicable information quality problem is number 4, which is associated to information overload. Since the overall communication was handled via e-mail, the risk for information overload increased. This is due to the fact that employees have a higher tendency to screen rather than actually read information provided via e-mail (R4, R5, R12, R17, White et al., 2010). All respondents (R1:17) mentioned that they in one way or another had experienced information overload from this information channel and that this makes it difficult for information receivers to filter and process what is most relevant and important information might as a result disappear. If the manufacturing site had chosen another communication channel, such as a phone call, they would with higher probability have been guided to the correct department immediately. Thirdly, in the 8th problem the overall emphasis is put on the importance that information is fulfilling its purpose, even when the surrounding settings change. Related to this problem, it did not matter in Incident 3 that valuable information was sent by email to the overseas market since it due to information overload was unable to use this information.

With regards to communication, the company may want to emphasise the use of both virtual and non-virtual communication when communicating internally. From this

incident it can be stated that non-virtual communication is emphasised to a lower extent than virtual communication. Respondents 1:17 all agree upon the fact that non-virtual communication is an essential complement to virtual, and if the communication would have been held by at least telephone, the effects of this incident could have been less significant (R8). Nevertheless, the consequences was quite severe from a financial viewpoint since the company was forced to pay for additional airfreights, which is approximately ten times more expensive than sea freight (R10). Also, a lot of time was used to amend the consequences of insufficient communication which ultimately result in less efficient use of workforce resources, and thus also money.

Effectiveness Impact Level

It is possible to state that this incident did affect human behavior negatively due to the fact that all the other dimensions affect it. However, in this incident, no effectiveness level impacts were tangible enough to initiate a discussion.

4.4 Incident 4: High Information Quality is Elementary for a Good Level of Communication

4.4.1 The Course of Events

The substantial part of the fourth incident was explained by the manager of the inbound department and is quite similar to Incident 1. This event shows that incorrect information is not only affecting the departments that are central to the incidents, as implied in Incident 1, but other parts of the company as well.

The inbound department is on a daily basis communicating with the national customs regarding for example documentation for imports and in order for the company to receive import licenses, it is important to report correct weights for the incoming goods (R10). Respondent 10 however explains that the quality of the weight information for the various parts can deviate to a great extent. At times, they are correct to the milligram and in other cases one can easily tell that the precision is inadequate. Sometimes the department have found relatively heavy parts to be categorised among the lightest. In these cases, R10 continues, it is easy to spot the

deviations that need to be amended and the discovery is therefore sent to another department for verification and administration. The problem however occurs when the deviations are smaller and thus more difficult to question, which was also agreed upon by Respondent 13.

When being asked the question if the respondents have used or forwarded information that they know is incorrect, 15 respondents agreed that they have at least once used or forwarded information that they know is incorrect. However, the respondents also mentioned that they always try to find the correct information prior to using or forwarding it. Respondent 10 explains that when the department know that the information is incorrect, they need to ask colleagues at other departments what the actual weight is, meaning that those colleagues use other systems and thus might have additional or more precise information than the inbound department do. However, if other departments do not have the correct information, incorrect information is used and they hope that customs do not consider the total weight deviation to be significant enough to withhold the incoming goods until the documents are corrected.

As mentioned above, the inbound department sends the discovery of incorrect information to another department that needs to verify the weight, dimensions etc. in order to manage the root cause of the issue and change the incorrect weight information (R2, R10). This deviation can cause a lot of disturbance for the company because, first of all, approval of the documentation from customs must be received before the suppliers dispatch the goods. Hence, if the documentation is not in order by the time the goods are arriving, the company may have to pay a fine to the authorities. Secondly, deviations may cause the goods to be held at customs until the documentation is corrected and sent once again for approval, which results in increased lead time. Respondent 10 express the experienced difficulties regarding information quality and communication by stating:

"It is extremely important that you have the correct information in the systems. If not, it doesn't matter how good the communication level is, you will still communicate wrong information. From a logistics perspective, it doesn't matter how much we can shorten the lead time by for example loading and unloading faster without correct

information in the systems. At the end of the day, we are frustrated because we do not succeed on the information part. " [R10]

Furthermore, other types of information from IS is needed when issuing these import licenses for each part number, such as description of use, dimensions, supplier, origin etc. These may from time to time also be incorrect, R2, R3, and R10 say in agreement. Similarly to the weight issue, the inbound department cannot change descriptions, dimensions and so on either since they have to follow the same procedure that is followed when the weight information is incorrect. When being asked if the respondent believed it would be more efficient if they were able to change the information themselves, R2 and R10 believe that both in terms of time and knowledge requirements, it is not an easy task to do and that it is therefore better that one designated department does it. On the other hand, Respondent 10 believes that the responsible department can be more proactive in the approach and investigate all parts, not only the ones provided by a coincidence. If so, they could continuously work on changing the incorrect information in the system. R10 further states:

"*Since the beginning we have had issues with the registered information about each part. It has not become worse but it has not become better either. We have had the same problems for a long time; I know this because I have worked here for a long time and it is very hard to get a conclusion on how to maintain the systems with the correct information, and it is about time that we do something about this.* " [R10]

The main consequences that the company face due to incorrect information is firstly that lead times might increase since customs is withholding the goods. The main issue here is not only that the particular part that has incorrect information is withheld, but rather that *all* the parts included in the same delivery are withheld. Hence, even though the weight information is correct for all parts but one, this one deviation may cause a delay that in a worst-case scenario may stop the manufacturing process (R8, R9, R10). The company is therefore sensitive to be provided with correct information. Secondly, a lot of additional work had to be done in order to fix a problem that initially would have entailed less friction if the underlying information had been physical rather than calculated.

4.4.2 Analysis, Incident 4 (I4)

Technical Impact Level

Concerning interoperability, if the systems would have been linked in this incident, the company might have been able to avoid spending unnecessary time and workload on chasing colleagues at other departments to receive the right information. Also, lead times may not have been affected to the same extent since it would no longer entail as many problems at customs caused by weight information deviations. It should however be mentioned that although linking the systems would entail advantages, the manufacturing company are facing the risk of enabling information overload to occur. As a result, they might not enhance information quality as was the initial objective, but in fact deterring it. Hence, before allowing interoperability among the systems, the company may want to make sure that the input information is representing users' demands and high quality.

In order to become more proactive in the approach to the issue regarding deviating weight information, as expressed by R10, the company might also consider exception reporting as part of a solution, as suggested by O'Brien & Marakas (2007).

Semantic Impact Level

Similar to Incident 1, I4 was mainly caused due to wrong information in the systems, which is in accordance to issue 3 by Strong et al. (1997). The semantic level therefore seems to be the major fundamental issue once more. Poor information quality resulted in extra workload which affected additional departments within the manufacturing company. As Respondent 10 mentioned, when the inbound department do not have the correct information they try to find the right one by asking colleagues at other departments, once more resulting in extra work load for all involved parties. This means that other departments are using different systems that sometimes, evidently contain more information than the inbound department has access to. A resulting consequence to the multiple sources of information is the decrease of credibility and consistency of the provided information which is in line with issue 1 (Strong et al., 1997). The problem in this situation is that the systems are designed for different purposes that call for similar information and this entails the risk that information is not updated consistently, as earlier mentioned by Strong et al. (1997). Moreover, considering the fact heterogeneous systems cause the accessibility level to be low.

Receiving the wrong information is at this point known to be rather distressful as the consequences are for example, similar to Incident 1, increased lead time and additional workload, which is time consuming and costly. Moreover, since the company occasionally has been forced to pay a fine to the authorities, unnecessary costs arise here as well.

Fortunately, the inbound department can occasionally collect information from other departments, and from a communication viewpoint it is important to highlight that sufficient internal communication is applied as a supporter in this incident and the inbound department can from time to time thus correct the information in their IS as well. Hence, when the information is needed in the future, the department will not face this impediment. Although internal communication does not resolve the underlying issue alone, it serves to counteract some parts of the overall issue of information quality.

Effectiveness Impact Level

It is not difficult to imagine the frustration of repeatedly not having access to the correct information in IS, or being required to contact a colleague that has access to the information (R10). The chain of reaction in Incident 4 is similar to Incident 1. Hence, the general consequences are negative as the attitudes towards the system decreases due to information inaccessibility. In turn, this may result in negative influence and behaviour. During the interviews, respondents were asked to rate, from one to ten, the systems usefulness and efficiency. All respondents agreed upon the fact that the level of usefulness is very high (six to ten) whilst the view of system efficiency was low (four to eight). It could therefore be concluded that the level of satisfaction is low and a few respondents mentioned that the level of satisfaction could increase by small means. For example, some of the respondents suggested the amendment of information overload (R4, R8, R10, R14), and being more proactive in managing incorrect information (R2, R5, R10) as example of small means for increased level of satisfaction.

Since the involved parties in Incident 4 perceives the information accessibility in IS to be of low level, the attitude may consequently decrease. In addition, the users' expectations towards IS are not met, and according to Respondent 10, there is not

much belief that they will be met anytime soon as he states that this is an issue that has been existing for a long time without any radical changes being pursued.

This might result in a bias towards employees' reliance in using IS in future situations to be inferior and result in contacting a colleague that can provide the right information, rather than access IS (which may or may not provide the correct information). Although this would be positive for the internal communication, the purpose and positive aspects of IS would be lost. Hence, unnecessary resources would be utilised there rather than being used elsewhere.

4.5 Incident 5: Insufficient Updates and Lacking Internal Communication

4.5.1 The Course of Events

Recently, the company faced another problem of incorrect information in the systems. According to Respondent 6, the disturbance was so great that it required one employee to spend one working week to solve the consequences – resources that would have been better utilised elsewhere. The course of events was as follows; an order was placed at one of the company's suppliers where it had been accepted. When the order was to be delivered, the supplier advised that the goods had been dispatched which in turn entailed that the information in IS was updated accordingly. The company was thus expecting the goods to arrive at the time that had been agreed upon. Hence, the supplier did everything according to the general procedure. The problem however appeared when the goods where consolidated at the company's consolidation point, where the goods were to be dispatched together with other orders. According to Respondent 6, there was a deviation in the transport from the consolidation point to the terminus which caused a serious delay. The delay was communicated from the consolidation point to the inbound department, which in turn resulted in the information that previously had been entered in the system to be illegitimate. Although the consolidation point administration notified the delay to the inbound department, they did in turn not forward the information nor change the information in IS and information about the changed situation did therefore not reach all affected parties. Respondent 6 further states that due to the fact that many of the

systems that were concerned in this case are linked, the information hat was initially entered into the systems (incorrect information) reached several parties at various departments.

Since the information in IS was not updated according to the new information, the risk of the correct information not reaching all affected parties increased. Hence, the risk of not being able to take the correct action increased concurrently, as explained by Respondent 6. The respondent continues by saying:

"*Since we trust the information that is provided in the systems, we are subject to huge risk for disturbances in these situations*." [R6]

Respondent 9 adds to the discussion as he states that, from experience, people tend to trust the information systems more than information that is contradictory or otherwise not in accordance with the information in IS. Respondent 9 further comments:

"It is human behaviour rather than the systems that are the issue with deviating information. Sometimes information needs to be inserted manually and in those cases we might have deviations in the systems, which you need to be cautious about. However, this is not a daily deviation in the systems and therefore we trust the information that is provided." [R9]

Respondent 6, 9, and 10 all mention that these kinds of issues are not occurring frequently, but they also agree that this year has entailed more disturbances than usual regarding illegitimate information in IS. In general, Respondent 3 and 6 believes that one of the main reasons that underlie these increasing issues is the fact that the systems are too difficult to learn and fully understand, and adds that if they were to become more manoeuvrable, the disturbances may decrease and the effects that follow may not be equally severe.

4.5.2 Analysis, Incident 5 (I5)

Technical Impact Level

Respondent 6 mentioned that one of the main reasons for this issue to occur is that the information systems are difficult to fully understand and learn. It might therefore be of interest to involve users in the development of systems, as suggested by Respondent 5 in I2. Other than the speculation that unfriendliness is a contributing factor to an increase in these disturbances, the systems were in this case considered to be technically sound.

Semantic Impact Level

The issue of incorrect information seems to be recurrent throughout the incidents. In this case, the systems are linked and thus incorrect information affects several departments throughout the company. Interoperability is therefore in this case not beneficial to the outcome, since an additional amount of people resultantly has access to incorrect information. This thus provides evidence that the information in the linked systems is required to be correct, otherwise it will not make any useful contributions.

Key problem 10, by Strong et al. (1997) is appropriate for this incident as the used communication channel (i.e. IS) is not trustworthy which in turn provides inadequate information. This incident also proves that once changes occur, the risk increases for lower information quality, since it requires the information to be updated accordingly, similar to key problem 8 (ibid). In this incident, information about the delayed goods was not updated according to the changes made by the consolidation point, which caused the information in the systems to be inadequate and the quality of information decreased as a result.

In these situations, additional pressure is put on the use of internal communication. Unfortunately this did not occur, since the inbound department did not forward the information that they received from the consolidation point. If the information had been communicated to the affected departments, alternative solutions could have been planned for and the company would not have to assemble the missing parts in retrospect. Alternatively, the same could have been done if the information would have been updated in IS.

Effectiveness Impact Level

Respondent 6 mentioned that the information systems are difficult to fully learn and understand. This statement might serve as an explanation for why IS was not updated and why information did not reach the end user that required it. Satisfaction plays, as mentioned several times before, a major part in IS usage and one may assume that if the respondents feel that the IS is difficult to understand and use, the level of satisfaction becomes rather low. If IS users continues to perceive negative experiences when learning and using information systems, the attitudes can be assumed to also be affected in a negative way and a negative spiral is therefore started. As R9 mentions, it is the human factor that is considered to be the issue in this incident, not the information systems as such since the users overlooked the fact that the information needed to be forwarded.

4.6 Incident 6: Conflicting Systems Causes Production to Stop

4.6.1 The Course of Events

For the sixth incident, Respondent 4 thoroughly explained that when his team arrived to the office one day, they found that there had been a deviation in the systems. Upon arrival, production was blocked due to an error in the production information systems. The facility of the production systems is vital for enabling production, as it provides specific and detailed information about the various steps in the production process. In the beginning of the workday, the products that were about to be manufactured were prevented due to contradictory specifications in the systems. The reason for this, Respondent 4 explained, was because the customers for these products had requested for changes when they are usually no longer allowed to be made. R4 moreover states:

"The market sent a request for changes, and the planning department analysed and accepted the request. However, they didn't inform production in the right time and they didn't update all the necessary systems for that either." [R4]

Regardless, the planning department had accepted the desired customer changes and Respondent 3 argues:

"*We figure that it is better to accomplish the desired changes before we start producing the product, even if we know that it will be tight in the schedule and*

difficult for the information to reach the various production departments in time. We believe it is more cost efficient than making the adjustments in retrospect since that is more time consuming." [R3]

Respondent 3 moreover explains that in the events where deadlines are not respected, another information system is used to insert information about the changes. Since the planning department had accepted the changes in the 'regular' system, but not added information in the system that is used when changes have been accepted, a conflict between the different information systems arose. Due to this misalignment, IS was unable to print or show the detailed work orders that are necessary for production. Although the planning department had received information about the change one week prior to this incident, no information was updated or forwarded to all involved parties. Since the planning department did not update the information in all systems according to the changes they had accepted, the information in the production system and the order system did not match which in turn caused this error in production.

Respondent 3 admits that these changes may affect logistics performance a lot, especially since they affect the amount of material that is ordered from suppliers. Hence, the company faces increased risk of additional costs in terms of rapid transportations, as well as displeased suppliers which may harm the relationships. Respondent 4 mentions that his department managed to make the necessary changes before production started. Respondent 9, on the other hand, had more comprehensive changes to organise, which entailed production to stop. As a result, although not all departments of the production were directly affected by the decision to allow the changes, they nevertheless became affected by the production stoppage.

Respondent 4 and 9 agree that changes such as the ones in this incident are not uncommon. They also mention that, until recently, the company recently used excel sheets and e-mail to manage and inform the involved parties about the accepted changes, but that the company has recently developed a system for this. Respondent 4 mentions that they are in the process of learning the new system, which thus causes these deviations and mistakes to happen. Regardless, Respondent 4 still stress the fact that it is a huge problem considering the fact that the order changes are reoccurring

and that it is important to communicate more clearly in this initial stage of learning the system. The respondents state:

"To receive wrong information in the systems is not that uncommon. For example, sometimes you find that the work order in the information system demands the wrong parts or the wrong quantity. For example, we might need to assemble two or three pieces of one specific part, but the IS for assembly only ask for one. It is neither uncommon for this manufacturing site nor for the company in general." [R3]

"Our information systems have not become worse over the past years, but it has not become better either, which would be a desirable course." [R4]

Respondent 9 agrees and adds that there is nothing wrong with the system as such, it is the human factor of mistakes that allows for these things to happen. R9 also adds:

"*Because of the human influence factor, one is more biased towards trusting information systems than people, and it is a tricky situation since it is difficult to know which information is added manually in IS.*" [R9]

When asking the question of what the main difference between managing the changes in a system rather than manually by Excel-sheets and e-mail is, Respondent 4 states that the sense of control and planning is the main advantage. Previously, the central planning department could send a compiled e-mail containing a massive amount of changes, all at once. At that point, they did not have any checkpoints and no reminders of specific changes. Now, the changes are updated in real time and they have better and more continuous control over potential changes. In that sense, due to increased control, quality has increased. However, R4 also mentions that, in a way, communication was better when Excel-sheets and e-mails were used since they were more or less forced to communicate to a greater extent at that time.

Respondent 4 moreover believes that this issue has to do with the fact that there is one global system that applies to all sites of the company. Respondents 2, 3, 4, 9, and 12 mean that the local systems are necessary because the plants are differently structured. However, in some manufacturing sites, local systems are required and the linkage

between the global and the local systems is not always efficient. They moreover mention that although their local systems tried to be a 'mirror' of the global system more space for local systems should be allowed within the global systems, since they are vital for the plant-specific production possibilities. The need for local systems is furthermore one of the reasons why most of the respondents experience the unnecessary amount of systems that they need to log in to in order to make a decision and/or to complete a task (R1:4, R6:10, R12:17).

4.6.2 Analysis, Incident 6 (I6)

Technical Impact Level

Incident 6 is characterised by system quality issues in terms of technical soundness, or how well the system can perform without encountering errors, since the system was blocked due to contradictory specifications. If considering the relationship between system quality and information quality, the poor system in Incident 6 proves to result in poor information, since none of the parties that actually needed the information about the change received it in time. It stands clear that system quality and performance is questionable since a conflict between the two systems arose, and rather than allowing for one of the systems to be dominate, specifications could not be printed and production stop was a result.

Respondent 4 mentioned that there is one global system that applies to all sites of the company but in some manufacturing sites, local systems are required and the linkage between these two types of systems is not always efficient. Additional respondents moreover state that more space in local systems should be allowed within the global systems, since they are vital for each specific manufacturing plant (R2, R4, R8, R13, R17). This is one of the main reasons why most of the respondents experience the unnecessary amount of systems that they need to log in to in order to make a decision and/or to complete a task.

Semantic Impact Level

Issue 3, 5 and 8, established by Strong et al. (1997), is in line with the course of action in Incident 6. As mentioned in the previous section, the regular system and the system used for order changes are heterogeneous, which cause the accessibility to be low. If

these two systems would have been linked, the planning department could have made changes in any of the systems and the production departments would have seen the changes earlier. Respondent 4 was lucky enough to make the necessary changes before production started but R9 was forced to stop the production which entails massive costs for the company. In this incident, information about the changed circumstances was not updated accordingly in all systems, which entails the information to be unsynchronised with the course of events. As a result, the information provided by IS was useless (i.e. information quality was low).

The underlying issue could have been solved if the internal communication between the involved departments had functioned better, as mentioned by R4. The respondent further mentions that IS has evidently improved quality regarding the requested adjustments from customers. The only problem with the implementation of the newly developed system is that communication has decreased in correlation to the implementation which strengthens the theory of this research that IS does not only enhance logistics performance. Since the virtual communication did not perform as desired in this incident, the complement would be to make sure that the involved parties received the required information to proceed without any obstacles. Two-way communication is thus vital in order to make sure that the right information has reached all involved parties at the right time. All respondents (R1:17) agree upon the fact that two-way communication and preferably face-to-face communication, is the ultimate way of communicating. However, although it is increasingly important to make sure that information is communicated properly when changes occur, this incident provides a good example that it is rather insufficient under those circumstances.

Respondent 9 further states that in the cases where the work orders and specification are incomplete or incorrect, the incorrect information is being shared with the IS that is used to order new material. Until the incorrect information is changed, material planners will organise on the initial premises, which causes them to plan according to the wrong specifications and increased risk for additional costs is a result for the company in general, and the logistics department in particular.

Effectiveness Impact Level

In the technical part of this analysis, respondents mentioned that they had to enter an unnecessary amount of systems to be able to make decisions and/or complete a task. In Incident 6, the attitude evidently becomes more negative when the involved parties need to enter several systems in order to complete their tasks or make decisions (R1, R3, R6, R9, R13, R17). Respondent 4 mentioned that the company are in the phase of learning the systems and that the system is still considered to be complex. Hence, the users might in this phase be reluctant to use the system, which may be an underlying factor for this mistake to happen. Since they are considered complex, dissatisfaction regarding user friendliness may be a result and the intended continuance of using the systems becomes inferior. Hence, similar to the events of the previous incident, complex systems can in this incident also be an underlying reason for the information not to be updated in both systems.

4.7 Incident 7: Order System Collapse

4.7.1 The Course of Events

This incident concerns a system collapse due to information overload in the order system. Respondent 15 explains that one of the company's customers placed an extraordinary large order that was far above the company's communicated restriction for the amount that can be placed simultaneously by the same customer. This incident resulted in a system collapse, causing all orders in the system to go into a pending-mode, including the orders made by other customers as well. According to Respondent 15, when incidents similar to this one occur, the IT department is immediately involved. In this case, because orders are required to pass several steps of the ordering process, the company had to manually release every individual order from the first step so the orders could continue to the second step. In the second step, all employees at the order department were forced to drop their individual responsibilities and assist with the orders that were pending in step two (R15, R16). In the third step they had to make sure that the company could manage to produce the requested orders in time for the preliminary date of delivery.

When customers place orders it normally takes about 15 minutes for the customer to receive an order confirmation. However, as a consequence from this incident,

confirmations were not provided until two to three days which caused stress and anxiety among the customers, which entailed additional communication to be carried out with the customers as well. In addition, during the system collapse other customers could not place any orders, which pressured the company to manage the issue in a quick manner (R15). Subsequently, as a follow-up to the root cause for the system collapse, the order department contacted the marketing department to clarify the limited amount of orders the system could manoeuver. It was moreover asked how the customer was able to place that large amount at the same time without the marketing department giving notice to the order department. It was explained that the marketing department had not received any information about this and they could therefore not notify the order department. Respondent 15 means that it is difficult to know whose fault it was, and states:

"*We are not sure why the restricted amount was not respected, it might be due to lack of communication on our part, or ignorance on their part, it is hard to say.*" [R15, translated]

In order to prevent similar events to occur in the future, the company inserted a system block with a maximum limit of the amount of orders that can be placed simultaneously.

4.7.2 Analysis, Incident 7 (I7)

Technical Impact Level

In Incident 7, the technical level is rather significant, since the system collapsed and brought stress to the manufacturing company, especially to the ordering department and its customers. An accepted level of system quality was therefore not achieved in this incident. Unfortunately the system was not prepared to manoeuvre this type of overload, which resulted in the system to break down. Because of the severity of the overload, it took several days for the company to process the requested orders and confirm that they had been received and allocated to a production period, which entailed additional workload for the employees.

Given that this incident demanded the involvement of every employee at the order department, resources that could have been utilised elsewhere had to be attentive to the prevailing issue. Considering the fact that customers could not place any orders until the default had been handled, it was crucial for the issue to be managed quickly in order to avoid forging revenues, as pointed out by Respondent 15. This incident is similar to Incident 2, where the orders were also pending in the system and thus they were not useful to the company as valuable information was inaccessible. Hence, the value that the pending orders were about to bring the company was put on hold, and moreover, important resources that could have been used for other important tasks were utilised to solve this problem, which entailed indirect costs for the logistics department.

Semantic Impact Level

Respondent 15 mentioned that the marketing department was not aware that one of the customers would place such a massive order. Poor external communication thus affected the internal communication as well. If the marketing department would have had sufficient information exchange with the customer, they could in turn have given the order department notification that a large amount of orders would be placed by one of the customers. By doing so, the order department would have been able to advise the customer to split the orders since they were aware about the limitations of the order system. As previously mentioned, the pending orders caused stress among the customers that were unaware about what had happened, which caused additional correspondence (and thus workload) to be carried out with the customers. Fortunately, this incident did not result in any severe consequences in terms of order cancellations or complaints and all orders that were placed could be produced in desired production period.

Effectiveness Impact Level

Similar to Incident 3, this incident had no distinct human behaviour-effects and an analysis is therefore redundant.

4.8 Incident 8: Human Involvement Usually Complicates Things That in Theory Works Fine

4.8.1 The Course of Events

In the eighth and final incident, the company had issues with a code that is used to mark produced products and this code is essential for production continuance. There is a section in the code that changes every year in order to indicate which year it was produced. When the system was to change the section to the current year's predetermined code, the system did search for the next year's code and thus found nothing. Resulting from this, the system did instead provide a blank space where the year-specific part of the code was supposed to be.

The system deviation however went unnoticed and production thus proceeded as usual, i.e. no deviation reports or warnings were provided. However, at the time when production entered the first testing phase (early in the production) no information could be uploaded as a result from the missing code. This was due to the fact that the code had to be entered into the system for it to be able to continue in the production. This is according to Respondent 3 in line with the lean management-approach, and in particular 'poka yoke', that the company is applying:

"*If we would not have had this poka yoke checkpoint in production, the consequences could have been much more severe and we could have had to reproduce all affected products, which would entail huge costs for the company."* [R3]

Hence, the company were 'only' required to reproduce the products that had been affected from the start of production up until the first product were to enter the testing phase. The subsequent actions were therefore to seek the root cause of the systematic issue and correct the fault, and subsequently test that the function operated without fault. Respondent 3 argues that this was a systematic fault, although it was supposed to be checked, updated, and validated by a co-worker, as according to the routine that had been established for this code. When being asked what action they were to take regarding the mistake made by the employee and the deviation from the routine, Respondent 3 stated:

"*There is not much to do about this deviation, the human involvement will always be complicating things that in theory works fine.*" [R3]

4.8.2 Analysis, Incident 8 (I8)

Technical Impact Level

The characteristics of Incident 8 shows that system quality appears to be bothered by systematic errors in this case. Since the system consists of poor performance, the information quality was in turn affected as well, which caused the manufacturing company to be required to reproduce the units that did not have a code. Since a column in the system was left to blank, the system could have notified the user by providing an error message, or similar. Hence, a potential solution to this systematic error could be exception reporting. Although the company is relying on IS to provide the codes automatically, human interaction also constitutes a vital part as an employee should verify that the code is correct. The correlation between system quality and the human impact in this incident is evident and this did in turn impact logistics performance. The logistics performance consequences were tangible from a cost- and time perspective due to the requirement of reproduction of several products.

Semantic Impact Level

The systematic errors caused information to go missing which is exactly in line with how Strong et al. (1997) define issue 3. The flaws in the system caused the quality of the information to be inadequate as well and there is a clear correlation between insufficient system performance, information quality and human impact.

Concerning the internal communication throughout this incident, it was non-existing until someone at the testing area was exposed to the problem of not being able to test the unit, and subsequently initiated internal communication regarding this issue. As mentioned in the description of the incident, after the deviation in the system had occurred, production was not notified about the problem, which is understandable since no one had been notified. If production had been informed that the code was missing, production would have been given the choice to postpone until the required information to continue production was provided. By doing so, the manufacturing company would most probably have avoided reproduction and thus saved resources in terms of both time and money.

Effectiveness Impact Level

In Incident 8, the system error was unexpected and the situation was not improved since the incident complicated the remaining production and assembly. Furthermore, the overall attitude towards IS may be decreasing as well and the risk that this attitude might affect future use of the IS. These errors are however difficult to safeguard against, and although the company had tried to do that by involving human interaction, it did not succeed. Moreover, as R3 mentioned, the human factor complicates things that in theory works perfectly fine.

4.9 Summary of the Critical Incidents

The two tables that can be found below are summaries of the critical incidents presented in this chapter. Table 4.1 is a general summary of the involved parties, a summarised description of the incident, and the logistics performance consequence(s). Table 4.2 is in a more detailed manner explain the impact of the various impact levels.

	Involved Parties	**Summarised Description**	**Logistics Performance Consequence(s)**
Incident 1	Outbound department HQ Customer and customs	Weight deviations for manufactured products, which is no longer accepted by customs	Prolonged lead times Order cancellations Additional tasks required
Incident 2	Order departments for all manufacturing sites	Reallocation of customer orders between various manufacturing sites	Prolonged lead times Inability to plan beforehand
Incident 3	Outbound department	Difficulties in providing the right amount of goods to one of the overseas market	Prolonged lead times Increased costs (air freight)
Incident 4	Inbound department Outbound department	Insufficient information quality causes national customs to occasionally withhold goods	Prolonged lead times Increased costs (fines)
Incident 5	Inbound department Material controls	Adequate information not updated in the systems nor forwarded to all involved departments	Prolonged lead times
Incident 6	Planning department Production Material controls	Order specification unable to be printed due to contradictory information in the systems	Production error Production stop
Incident 7	Order department Marketing department IT	System collapse as a result of too many orders placed at the same time	Prolonged order confirmation Extra workload
Incident 8	Planning department Production IT	System error causing a vital code to go missing	Prolonged lead time Production error Reproduction

Table 4.1 Compiled summary of the critical incidents and the resulting consequences.

From Table 4.1, it can be seen that all incidents in one way or another entails non-beneficial logistics performance. It can be concluded that all logistics performance consequences involve increased and unnecessary costs. Apart from the cost increases that result from for example additional airfreight, fines, production stop, there are events that result in indirect cost increases (e.g. prolonged lead times and extra workload). Prolonged lead times is a consequence that occurs in several incidents and although it does not immediately draw the mind to increased costs, it is an important measure for logistics performance and it may in the long run entail lost revenues and dissatisfied customers, which may be an even more severe consequence than additional direct costs.

	Technical Impact Level	**Semantic Impact Level**	**Effectiveness Impact Level**
Incident 1	Systems not linked	Information quality Several sources of information Inadequate information quality due to wrong input Limited access to information Communication Insufficient internal communication (in general)	Dissatisfied users due to inadequate information and unlinked systems
Incident 2	Low level of flexibility	Information quality Information is not following changes Communication Insufficient non-virtual internal communication	Dissatisfied users due to system inflexibility.
Incident 3	N/A	Information quality Inadequate information quality due to wrong input Information overload Information not following changes Communication Insufficient non-virtual internal communication	N/A
Incident 4	Systems not linked	Information quality Several sources of information Inadequate information quality due to wrong input Communication Good internal communication in general	Dissatisfied users due to inadequate information and unlinked systems
Incident 5	N/A	Information quality Information not following changes Inadequate information quality due to wrong input Communication Low level of internal communication in general	Trusting the systems means increased risk for disturbances and thus entails a negative attitude
Incident 6	Interoperability not existing Conflicting systems	Information quality Inadequate information quality due to wrong input Heterogeneous systems causing contradictory data Information not following changes Communication Insufficient non-virtual internal communication	Dissatisfaction due to heterogeneous, multiple information systems
Incident 7	System quality not technically sound	Information quality N/A Communication Poor external communication, which affected the internal communication Good internal communication in general after the collapse	N/A
Incident 8	System error causing a vital code to go missing	Information quality Information not following changes Communication Non-existent communication	"Human involvement complicates things that in theory works fine"

Table 4.2. Illustration of the negative impacts from the various levels

Table 4.2 highlights the negative impact the various impact levels on logistics performance in a more detailed manner. It can be concluded from the table and the analysis that the semantic level has the most distinct impact on logistics performance. More specifically, incorrect information and lack of non-virtual communication is the most protruding issues. From the technical level, lack of interoperability is the most recurring issue, which by extension result in various issues in the other levels, such as dissatisfied users and low information quality due to the various information sources not being updated coherently. The effectiveness level is the level that is most ambiguous in its impact on logistics performance, since it to a great extent is affected by the other two levels. Nevertheless, dissatisfied users are the most recurring issue that impact negative logistics performance.

5 Cross-Case Analysis

In this chapter, a cross-case analysis will be provided and will mainly be based on the analysis from each incident in chapter 4, accompanied by previous research from the literature review. The aim with this chapter is to provide a broader context of the relationship between IS and logistics performance.

5.1 "In Which Situations Do IS Have Negative Impact on Logistics Performance?"

From the different incidents, various factors have contributed to inferior logistics performance. From the compiled summary of the incidents in Table 4.2 we can see that the semantic level is the main influencer to poor logistics performance since it is present in all eight incidents. The underlying reason for this will be discussed below along with the influence power that all the four dimensions (within the three levels) carry to poor logistics performance.

5.1.1 The Technical Impact Level

5.1.1.1 System Quality

In six of the presented incidents, system quality has been a significant factor to poor logistics performance. In these events, user friendliness and flexibility have not performed according to a desired level, and unlinked systems have caused distress in various situations. As according to the suggestion about system interoperability made by O'Brien and Marakas (2007), which was also agreed upon by Park & Ram (2004), it is in this research also acknowledged that linking the systems would diminish some of the negative consequences and thus enhance logistics performance, as stated by several respondents (R1:R4, R8, R10, R12:13, R17). For example, if the information systems would have been linked in Incident 4, inbound department would not have had to contact co-workers to collect additional information which they did not have access to themselves. Hence, workforce resources could have come to better use elsewhere, and the additional time it takes to receive the information will by extension affect lead time in the events where goods are being withheld at customs. Similarly, in

Incident 1, increased pressure on internal communication would not have been required to the same extent if the systems were linked, and thus HQ would not have to choose between two contradicting weights. Moreover in Incident 6, heterogeneous systems were one of the main contributors to the inability to print the work order, which caused production to stop. Hence, logistics performance was impacted in a negative manner, not the least considering the increased costs that was a result from the production stop.

In one of the incidents (I5), the systems were actually linked but the outcome was nevertheless not beneficial. The reason for this was however that the quality of information was insufficient which caused incorrect information to spread throughout the company. Hence, it goes without saying that homogeneous systems in most cases solely enhance logistics performance when the underlying information is correct. As a result, in the events where information systems are not linked to each other and the underlying information is adequate, the use of IS evidently have negative impact on logistics performance, as according to this study.

As mentioned by Respondent 10, system quality has not changed to the better for several years, which is in line with Whittaker & Voas (2006) and Parnas & Lawford (2003). This low level of system quality (especially in I1, I2, I4, I6, I7, and I8) has clearly resulted in poor information quality, which in turn has affected logistics performance. In that sense this research confirms the results of Gorla et al. (2010).

5.1.2 The Semantic Impact Level

5.1.2.1 Information Quality

When analysing each incident with Strong et al.'s (1997) 10 information quality potholes in mind, issue 1, 3, 4, 5, 8, and 10 were applicable to at least one of the presented incidents. Issue number 3, 8 and 10 were the most recurring issues. Issue number 3 and was found in I1, I3, I4, and I6, and issue number 8 were found in incident I2, I3, I5 and I6, whereas issue number 10 was only represented in two incidents (I1 and I5). Hence, validation of input data (issue number 3) and changes in task needs (issue number 8) are the most distinctive issues for the company in terms of information quality. Moreover, issue number 10 regards limited access to

information, which is the third largest issue for the company in terms of information quality. This is, as earlier highlighted, concerning the fact that the systems are not linked and thus accessibility naturally becomes more complex.

In addition to Strong et al.'s (1997) framework, information overload is another issue for the company and it is especially evident in Incident 3, where an employee at the manufacturing site chose a communication channel that is highly associated to information overload. In these situations it is even more important to receive confirmation that the information has been received and noted, as also concluded by Welch & Jackson (2007). Moreover, in line with the arguments of Eppler (2015), this incident shows the challenge to be attentive to the required information, which in turn results in inferior problem solving.

From the empirical data it can clearly be stated that information quality is the aspect that carries the most substantial consequences for logistics performance. Although it occurs in all incidents but one (I7), the consequences are most severe in Incident 1 and Incident 4. In I1, low information quality caused order cancellations and prolonged lead times. Longer lead times were also evident in Incident 4 where goods were withheld in customs. These consequences are by extension resulting in decreased brand image since deliveries were not according to order specifications, and lost revenues. These issues can be avoided if the systems provide correct information and if the correct information is accessible to all users that require it.

Incidents	**Information Quality Issues***
Incident 1	1, 3, 10
Incident 2	8
Incident 3	3, 4, 8
Incident 4	1, 3
Incident 5	8, 10
Incident 6	3, 5, 8
Incident 7	N/A
Incident 8	3

Table 5.1 Information quality issues appearance in the incidents.
**A summarised explanation of the issues can be found in Appendix C.*

5.1.2.2 Internal Communication

Communication is yet another issue that is present throughout all the presented incidents. Although it is difficult to determine communication as the main influencer to the resulting inferior logistics performance in each incident, it is nevertheless a contributor in all presented incidents and its importance should therefore not be undermined (e.g. R8, R10). Jacobs et al. (2016) are in agreement to the importance of internal communication as they mention that it has been somewhat neglected and that it has substantial importance in business (hence, also logistics) performance, which is a conclusion that is in line with Kembro & Näslund (2014) who conclude the same in their study. Communication is shown to be an especially large contributor to poor logistics performance in four of the incidents (I2, I3, I5, and I6). These four all have in common that they represent changes that deviates from "business as usual". To be more specific, it concerns changes regarding customer orders; change in order allocation, change in the mode of freight, change in specifications, or date of arrival. While it is crucial to make sure that communication is efficient and that non-virtual communication serves as a complement to virtual communication (Eppler, 2015), the manufacturing company is demonstrating insufficient performance in this area when unexpected changes occur.

Incident 3 is a good example to more specifically present the effect that miscommunication may have on logistics performance. Miscommunication directly caused increased costs because of the use of airfreight. Furthermore, since the overseas market had to wait for the second airfreight to arrive with the missing parts, lead time increased. When analysing the incidents, it can clearly be stated that the majority of them generated increased lead time as a result from miscommunication.

5.1.3 The Effectiveness Impact Level

5.1.3.1 Human Behaviour

As mentioned by DeLone & McLean (1992, 2003), the impact that IS have on the behaviour of individuals is difficult to pinpoint, and this statement is further reinforced in this research. There is a wide range of aspects that influence an individual to take certain actions or make decisions and the attitude towards IS is one

of them, as both seen in the empirical part of this study (e.g. I1, I2, I5), as well as in previous studies (Bhattacherjee, 2001; Jackson et al., 1997; Ajzen & Fishbein, 1977).

In order to understand an individual's attitude towards IS and measure the probability of continued usage, Bhattacherjee (2001) developed ECT as an attempt to sort the multifaceted nature of human behaviour and IS usage. Similar to the suggestions made by Bhattacherjee, this study found that the intention of continued use of IS is influenced by the level of satisfaction and the usefulness of it. All respondents were asked to scale, from one to ten, the level of satisfaction towards IS based on previous use and the level of usefulness they perceived IS to be. The respondents had various answers were ranging from four to eight on satisfaction and from six to ten on perceived usefulness. These are subjective questions, yes, but when we compare answers for the level of perceived usefulness and the level of satisfaction with the same respondent, it stands clear that all respondents believe that the satisfaction level is lower than the level of usefulness. The respondents thus desire the satisfaction level to be higher than it is today. Respondent 5 further emphasised the importance of positive attitudes towards IS, and moreover stated that human behaviour is the dimension where most significant enhancements can be made. Respondent 9 is in agreement with this opinion as he mentions that human behaviour has a lot of impact on how well information systems are performing. A few respondents further mentioned that the satisfaction level could by small means become higher. For example, some of the respondents suggested the amendment of information overload (R4, R8, R10, R14), and being more proactive in managing incorrect information (R2, R5, R10) as example of small means for increased level of satisfaction.

A few respondents highlight a reluctance towards information that is provided by IS. For example, Respondent 1 mentioned that although evidence of incorrect information from IS exist, there is no chance to confirm all the information provided, which ultimately results in a general suspicion towards IS accuracy. Similarly, Incident 4 indicates the same outcome, and R10 mentions that these issues have been present for several years, yet no radical attempts to increase the satisfaction level have been carried out. This too shows of little confidence towards the future usage of IS. Incident 5 also highlight the ECT, although this expectation is more related to manoeuvrability of the system, rather than the output. I3 and I5 are similar in the

manner that human behaviour is affecting the way information is communicated (or not communicated in those incidents).

Similar to the aspect of communication that has been discussed above, it is difficult to establish a direct causal relationship between human behaviour and logistics performance. Nevertheless, it can be stated that this study confirms previous researchers' findings that attitudes towards IS affect the general intention for further usage (e.g. Ajzen & Fishbein, 1977; Jackson et al., 1997; Bhattacherjee, 2001). This may in turn result in mistrust towards the systems and ultimately prolong lead times as a result of validating information. As probably noticed, there are a lot of 'may' in this analysis and this shows that the dimension of human behaviour is rather ambiguous. What can be said however is that human behaviour and attitudes towards IS do affect the subsequent course of events, and decision-making that entails a certain situation or task, as mentioned by several respondents (e.g. R5, R6).

5.2 "What Tools Can Organisations Use to Counteract the Potential Negative Impact(s)?"

5.2.1 The Technical Impact Level

5.2.1.1 System Quality

It is evident that system integration is the most recurring issue for the company in terms of the technical level. In order to counteract the problems that have been acknowledged in the previous sections, the company should consider following the advise of O'Brien & Marakas (2007) and strive for more synchronised systems. If doing so while at the same time making sure that the major issues regarding incorrect information is managed, they would probably experience more beneficial outcomes in logistics performance. The company will most likely continue to encounter issues emerging from inadequate information but presupposing that the issues are not of reoccurring nature such as some of the incidents presented here, the benefits may overcome the disadvantages with linked systems. However, prior to linking the systems, the need to eliminate redundant information needs to be emphasised and thus ensure that information overload is avoided. The quality of information would

therefore maintain a high standard, which is also argued by Park & Ram (2004) and O'Brien & Marakas (2007).

Inflexibility is another issue that was presented in the incidents. As mentioned by Respondent 5, the most proper approach to solve this issue is to involve the users of the systems, as this would allow the users to express their opinions and give suggestions for improvements. Hence, this approach would by extension most probably also improve user satisfaction, both in terms of users feeling that their opinions matter and less friction in using IS as a result.

With regards to the attitude the respondents have expressed towards system quality, a software update and increased user friendliness are the most outstanding desires of system quality improvements. However, as several researchers conclude, it is not only the investments as such that contributes to outperforming competitors, but rather skills and organisational learning (e.g. Bharadwaj, 2000; Tippins & Sohi, 2003; Gorla et al., 2010). Hence, in order to increase user friendliness, the company may consider investing in new systems or redevelop existing ones and allow users to be involved in the process, as suggested by for example Hartwick & Barki (1994) and Respondent 5. This approach, as R5 mentioned, has previously proven to be a success within the company and, therefore, if the company is to invest in system quality improvements, it should include organisational learning in the process, similar to the approach of the most recently developed system mentioned in Incident 2. This approach is moreover in line with previous research, which state that involving IS users in the development phase entails increased possibility to success in IS utilisation (Robey & Farrow, 1982; Ives & Olson, 1984; Barki & Hartwick, 1989).

5.2.2 The Semantic Impact Level

5.2.2.1 Information Quality

By improving system quality, Gorla et al. (2010) mention that the chance for enhancing information quality increases, and by extension business performance as well. This is vastly in line with the viewpoint of this study as well, since system quality affects both information quality and human behaviour (Mason, 1978; DeLone & McLean, 1992, 2003; Gorla, 2010). If expectations are met in human behaviour and

information quality is enhanced, perceived satisfaction and usefulness of IS is elevated and users will most likely experience better decision-making, which ultimately impacts logistics performance (see figure 4.1 for illustration).

Moreover, what distinguishes the incidents that concern information quality is that there are no exception reports or system errors warning about inadequate information. Hence, unless an employee initiates an investigation or reports the inadequate information, it has the possibility to stay in the systems in perpetuity and thus continues to provide incorrect information to IS users. In addition to this, the company can for example make sure that the inserted information is physical rather than calculated, as in the case for the weight information in Incident 1 and Incident 4.

From a managerial point of view, follow-up should be encouraged and prioritised in the events where resolving inadequate information is forwarded to another department as well as being notified when the reported issue has been resolved (R1:R3, R11:14). According to R2 and R10 this is not being emphasised to the proper extent and they mention that when incorrect information is discovered, it is being forwarded to another department to solve, without a routine for follow-up. This should however be in the interest of the departments, especially the ones involved in I1 and I4, since that information is used on a daily basis.

Information overload is yet another concern and from the incidents it can be stated that information overload is a disabler to increased information quality, which reinforces Eppler's (2015) conclusion as well. If the redundant information were to be removed, it would be easier to sort out the relevant information and the quality of the information would thus be higher. If the company were to follow the suggestion of exception reporting made by O'Brien & Marakas (2007) it could, at least in incidents 1 and 4, be more proactive in detecting obvious information errors. Using exception reporting is also an approach to reduce information overload, which were expressed by all respondents as a problem.

A final issue within the information quality-level is limited access to information. In order to amend this problem, the company ought to for example link the systems and allow for the information to be accessed by an increasing amount of people, or simply

providing the users access to more systems. The latter options may however entail more negative attitudes from the users since there would be increased amount of IS to learn and use.

5.2.2.2 Internal Communication

Most importantly, the company should put more emphasis on internal communication in general, but to be more specific, it should emphasise the non-virtual communication further. The general impression regarding communication is that users of IS are preferably using virtual communication throughout all the incidents, which is in line with Cubbage (2005) and Cornelissen (2014). It was as a result found that increased focus should be placed on non-virtual, two-way communication, especially at times when changes occur. In line with the abovementioned authors, it is recommended to apply face-to-face conversations to the largest possible extent in these occasions. We are in that sense in agreement with Eppler (2015) as he states that both virtual and non-virtual communication is needed to succeed in business performance.

When unexpected changes do occur it is further important to establish a communication standard, or matrix if you will, similar to the one provided by Welch & Jackson (2007). This is recommended to implement in order to emphasise the importance of non-virtual communication as well as provide guidance on how to proceed with internal communication in more detail. In addition, if the involved parties in I3, I5, and I6 would have followed a guide or routine after being notified of a change to occur, unnecessary waste of time could have been avoided and the company could have kept the delivery promise and avoid production to stop, as according to the events of Incident 6.

5.2.3 The Effectiveness Impact Level

5.2.3.1 Human Behaviour

As mentioned by several respondents, the company should be more attentive to the features or events that cause users to be disappointed with IS (e.g. R2, R4, R5, R14).

This may, as abovementioned, involve proactivity in terms of incorrect information, decrease information overload and thus increase information quality. This may also involve linking the systems in order for users to avoid the necessity to enter several systems in any given task that demands a solution. By doing this, users' expectations will more likely be confirmed, and thus the satisfaction level and the perceived usefulness increases, which is in line with the arguments made by Jackson et al. (1997) and Bhattacherjee (2001). Considering the fact that human behaviour and attitudes influences further actions and decision-making, the human behaviour-dimension should be highly prioritised. In order to prioritise it properly, it is however important to focus on the prevailing and tangible problems that arise in the other dimensions, considering the fact that effectiveness level and human behaviour are the only level and dimension that is influenced by all other levels and dimensions (see figure 4.1). Moreover as mentioned by some of the respondents, small means can help increase the satisfaction level to a great extent (R2, R4, R5, R8, R10, R14). Hence, by acknowledging the suggestions and requests made by the users of IS, the level of satisfaction and the perceived usefulness will most probably once more be enhanced.

As a final note it should be stressed that since the manufacturing company will most probably not stop using IS, the company needs to realise information systems' influence on users' decision-making, and make an attempt to handle the sources of dissatisfaction, as illuminated by several respondents (e.g. R2, R3, R10). Moreover, the adjustments that are made within the dimensions studied here, synergetic effects will follow as a result from their dependent natures. As mentioned several times, if for example system quality is enhanced (e.g. by linking the systems), information quality and human behaviour will be influenced positively as well and the three improvements can affect logistics performance to the better, thus creating synergetic beneficial effects.

5.3 A Snapshot of the Analysis

A summarising table of the analysis can be found in Table 5.2 below. The table illuminates the discussions that have been carried out for each of the research questions, and also which of the dimensions and impact levels that the issues and the

suggested amendments belong to. What can be stated is that all issues that have been acknowledged in the analysis have at least one amendment that can be applied in order to counteract the negative impact that each problem has on logistics performance, which is a promising result for the future usage of IS in relation to logistics performance.

"In Which Situations Do IS Have Negative Impact on Logistics Performance?"	"What Tools Can Organisations Use to Counteract the Potential Negative Impact(s)?"	Dimension	Impact level
In the events of unlinked systems	Invest in linking the systems	System quality	Technical
In the events of low user friendliness-level	Involve system users in system developments and updates	System quality	Technical
In the events of inflexible systems	Involve system users in system developments and updates	System quality	Technical
In the events where incorrect information is provided	Validate input data	Information quality	Semantic
	Exception reporting		
	Encourage follow-up when incorrect information is detected		
In the events where users face information overload	Exception reporting	Information quality	Semantic
	Dismiss abundant information		
In the events of limited access to information	Link the systems or allow for increased amount of users in the IS	Information quality	Semantic
	Allow for increased amount of users in IS		
In the events of changes in the day-to-day business	Establish communication guidelines in the events of changes	Communication	Semantic
In the events where non-virtual communication is insufficiently used	Prioritise non-virtual communication to the greatest possible extent	Communication	Semantic
In the events where internal communication in general is insufficiently used	Prioritise and encourage internal communication; both cross-functionally and within the various departments	Communication	Semantic
In the events of too complex systems	Involve system users and prioritise proper education of the systems	Human behavior	Effectiveness
In the events of users having to enter several systems to collect information	Link the systems	Human behavior	Effectiveness

Table 5.2 Summarising table of the analysis

6 Conclusion

In this chapter, answers to the research questions will be presented. This will be done with the help from the literature review, the empirical findings and the analysis from the previous chapter. As concluding remarks, the study's academic contributions will be presented and suggestions for future research will be provided.

6.1 Findings and Contributions

This research has investigated the relationship between IS and logistics performance. Previous studies have highlighted the advantages of companies using IS and how this usage have enhanced logistics performance. In this research, a multiple case study at a multinational manufacturing company has been carried out in combination with an extensive literature review. The analysis found certain influencers to be dominating in affecting logistics performance negatively. In order to counteract these influencers, the analysis has moreover provided suggestions of tools and amendments that the company can utilise to improve the performance. It can from this study be stated that IS, and thus also information as such, is not only a source of value creation and enhancing logistics performance when properly managed, but also a source of value destruction when mismanaged.

Two research questions were established to study the role of IS usage in logistics performance: '*In which situations do IS have negative impact on logistics performance?'* and *'What tools can organisations use to counteract the potential negative impact(s)?'*. Regarding the first question, the analysis clearly shows that difficulties in the semantic level generate the most severe consequences. More specifically, the main issues lie in information quality not maintaining a high standard, and communication not being sufficient when changes occur. Tools that can be applied in order to counteract the negative impact on logistics performance have been provided in Table 5.2 and it includes communication guidelines, reducing information overload, exception reporting, and encouraging follow-up. Given the severe impacts that the semantic level entails in the eight incidents, it can from this research be stated that more effort should be placed on communication and information quality, since the company otherwise will encounter increased and avoidable costs, as well as risking to forgo business opportunities.

The lack of interoperability is a repeatedly distinctive issue for the technical level throughout the empirics and the analysis. Hence in order to answer the latter research question, it is encouraged to strive for a higher level of interoperability. However, we stress that prior to this potential investment it is vital to manage the prevailing information quality-issue mentioned above in order to avoid low quality level information to contaminate additional parts of the company. Although companies and previous researchers have emphasised and studied the technical aspect of IS usage to a large extent, this research shows that the technical level is the least severe influencer to poor logistics performance. Hence, this research indicates that the substantial part of the effort that is placed on IS should be re-prioritised towards the semantic and the effectiveness level.

Dissatisfied users are shown to be the main underlying issue to negative impact on logistics performance for the effectiveness level. Considering the fact that the effectiveness level and human behaviour is the only level and dimension that is influenced by all other levels and dimensions, it is suggested that the company focus on amendments for the prevailing issues in the other dimensions as a first step. This will most probably result in synergetic effects and enhance the effectiveness level as a result. The amendments, such as the ones mentioned above, should be focused on the goal of confirming users' expectations on IS in order for the users to become more satisfied. This study further shows that human behaviour is the most ambiguous influencer to logistics performance compared to the other dimensions. However, it is nevertheless the dimension where most significant enhancements can be made, if managed properly.

On a more general note, the risk for failure and undesired consequences are greater considering the fact that the dependence towards IS and managing information is seen as 'business as usual' in the information society where companies are present. It is furthermore established that although focus has shifted towards IS in general and system efficiency in particular, other aspects of IS usage influence the efficiency of information systems, which by extension thus will have impact on the outcome of logistics performance. Companies must therefore not merely look at system efficiency from a technical viewpoint and, as a result, overlook other dimensions influencing IS,

such as the ones presented here. Especially evident is the fact that from the four different influencers that have been presented, system quality was contributing least to the severe consequences. A potential explanation to this is that it is the influencer that is most straightforward in terms of measurability, which makes it easier to manage potential inefficiencies. Nevertheless, companies must not neglect to amend issues in IS that are more difficult to measure, and that in general are of complex nature such as information, communication, and human behaviour. The four influencers complement each other and one influencer cannot rule out another. It can moreover be concluded from the study that information systems do not have any intrinsic value. Therefore, in order for companies to be able to leverage other resources through utilising IS, companies must provide the right input and supporting tools. If comparing this premise to a car, it requires the right fuel, a licensed driver, and intact technology in order for it to move from point A to point B in a safe and efficient manner. Considering the fact that IS and the influencing factors that have been presented in this study are all served by human beings, this research conclude that *information systems are only as good as the people behind them.*

To summarise, the results from this study allows us to conclude that the research contributes to the growing importance of how to utilise IS to the best possible extent in order to improve logistics performance, which previously has not received much attention. Furthermore, the results allows for other multinational manufacturing companies to widen their perspectives regarding IS utilisation in terms of essential focus areas. The findings of this study have contributed to fill important academic gaps as it has given new perspectives of how IS disables proper logistics performance in a multinational manufacturing company and in which situations.

6.2 Future Research

The viewpoint on the IS field of study that is presented here, where the main disadvantages of IS in correlation to logistics performance are illuminated, is rather

unexplored. Moreover, the importance of internal communication and human behaviour as a complement to IS has also previously been rather neglected. The results of this investigation however show that these aspects play major parts in affecting a company's logistics performance. However, it has in this research not been investigated *to what extent* these influencers are affecting the logistics performance in terms of IS usage. Because both internal communication and human behaviour are influencers that are relatively difficult to measure it would be an interesting topic for further research and it may strengthen the results of this research as well.

Furthermore, since it generally exists a poor selection of academic literature highlighting the drawbacks of IS and the importance of internal communication future research would contribute to IS research by investigating and highlighting these problems. Another recommendation is to do a comparative study where the setting and respondents are different from this investigation in order to find other essential conclusions that may enforce this study, as well as further fill academic gaps.

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Appendices

A. Interview Guide

BACKGROUND

- Which logistics department do you work at?
- What is your role there?
- How long have you worked there?
- Since you started at the company, have you always been using information systems (IS)?

INFORMATION SYSTEMS

- How often do you use IS?
- Could you give an example of when you gather information from information systems?
- Have you ever been given a reason not to trust information system?
    - When?
    - Why?
- In light of the previous question, did you use the information anyway?
- How often does it happen that you use information that you know is incorrect?
    - How often is this information incorrect or otherwise not trustworthy?
- Which actions do you take after you have realized that the information is incorrect or otherwise not trustworthy?
    - Is there any routine for these occasions?
- What is your opinion regarding information systems and the assistance in decision-making?
- What is you opinion regarding information systems and the efficiency in sharing information?
- How would you value information systems on a scale from 1 to 10 to your daily business in terms of:
    - A: Usefulness?, and
    - B: Satisfactory performance?

- How are information systems being marketed in the company? I.e. what is the view of information system success from a top-down point of view? And what is the general view from a bottom-up point of view?

COMMUNICATION

- During a day, what does your internal communication look like? What communication channels do you mainly use?
- Based on the previous question, how often do you communicate via each of the channels during a day (approximately, in percentages)?
- In what communication channel do you feel that internal communication is the most effective? (i.e. the message is received, understood and has led to an action)
- Do you have a standard for how to communicate internally?
    - If yes, how do you follow it?
- What are the main advantages and disadvantages concerning the way you communicate internally today at work?

LOGISTICS PERFORMANCE

- How do you think that the use of IS affect logistics performance in general?
- How do you think that your internal communication is affecting the logistics performance of your company?
- How can it be improved?

CRITICAL INCIDENTS

- Can you identify one or more events where, for example:
    - The quality of the information in the information systems is poor but it was used anyway*, or*
    - The information from the information systems is preferred over information from any other channel
- Please describe the incident in detail:
    - What happened?
    - How did this incident affect logistics performance?
    - What consequences did the incident result in for the company?

B. Schedule of the Interviews

Respondents	Face-to-face interview		Telephone interview	
Respondent 1	February 17th	09.00-09.45	March 29th	13.30-14.00
Respondent 2	February 15th	13.00-13.40	March 30th	13.00-13.45
Respondent 3	February 17th	10.00-11.00	March 23rd	15.00-16.00
Respondent 4	February 15th	10.00-11.00	March 23rd	14.00-15.00
Respondent 5	February 16th	08.30-09.45	March 23rd	12.30-13.30
Respondent 6	February 18th	09.00-10.00	April 1st	16.00-16.50
Respondent 7	February 19th	15.00-16.00	March 24th	18.00-19.00
Respondent 8	February 22nd	09.30-10.30	April 7th	17.00-18.00
Respondent 9	February 18th	09.30-10.30	April 6th	16.00-16.45
Respondent 10	February 19th	10.00-11.00	March 24th	13.00-13.40
Respondent 11			February 16th	10.00-10.30
Respondent 12			February 16th	10.40-11.10
Respondent 13	February 19th	15.00-16.00		
Respondent 14			March 23rd	15.00-15.30
Respondent 15			April 6th	11.00-12.00
Respondent 16			April 6th	10.00-11.00
Respondent 17	February 15th	13.00-14.00		

C. Overview of Information Quality Potholes

Problem	Description	Consequences
1. Several sources	The same information can be found in several sources which affects the value of information.	The utilisation level decreases and users mistrust the information.
2. Subjective judgments	Subjective judgments are used when producing information, which causes predetermination.	The information becomes hard to evaluate due to decreased objectivity.
3. Errors in production	Loss of information is caused by systematic information errors in production.	Search of information is increasing which is a time concern
4.Information overload	Due to too much information, the information access become rather difficult and time consuming.	To derive and summarize information, additional time is required.
5. Distributed heterogeneous systems	This kind of systems contributes to values, definitions and formats that are inconsistent.	Due to differences in incompatibilities and formats, information can no longer be combined.
*6. Nonnumeric information**	It is not enough to provide nonnumeric information. Users need numeric as well in order to be able to calculate trends.	Changing type of storage can be rather costly and in some cases result in little benefit.
7. Automated content analysis not yet available	Problems when using text information and images for analysing trends.	Information is very limited.
8. Changes in task need	As organisational environment and tasks continuously changes, relevant and useful information changes as well.	The correlation between available information and task needs is not synchronised.
9.Privacy and security prerequisites	A conflict may arise between easy access information and prerequisites for privacy and security.	Delayed access to information or security blocks which results in decreased information value.
10. Lack of sufficient computing resources	Incomplete information due to devious lines of communication.	Limited access to information.

** Issue 6 is not applicable in this context since electronic storage is widely utilised at the company and therefore it will not be used.*