SteriNoord: a vicious or virtuous cycle?

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Abstract: Well-functioning supply-chains are considered as a competitive advantage. However, the supply-chain of the company that was the subject of this study (SteriNoord) was not functioning well. This was due to the specific type of supply-chain (closed-loop) of SteriNoord in combination with lacking delivery performance. To improve the supply-chain, the delivery performance needs to be increased. This research paper investigated how delivery performance in this supply-chain can be influenced. Four factors from a close match supply-chain are tested. *Trust, planning & control, group learning* and *contract* prove to positively influence the delivery performance.

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1. INTRODUCTION

1.1 Problem Statement

When doing business, having a well functioning supply chain is considered as a competitive advantage. During my bachelors' assignment, I had the chance to investigate the supply chain of the company SteriNoord. SteriNoord is an organization that provides a sterilization service of medical instruments to hospitals. Its customers (hospitals) demand timely delivery of sterilized instruments, since lives are depending on it. The conclusion of this investigative assignment has several presented factors that contribute to SteriNoords' low delivery performance. Delivery performance is the ability to conform to agreements between supplier and buyer, that is timely delivery of the right quantity & quality (Sarmiento, Byrne, Contreras & Rich, 2007). Delivery performance plays a major role in supply chain performance and has a big impact on the relation between SteriNoord and its customers.

The relation between supplier and buyer is crucial to business survival. Especially when it concerns a relation like the one of SteriNoord and its customers. SteriNoord provides a service for hospitals, sterilizing utilized medical instruments. The amount of instruments in need of sterilization depends on the usage of the instruments by the hospitals. There lies the problem; there is fluctuation in the quantity & quality of instruments received by SteriNoord. Literature provides solutions on how service organizations can cope with demand fluctuations in supply chains and improve the relation. In addition, these solutions can also increase/stabilize the delivery performance. However, in this case the literature does not apply, because SteriNoord is positioned in a unique supply chain. SteriNoord is situated within a closed-loop supply chain (CLSC). What sets a CLSC apart from the traditional forward supply chain (FSC)? The main difference between a CLSC and FSC is the fact that FSC companies only manage forward logistics. CLSC companies manage forward- and reverse logistics directly (Östlin, Sundin, & Björkman, 2008). Additional differences and explanations will be provided in the theoretical background.

This paper sets out to investigate factors that influence delivery performance within a CLSC. Factors from FSC literature are applied in combination with factors derived from interviews held in the investigative phase with SteriNoords' management. Why factors from the forward supply chain literature? Because it is the most comparable supply chain, it is theoretically half of the CLCS. These factors have a proven influence on delivery performance in FSCs. Factors

such as *continuous improvement*, *buyer trust*, *inventory*, interdependence, *contractual governance* and *performance* (Ahimbisibwe, 2014; Gunasekaran, Patel, & McGaughey, 2004; Inkpen & Currall, 2004). During the investigative phase at SteriNoord, managers were asked for possible solutions solving SteriNoords' low delivery performance. Solutions such as *strict contracts*, the ability to *plan production* and *trial-and-error* were mentioned. Combining overlapping factors of both sources resulted in: interdependence, trust, inventory, contract, planning & control and group learning to be the subjects of this investigation.

This paper sets out to explain which factors are present and what their influence is on delivery performance in a CLSC. The main research question therefore will be: *How can delivery performance in a closed-loop supply chain be improved?*
The following questions need to be answered before the research question can be answered.
1. Which of the factors are present in a CLSC?
2. Do the factors influence delivery performance positively/negatively?
By answering these two questions this paper adds to the literature of operation management and supply chain management. In which little is known about closed-loop supply chains and what factors influence the delivery performance in this unique supply chain.

1.2 Preview of the Report

The theoretical background will present explanations of the factors presented in the introduction: trust, inventory, contract, planning & control and group learning. Hypotheses and a conceptual model are presented. Furthermore, what methodology will be utilized to collect the data and perform the analysis will be presented. For data collection a questionnaire is used. The data is then analysed within the result section using statistics to proving relations. Finally, the discussion & conclusion of the results will be presented among with limitations, further research and recommendations.

2. THEORETICAL BACKGROUND

As stated in the introduction, SteriNoord is located in a CLSC. What sets a CLSC apart from the more traditional FSC? The differences will be explained in the following section. First, in the FSC only the forward logistics are managed. Within a CLSC however, the forward- and the reverse logistics are managed directly by the company (Amin & Zhang, 2012; Guide & Van Wassenhove, 2000). Forward logistics is the flow of products from a producer to its customer(s). Reverse logistics is the flow of used products from the customer(s) back to the producer. In a CLSC, both forward- and reverse logistics are managed; thus both companies are buyer and supplier at the same time (Östlin et al., 2008). Additionally, a CLSC depends on feeding used products back into the production cycle as raw materials, without these used product firms cannot operate (Blanco & Cottrill, 2014). SteriNoord depends on the used instruments of the customer (hospital), as input for their production process.

Adding to this, Wells & Seitz (2005) indicate that a service-contract is essential for operating in a CLSC. In the case of SteriNoord a service-contract dictates the amount of instrument sets circling through the CLSC. However, when and in what condition these instruments return is not clear. This uncertainty in quantity & quality as one of the typical aspects of a CLSC (Östlin et al., 2008). In contradiction to a FSC, where a service-contract directly results in a known number of products when and how to be worked on (Östlin et al., 2008). Uncertainty makes it hard for any firm to plan and structure production.

Furthermore, Guide & Van Wassenhoven (2000) argue that in a CLSC customers do not distinguish between new or reused products. Customers experience no difference between new or reused products. In the case of SteriNoord, the hospitals do not distinguish between new or reused instrument set; instruments only need to be sterile and sharp. In comparison to the FSC with a reuse element, the products are remanufactured to be as close to new, but are never considered to be new (Guide & Van Wassenhove, 2000).

Finally, within a CLSC ownership does not resides with the production company (Östlin et al., 2008). The customer always has ownership, even when the product is in production (Östlin et al., 2008). In a FSC however, the ownership is transferred from producer to customer as soon as the product leaves the final production stage.

In conclusion, a CLSC is different from a FSC because of the management of two logistics flows, the uncertainty in quality & quantity of instrument sets, the difference in products (reuse vs. new), and who gains/has ownership of products.

This paper takes factors of influence from FSC literature and managerial interviews and tests these in the context of a CLSC. In order to test the factors, the factors are defined and their relation towards delivery performance explained. Each segment will conclude with a hypothesis, which will result in a conceptual model. It is important to indicate that the factor of interdependence is present in both forward- as closed-loop supply chains. There is no indication that interdependence is (or should be) higher in one of the two forms. Besides, in the case of SteriNoord it is a dyadic supply chain. Which means that there are only two players in the supply chain, a buyer and a supplier. Therefore dependence in imitate, thus the factor of dependency is certainly present. Therefore interdependence will not be examined.

2.1 Trust

Trust is the first factor that could impact the delivery performance within a CLSC. Trust describes the extent to which a firm believes that its exchange partner is honest and/or benevolent (Geyskens, Steenkamp, & Kumar, 1998). Besides the honest belief of exchange partners, trust refers to the decision to rely on a partner with the expectation that the partner will act according to common agreements, with or without contractual governance (Inkpen & Currall, 2004). Using an empirical analysis, scholars have found that trust amongst supply chain partners directly affects relationship performance and supply chain integration & collaboration (Flynn, Huo, & Zhao, 2010; Liu, Wang, Hui, & Lee, 2012). Trust therefore can be categorized as an important factor that influences the performance outcome of organizations. However, the effects of trust within a CLSC remain unclear. Due to the importance of trust in forward supply chains, the effects of trust in a CLSC needed to be identified. During the investigative phase at SteriNoord, interviews resulted in a conclusion that trust could influence delivery performance in a positive way. Therefore, this paper investigates in to what extent trust is present and if its influences the delivery performance. The expectation is that trust positively influences the delivery performance.

2.2 Contract

As the definition of the factor trust indicated: the presence of contracts (contractual governance) can result in a better relation between partners (Inkpen & Currall, 2004). Having an agreement can result in an effective relationship and provide guidance in times of uncertainty (Östlin et al., 2008). Therefore the second factor is the presence of a contract. The effects of a contract on delivery performance within a CLSC will be examined. A contract is an agreement in which is stated what services are being performed under which conditions,

like payment, time-constraints (Östlin et al., 2008). Contractual-based governance emphasizes the importance of formal rules of compliance and contracts between supply chain partners (Lumineau, Fréchet, & Puthod, 2011; Reuer & Arino, 2007). SteriNoord is under a service-contract according to Östlin et al (2008). A service-contract is defined as a type of relationship that is based on a service between a manufacturer and a customer (Östlin et al., 2008). Contracts, like the contract between SteriNoord and it customer, result in formal rules that allow for effective and dependable performance (Griffith & Zhao, 2015). The effects of a contract are depending on different aspects of the relation (Griffith & Zhao, 2015; Östlin et al., 2008). So, what are the effects of a contract on the delivery performance in a CLSC? Expected is that a contract will lead to higher delivery performance.

2.3 Planning & Control

The advantages of a contract are guidelines and accountability between parties. Which should result in a production process that could be planned and controlled. As mentioned in the introduction, SteriNoord depends on the used instruments of its customers, as the input for their production process. With depending on customers, comes the risk of uncertainty in quantity & quality (Fleischmann, van Nunen, & Gräve, 2003; Handfield & Bechtel, 2002). This uncertainty presents difficulties for production planning and establishing processing times. The difficulties have resulted in SteriNoord implementing a new information system to track product returns (quantity), the quality of products and to track the performance of remanufactured units. However, does this new system provide SteriNoord with sufficient evidence to enhance their delivery performance? In a FSC, planning & control lead to increased delivery performance. But is this the case in a CLSC? Expected is that increased efforts for planning and control lead to higher delivery performance.

2.4 Inventory

Like trust, inventory is probably one of the most examined and related concepts of influencing delivery performance. Inventory is the amount of units that is kept in reserve for unforeseen situations or continuum of operations (Van Der Laan, Salomon, Dekker, & Van Wassenhove, 1999). Within a FSC, an increase in the inventory results in a company being more capable of coping with unforeseen scenarios, like a delayed delivery or a stock-out (Natarajan & Goyal, 1994). Being able to cope with uncertainty is one of the main focus points to enhance the performance of any supply chain in general. Thus, for forward supply chains as well as closed-loop supply chains. In this paper the factor of inventory will not be

examined due to three reasons. First, the effects of having more inventory has a beneficial effect for both supply chains, therefore not resulting in any new knowledge. Besides, at SteriNoord an extra unit of inventory has high purchase price, one instrument set can cost up to □100.000,- . Therefore, only the necessary amount of instrument sets is acquired. Since SteriNoord only facilitates the serialization, and ownership remains at the customer, inventory cannot be influenced. Finally, SteriNoord is a company that does not hold inventory, as soon as the instruments come in, they are being processed and shipped out. Due to these 3 reasons, the decision to not examine the factor of inventory in made for this paper.

2.5 Group Learning

Finally, group learning as a potential factor of improving delivery performance. Pierce & Jussila (2010) put group learning among potential benefits of trust among supply chain partners. Group learning is defined as those activities that a group conducts so that it can adapt and improve (Druskat & Pescosolido, 2002). For this paper group learning will be examined, due to the human side and based on the conclusion that structural adjustments like adjusting the scope are out of the question (Stevens & Johnson, 2016). Group learning results in employees feeling more part of the organization and as a result more willing to take risks, discuss errors and be open to feedback (Edmondson, 1999; Pierce & Jussila, 2010). Group learning is important for organizations, since it helps to improve organizational- and employee behavior and production processes (Druskat & Pescosolido, 2002). For the group effectiveness, Pierce and Jussila (2010) suggest that group learning could lead to increased employees' performance in the workplace. Which in turn will result in higher productivity and higher changes of obtaining set objectives, like contractual deadlines. Since SteriNoord is a young organization (<1year old), group learning is of importance for decreasing the delivery times. Furthermore, literature proves the influence of group learning on delivery performance. Therefore group learning could be of importance in CLSC to increase delivery performance. Group learning is expected to have a positive influence on delivery performance.

2.6 Conceptual Model and Hypotheses

Trust, contract, planning & control and group learning are expected to influence delivery performance in a CLSC. The conceptual model (figure 1), shows the relations as presented in the FSC literature and by interviewees. All the factors have a direct influence on the delivery performance. For an organization to operate with a high delivery performance, each factor needs to be present and be positive. If only one factor would score low in this relation, it would have a negative effect on the delivery performance. The conceptual model states the 4 hypotheses that have been presented in the previous segments of this chapter. Hypotheses on which the conceptual model is based:

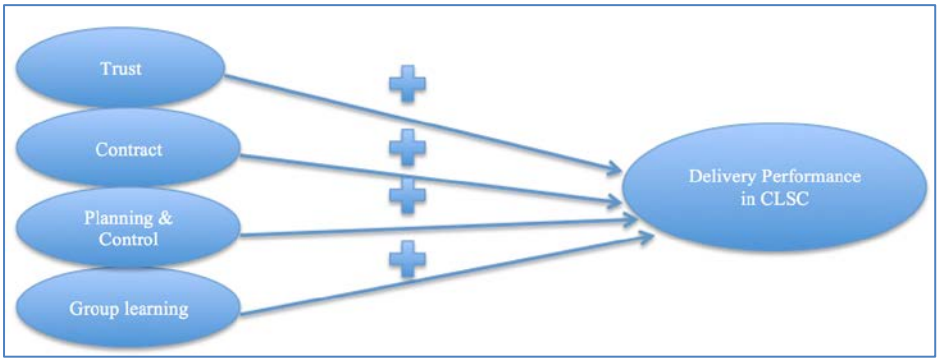
H1: Trust between supplier and buyer results in higher delivery performance.

H2: More comprehensive contractual governance results in higher delivery performance.

H3: The ability to plan and have control over the production process, results in higher delivery performance.

H4: When group learning occurs within a CLSC, it leads to higher delivery performance.

Figure 1: Conceptual model



The next step is to test the conceptual model and it hypotheses. But, first the methods of analysis will be presented in the methodology chapter. A questionnaire is used to determine if the four factors are present in this CLSC. And what their effect is on delivery performance.

3. METHODOLOGY

This chapter explains how the data to answer the research- and sub questions will be gathered. A questionnaire of 26-questions has been prepared for the employees of SteriNoord and its customer. Using Likert-scale questions and SPSS-analyses, conclusions will be draw concerning the presence and influence of the factors. The first section will present how data is gathered, followed by what the target population of the questionnaire is. Thereafter, measurement methods and unit of analysis will be explained. The findings of the data-analyses will be presented in the next chapter.

3.1 Study Design

As mentioned in the introduction, factors solving low delivery performance were taken from FSC literature and from interviews with SteriNoords' management, performed during the investigative phase. These factors, from literature and the interviews, were combined and used as a basis for the questionnaire. The questionnaire was held under the employees of SteriNoord. This way the literature and the solutions of their managers could be tested. The qualitative data from literature and interviews provided enough evidence to facilitate a quantitative case study. This way additional information is gathered concerning these factors and their influence in a CLSC.

It is important to establish the presence of the four factors, since the absence of one could result in low delivery performance on its own. Therefore, questions were used to prove the presence of the factors. For each factor 2-5 questions were used to establish presence. Combining the means of the questions, and calculating an average mean, resulted in a more reliable mean per factor. Secondly, questions were used to examine what kind of influence these factors had on the delivery performance. Influence was determined with 2-3 questions.

All the questions for the questionnaire were derived from journal articles (Chow et al., 2008; Handfield & Bechtel, 2002; Huo, Ye, & Zhao, 2015; Li, Rao, Ragu-Nathan, & Ragu-Nathan, 2005; Panayides & Venus Lun, 2009). These articles presented validated questions, which in turn were modified to be applicable on the situation of SteriNoord. By using validated questions, the reliability of the findings from the questionnaire would lead to a more reliable and convincing conclusion.

The respondents were asked to answer the questions using a seven-point Likert-scale (where '1' means completely disagree and '7' means completely agree). The target population is the number of employees working at SteriNoord and the involved employees from the customer. During the investigative phase, the low delivery performance proved to be a sensitive topic to talk about. Therefore, the questionnaires were handed personally to employees; this resulted in a high response (55%) rate and additional qualitative data.

3.2 Measurement Methods

In this paper 15 employees of SteriNoord responded to the questionnaire and 4 employees of the customer, resulting in a total of 19 respondents. The questionnaire is used to first establish the presence of the factors and then to determine their influence. The following criteria provide guidance determining the presence and influence on delivery performance:
(1) A factor is present when the average mean of the bundled questions is >4.00
(2) For a negative influence on delivery performance the average mean is <3.50
(3) For a positive influence on delivery performance the average mean is >4.40

The reasoning behind these criteria is the following; on a seven-point Likert-scale 4.00 is considered neutral. Everything above should indicate presence. The same goes for influence. Every bundled mean beneath 3.50 is negative and above 4.40 is positive. The area of 3.50-4.40 is determined as being neutral.

3.3 Unit of Analysis

The results from the questionnaire were entered in SPSS. Thereafter, the mean per question was calculated. That resulted in the means presented in appendix B. By combining the results of multiple questions per factor, a more complete analysis of this factor is performed. The questions regarding the influence of a factor on delivery performance were setup to question via multiple questions the effect the factor has on delivery performance. Combining the results of these different questions resulted in a more complete analysis of the influence this factor has on delivery performance.

With the average mean per factor, conclusions can be drawn. The results and interpretations are presented in the result chapter.

4. RESULTS

This chapter presents the results of the questionnaire and how to interpret these results. It presents for each factor if it has been proven to be present in a CLSC. But more importantly this chapter describes the effects of the factors on delivery performance.

4.1 Analysis of the Findings

Having established the mean for each question, the questions are bundled for each individual factor and average means are calculated. How the questions establishing presence are bundled and those results are presented in figure 2.

Figure 2: Bundling and results of the presence determining questions

Trust	*Survey questions: 1,2,3,6&8*	*Calculated mean: 4,41*
Contract	*Survey questions: 9,10,12&13*	*Calculated mean: 3,05*
Planning & Control	*Survey questions: 15,16,17&22*	*Calculated mean: 4,47*
Group learning	*Survey questions: 23&25*	*Calculated mean: 5,23*

Trust scores a 4,41, which is higher than the required 4.00. Therefore, trust is considered present. Secondly, the factor contract results in an average mean of 3,05. Which is lower than the required score of 4.00. Therefore, contract is not present in this CLSC. Next, planning & control scores a 4,47 establishing presence. Finally, group learning scores an average mean of 5,23 and therefore is present in this CLSC. The results show that all the factors except contract are present. This absence is interesting since both literature and interviewees indicate that contract should be present. More interestingly, there is in fact a service-contract between SteriNoord and its customer. The absence of the factor contract could be the source of SteriNoords' low delivery performance. Why does contract not score higher?

While performing the questionnaire, employees complained about the contract: "The contractual time-constraint is unachievable", "We work so hard, this contract is unnecessary", "Without a contract we would work just as well, maybe even better", "We are not the only ones to blame if a set is not returned within the contractual time-period". While my intentions were not to gather qualitative data, these strong emotions could be the cause why contracts scored low. The target population of the questionnaire were the employees, if they have such strong opinions about the contract; it seems more than likely that they would have scored these questions low. The literature and interviewees both provide evidence that should indicate the presence of the contract. As it turns out, both were right. The contract is present,

although it scored below the criteria of a 4.00. The fact that there is a service-contract, and the negative opinions of the employees towards the contract supports its presence. This conclusion will be further analysed and supported in the result interpretation section (4.2).

After the presence, the influence of the factors on delivery performance needs to be determined. In figure 3, presents the results of influence. The factor trust scores an average mean of 4,68>4,40. Resulting in a small positive influence on delivery performance. Next, contract scores 4,23 on influence. This score falls within the neutral influence range and therefore has no effect on delivery performance. Planning & control which scores a 5,25 resulting in a positive influence. Lastly, group learning scores a 5,28 resulting in a positive influence. Thus, the factors of trust, planning & control and group learning have a positive effect on delivery performance in a CLSC.

Figure 3: Bundling and results of the questions determining influence

Trust	*Survey questions: 4,5&7*	*Calculated mean: 4,68*
Contract	*Survey questions: 11&14*	*Calculated mean: 4,23*
Planning & Control	*Survey questions: 19,20&21*	*Calculated mean: 5,25*
Group learning	*Survey questions: 18,24&26*	*Calculated mean: 5,28*

The results of the questionnaire regarding influence indicate that all the factors except contract are positively influencing the delivery performance. This is almost in compliance with what literature and interviews with SteriNoords' management predicted. Both sources predicted a positive influence of a contract on delivery performance. The neutral influence of the contract can be explained by the fact that literature indicates that the effects of a contract can be positive/negative depending on circumstances (Griffith & Zhao, 2015; Lumineau et al., 2011; Wang, Yeung, & Zhang, 2011). Employees clearly are not happy with this service-contract. A contract is present but scores rather low; this contract therefore is likely to be the cause of the low delivery performance. The contract needs altering before the delivery performance of SteriNoord can be increased. The recommendations in the next chapter provide suggestions on how to do so.

In conclusion, group learning results in the biggest influencer of delivery performance. Furthermore, all four factors are present and could positively influencing delivery performance, although the influence of the contract needs to be interpreted further. This interpretation is presented in the next segment.

4.1 Interpretation of the Results

Although the questionnaire shows the absence of the factor contract, a contract is present. A bad or forced contract will result in resistance, shown in this instance by employees complaining during the questionnaire and scoring the factor of contracts low. The strong negative opinions towards the contract provide reasoning why the delivery performance is low. To be able to increase the delivery performance, the neutral influence of the factor contract needs to be turned positive. A neutral influence indicates that the contract does not comply with the needs and desires of some of the parties involved. The purpose of a contract is to provide both companies and their employees with the guidelines. If a contract does not comply with the needs of both parties, it could lead to mall-functions. In this case employees feel like the time-constraint in the contract is forced upon them, without concerning them. Factors such as mistrust start developing, building on the negative feelings from employees towards the contract and the other party. Employees in this relation feel taken advantage of and are therefore not willing to work as hard for the success of the relation as they should. Resulting in a vicious circle of cause and effect. The underappreciated employees do not value the relation as they should, and do not perform as they should. The other party does not receive the products in time, develops mistrust and demands even more from the other party. Causing a negative spiral towards destruction of the relation. Therefore, the contract will also result in issues with buyer-supplier trust and planning & control. If the negativity around the contract is solved, the organizations can once again start building trust, and apply planning & control strategies to improve delivery performance.

Further interpretations of the results indicate that, while group learning results in the highest increase in delivery performance, it will only present these results in de first few years. The long-term benefits of group learning decrease as for example the learning curve of employees starts declining. Establishing relations and building trust takes time, the same goes for planning & control. Eventually the company will have gathered vast amounts of data, upon which it fairly accurately can predict the flow of products. Therefore, SteriNoord should not focus solely on group learning, also invest in long-term influencers of delivery performance like building trust and gathering data to perform planning & control activities.

In conclusion, all four factors are present. Their influences when correctly applied are positive, especially for the factor contract. A good contract will be beneficial for both parties; a mall-function contract will lead to a neutral or negative influence on delivery performance.

5. CONCLUDING DISCUSSION

In this study I have shown that delivery performance in CLSC is influenced by trust, contract, planning & control and group learning. The four to be tested factors were stated in FSC literature and mentioned as solutions in interviews with SteriNoords' management. Evidence for this conclusion comes from the results of the questionnaire and reactions on the questionnaire. Together, the questionnaire results and reactions prove the presence of trust, contracts, planning & control and group learning. Furthermore, the results of the questionnaire indicated the positive influence of three of the factors: trust, planning & control and group learning. The results show that trust has a slightly positive influence (4,68) and that planning & control (5,25) and group learning (5,28) are even more influential. A contract will increase the delivery performance of an organization, but only if its terms are satisfying the needs and desires of all parties involved. The absence of, or in this case negative feelings towards, the contract have led to the low delivery performance. To increase delivery performance, all four factors must be present. Trust, contract, planning & control and group learning can be regarded as positive influencers of delivery performance in a CLSC.

5.1 Limitations

This paper encountered several limitations. First, the sample size was too small to provide the researcher with the ability to significantly accept or reject the hypotheses. For future research, the questionnaire should be held at a company with more than 30 employees. Secondly, the number of questionnaire questions could be more extensive to establish a complete picture of presence and influence. Having more would result in a more reliable conclusion. Additionally, more questions would give the researcher the opportunity to conduct a reliability analysis. When the Cronbachs' alpha would result in 0,8 or higher, the validity of the research would be increased. It should be taken into account that more questions would result in more reliable results, but leads to fewer respondents. Furthermore, there were a lot of emotions. Resulting in low scores on the factor contracts, which otherwise would have scored higher. Finally, one survey respondent scored the first 14 questions with a "1". This unexpected response might by explained by the fact that this respondent either did not understand the questions or was not motivated to fill out the questionnaire or even was overwhelmed by too much emotion? However, excluding this respondent did not alter the conclusion. Therefore, this response remained included in the conclusion. It could be worthwhile to contact this respondent and ask their reasoning for their reasoning.

5.2 Further Research

This paper provides a basis for future research. It provides an indication for future researchers that the factors: trust, contract, planning & control and group learning are also present in a CLSC. Possibilities for future research reside in the fact that this conclusion is drawn upon 19 responses. Testing on a bigger scale is required, resulting in significant proof to accept or reject the hypotheses of this paper. Besides enlarging the target population, qualitative research regarding the contract should be done. Asking employees about their negative feelings towards the contract. It would be interesting to get to the bottom of their frustrations, why do they feel pressured by time, why do they feel that the contact is forced upon them and why do they feel unappreciated? By performing interviews with employee and management about the contract, could lead to insights into why this contract is so controversial. It would also lead to insights into contractual governance activities/effects in a CLSC. Furthermore, the influence of a mathematical model as basis for production planning requires testing. This paper only speculates that planning via a model based previous numbers could result in an increase of delivery performance. But does a mathematical model really result in an increase of delivery performance in such an uncertain supply chain? Finally, the inventory was excluded from this paper due to several reasons. But it has such an impact on the delivery performance in a FSC that, in the case of another company with lower inventory purchasing prices, it could be worthwhile to investigate what the influence of inventory on delivery performance is in a CLSC.

5.3 Recommendations

This last section provides recommendations to SteriNoord, or similar companies. First, it is important that all four factors are present to improve delivery performance within a CLSC. In case one is absent, the score/influence of the other factors does not matter; the delivery performance will remain low. Only when all four are present, they can be used to increase the delivery performance. Since, the factor contract is absent in the case of SteriNoord, recommendations on how to increase this factor are provided.

To start, employees feel that they are being pressured by the contract. Additionally, they feel like the contract is forced upon them. Lastly, they feel unappreciated. It is important that the employees feel heart, appreciated and comfortable with the contract; this can be achieved using the following methods. Initially, the input for the contractual time-constraints and guidelines came from management. Invite employees to take part in a collaborative feedback

session. How have they experienced the contractual constraints over the past year/time period? During this meeting/session employees can explain their feelings and issues towards the contract. The task of management is to listen and consider their feedback. By giving employees the change to explain their frustrations, they feel heard and not taken for granted. The ability to express their feeling will lead to more commitment, they just want to feel heard and taken seriously. On the long-term their feedback has to be implemented in some sort of way. Otherwise the effect is even worse, employees feel fooled, develop frustrations, become more resistant and possibly leave the company altogether.
Secondly, only the complaints are communicated to employees. How about rewarding them for achieving a deadline? By doing so, they receive recognition for their work (feeling appreciated), which in turn works as encouragement to work harder. Rewarding can be as simple as some flashy message on the screens in the production area congratulating employees on having achieved yet another deadline. This stimulated their intrinsic motivation.
Implementing feedback sessions and taking up this feedback, in combination with a reward system will result in higher employee commitment. Higher commitment will lead to increased group learning, building trust and increasing productivity in the process. The increased productivity in turn will lead to higher delivery performance.

In summary, I conclude that delivery performance in a closed-loop supply chain can be influenced with the factors trust, contract, planning & control and group learning. Only when all four factors are present, the delivery performance can be increased. When all four are present, stimulating group learning initially presents the biggest increase in delivery performance in the short-term. On the long-term, building trustworthy relations and gathering data to use for planning & control provide the most promising results in terms of increasing delivery performance in a closed-loop supply chain.

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7. APPENDIX A: QUESTIONNAIRE

Omcirkel bij elke stelling in hoeverre u het hiermee eens bent.

1 = Volledig mee oneens 7 = Volledig mee eens

Deze vragenlijst gaat over enkele concepten die vanuit de literatuur gevonden zijn en een bewezen invloed hebben op delivery performance. Om te testen of deze concepten ook van invloed zijn op SteriNoord en het UMCG zal deze vragenlijst gebruikt worden. Aan de hand van de verkregen resultaten worden conclusies getrokken en kunnen adviezen gegeven worden over hoe deze samenwerking beter ingericht kan worden.

Vraag 10-13: De tijds-eis van het contract tussen SteriNoord en het UMCG geeft aan wat het tijdslimiet voor een set is om na aanbod gesteriliseerd in het magazijn van het UMCG te liggen. Namelijk: Verontreinigde sets die op reguliere werkdagen voor 19:00uur worden aangeboden, zijn de volgende werkdag 6:30 steriel retour (en voor 7:15 bij het magazijn).

1. Ik heb vertrouwen in de relatie tussen SteriNoord en het UMCG.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

2. De relatie tussen SteriNoord en het UMCG zal nog lang bestaan.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

3. Er kan meer samen gewerkt worden tussen SteriNoord en het UMCG.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

4. Als er beter samengewerkt wordt tussen SteriNoord en het UMCG, resulteert dit in een sneller proces.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

5. Door gebrek aan interesse, in het sterilisatie proces, vanuit het UMCG werkt SteriNoord niet op 100%.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

6. Er wordt alles aan gedaan om instrumenten sets zo snel mogelijk in het UMCG te krijgen.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

7. Doordat ik vertrouwen heb in de relatie UMCG-SteriNoord, presteer ik beter.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

8. Het UMCG zorgt ervoor dat vuile sets zo snel mogelijk naar SteriNoord getransporteerd worden.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

9. Er wordt voldoende gekeken naar de prestaties van de samenwerking tussen SteriNoord en het UMCG.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

10. Het contract zorgt voor structuur in de samenwerking tussen SteriNoord en het UMCG.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

11. Het contract zorgt voor betere prestaties.

Volledig mee oneens						Volledig mee eens
1	2	3	4	5	6	7

12. Het contract bevat een haalbare tijds-eis.

Volledig mee oneens Volledig mee eens

1 2 3 4 5 6 7

13. Het contract tussen SteriNoord en het UMCG, is overbodig.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

14. Ik ben in staat om de van mij verwachte/met mij afgesproken deadlines te halen.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

15. Ik ervaar tijdsdruk tijdens mijn werk.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

16. De aantallen van vuile instrumenten/containers vanuit het UMCG varieert elke week.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

17. Er wordt geluisterd naar de signalen vanuit het UMCG m.b.t. het inplannen van personeel.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

18. SteriNoord zou beter presteren als er een voorspellingsmodel zou komen op basis van gegevens van het afgelopen jaar.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

19. Ik kan efficiënter werken als ik van tevoren weet hoeveel containers er binnen zullen komen
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

20. SteriNoord kan snel op verzoeken vanuit het UMCG reageren (bv. een spoedorder).
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

21. Als SteriNoord op het terrein van het UMCG zat, zou de contractuele tijds-eis vaker gehaald worden.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

22. Vuile instrumentensets vanuit het UMCG variëren in kwaliteit (mate van vuilheid, slijtage, etc.).
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

23. Ik kan goed overweg met het computersysteem (InstaCount).
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

24. Als ik het informatie systeem beter begrijp zou ik sneller kunnen werken.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

25. Ik voel mij vertrouwd met de wasmachines/sterilisatie apparatuur op SteriNoord/UMCG.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

26. De werkwijze op SteriNoord zou beter kunnen.
Volledig mee oneens Volledig mee eens
1 2 3 4 5 6 7

8. APPENDIX B: MEAN PER QUESTIONNAIRE QUESTION

The table below presents per question of the questionnaire the calculated mean.

Q1 = 3,76	Q14 = 5,27
Q2 = 4,06	Q15 = 4,50
Q3 = 5,18	Q16 = 5,06
Q4 = 5,88	Q17 = 2,38
Q5 = 4,76	Q18 = 4,24
Q6 = 4,29	Q19 = 4,41
Q7 = 3,41	Q20 = 5,06
Q8 = 2,88	Q21 = 6,47
Q9 = 3,00	Q22 = 5,38
Q10 = 2,94	Q23 = 5,57
Q11 = 3,12	Q24 = 4,79
Q12 = 3,18	Q25 = 4,76
Q13 = 3,06	Q26 = 5,76