



OCTOBER 15, 2018

# FINDING IMPROVEMENT OPTIONS WITHIN THE PLANNING OF COMPANY X

BACHELOR THESIS

DESMOND VAN DEN BROEK  
UNIVERSITY OF TWENTE  
Drienerlolaan 5, Enschede

---

| Company X





**Bachelor thesis**

Finding improvement options within the planning of Company X

15-10-2018

**Author**

Desmond van den Broek

s1757520

d.vandenbroek@student.utwente.nl

Bachelor Industrial Engineering and Management

University of Twente

**Supervision**

Supervisor University of Twente

Dr. H. Heerkens

Industrial Engineering and Business Information Systems

2<sup>nd</sup> Supervisor University of Twente

Dr. P.C. Schuur

Industrial Engineering and Business Information Systems

Supervisor Company X

## Management Summary

*Part I has been left out for confidential reasons*

### Phase 1

The research is divided into two parts. The first part consists of the research is providing an overview of improvement options within the planning. Firstly, to narrow down the research, one department has been chosen. An analysis of the historical data and deliberations with different employees from Company X have been carried out to choose the department. A decision on which department is made by looking at the departments from two perspectives. Four KPIs have been made to help to decide which department to focus on. The first perspective is looking at one KPI, namely the absolute number of orders too late. This KPI gives a direct indication of the severity of the problems within each department. The second perspective is the combination of the three KPIs, the average number of days too late per order, the percentage of orders which is too late and the number of orders. Each KPI has been given a weight. Afterwards, all departments are given scores on each KPI and the scores are multiplied with the weight. Both perspectives give the same result, namely to focus on the assembly department.

When the department was chosen, an overview of the problems has been made and the core problem has been chosen. The factors that have a negative impact on the planning are

- Low Logistics Performance Index(LPI)
- Errors internal production
- Planned over capacity
- Defects
- Illness
- Days off
- Current backlog
- Using iMake as a relevant planning system
- Lack of interaction with LIMIS
- Focusing on own department

To choose the core problem, multiple aspects have been considered. Firstly the feasibility is checked whether it is possible to focus on that problem. Secondly, relevance is being looked at. If fixing the problem would not make a big impact, it is not logical to focus on fixing that problem. When these aspects are considered, two main problems remain. After a deliberation with the planners, one of the two remaining problem was chosen, which is the lack of interaction from the employees with LIMIS. The core problem was chosen which rounds up the first phase of the research.

### Phase 2

In the second phase of the research, a solution is provided for the core problem. Firstly, three solution methods have been explained. These are the ABC-model, the 7E-model and nudging. Based on five criteria, a method has been chosen. The five criteria are:

1. Feasibility within Company X
2. Internal acceptance
3. Costs
4. Difficulty of implementing
5. Duration of implementing

After analysing the three models and giving scores to each criteria, the 7E-model is the model that is chosen to provide the solution.

In the 7E-model, seven steps have to be taken in chronological order. Firstly, the enlighten phase needs to be carried out. All employees have to be informed once more about the steps that have to be taken to have to be taken with LIMIS. A meeting will be held with the chefs of the different departments and all necessary information will be given. During this meeting, all steps that have to be taken will be explained as detailed as possible, to avoid remaining ambiguity amongst employees. Moreover, the importance of the interactions together with the impact of not interacting needs to be discussed to make the personnel aware of the concerns of the interactions. Furthermore, it has to be very clear for all employees that reminding each other is always helpful.

The second step of the 7E-model is the enthuse phase. To create enthusiasm amongst the employees, it is important to show the employees Company Xs vision, about their willingness to develop and constantly improve.

Thirdly, the encourage phase needs to be encountered. A useful way to encourage employees is acknowledging their potential. Sometimes it helps to speak about the things employees do not want to hear. Making clear that employees taking the interactions with LIMIS too lightly is one of the things employees might not want to hear. But then also saying that they can think more about the interaction and that they can interact perfectly with LIMIS. Another way of encouraging is naming out good qualities of them and add what they can improve. In Company Xs case, they can inform the employees on the great work that they are delivering, but still need to improve on the interactions with LIMIS. (McGammon, 2015)

In the exemplify phase, it is important for the planners to imply on a new situation without changes at the last moment and a clearer situation of what processes have to be taken care off. When the new situation is created, fewer orders will be pushed back in the planning and the follow-up departments will not miss any components because the interaction has been done correctly. Because both of these problems will be fixed, a clearer production planning will be created.

The enable phase does not have to be taken care of, since LIMIS is working properly.

In the sixth phase, the engage phase is carried out. Within Company X several employees are interacting with LIMIS extremely well. For the planners it is essential to find at least one employee per department who is capable of being a role model. The role model should already be interacting greatly with LIMIS. When every department has one role model, it is easier to engage with the other employees, since they are more available, because they are close by.

Lastly, Company X needs to experience. When the 7E-model is implemented, the interaction and therefore the planning should run more smoothly. Both the planners and the production employees will experience the positive impact of the improved interactions.



## Preface

In this bachelor assignment the main goal is to provide Company X with an overview of different deficiencies within their planning process and give a recommendation on how to solve one of those found deficiencies. It is important to become a link between the board and production personnel.

During my research I had a chance to use the knowledge I gained during my studies in a real company. It is completely different to use the knowledge from university in a company. I gained a great impression of what working in the office of a production company is like. Throughout the research, I was working in the office, but I was also at the production floor, which gave me a view of both perspectives, which has been valuable for my own development.

The research helped me developing myself and I would like to thank some important people for that. First of all I want to thank Supervisor A for helping me form the research, sharing his expertise and having discussions with me when necessary about the research. Also, I would like to thank Colleague B for helping me understanding the planning within Company X and sharing his expertise when necessary. Moreover, I would like to thank Company X and all its staff for giving me this chance to do the research, welcoming me with open arms and taking their time when I needed information or their own expertise.

Furthermore, I would like to thank Hans Heerkens for supervising me during the research. The critical feedback that were provided were of huge importance for carrying out a successful research. Lastly, I want to thank Peter Schuur for being my second supervisor and giving me critical feedback to improve my report.

Enjoy reading this report.

Desmond van den Broek

16-09-2018

## Table of Contents

Management Summary.....	iii
Phase 1 .....	iii
Phase 2 .....	iii
Preface.....	vi
1 Introduction.....	2
1.1 Company X.....	2
1.2 Research motivation.....	2
1.3 Action plan.....	2
2 Making the planning.....	4
2.1 The planning process.....	4
2.2 Requirements .....	4
2.3 Priority .....	4
2.4 Green Stream .....	4
2.5 Summary.....	5
3 Choosing the department .....	6
3.1 Key performance indicators .....	6
3.2 Weights.....	7
3.3 Scores .....	8
3.4 What happens at the assembly department?.....	10
3.5 Conclusion .....	10
4 Finding the core problem .....	12
4.1 Delta .....	12
4.2 Factors which increase the delta.....	12
4.2.1 LPI(Suppliers).....	12
4.2.2 Exceeding capacity .....	13
4.2.3 Errors during internal production .....	14
4.2.4 Current backlog .....	14
4.2.5 Still using iMake as a relevant planning system.....	14
4.2.6 Lack of interaction from employees with LIMIS.....	15
4.2.7 Focusing on own department instead of Company X .....	15
4.3 Common problems.....	16
4.4 Choosing the core problem .....	16
5 Solving the problem .....	18
5.1 The core problem .....	18
5.1.1 Improving the current situation .....	18



5.2 ABC-method .....	18
5.2.1 Antecedent .....	18
5.2.2 Behaviour .....	18
5.1.3 Consequence .....	18
5.3 7E-model .....	19
5.4 Nudging .....	19
5.5 Choosing the model.....	20
5.5.1 Criteria .....	20
5.5.2 Scores .....	21
5.6 Desired situation .....	21
5.7 Conditions desired situation.....	21
5.8 Applying the 7E-model .....	21
5.8.1 Enlighten.....	21
5.8.2 Enthuse.....	22
5.8.3 Encourage.....	22
5.8.4 Exemplify .....	23
5.8.5 Enable .....	23
5.8.6 Engage .....	23
5.8.7 Experience .....	23
5.9 Evaluating .....	23
5.10 Summary.....	23
5.11 Limitations.....	24
6 Conclusions and recommendations .....	26
6.1 Conclusion .....	26
6.2 Recommendations.....	26
Terms and definitions.....	28
References.....	29
Appendix A .....	30
Appendix B .....	31



# 1 Introduction

*The introduction provides information about Company X, the motivation for this research and the action plan of the research. This research has been done in the third year of the bachelor study industrial engineering and management. The research has been performed at Company X in City Y.*

## 1.1 Company X

*Part II has been left out for confidential reasons*

## 1.2 Research motivation

Company X has been growing rapidly the last one and a half years. This is marvellous for Company X, but it also triggers struggles within the company; new employees are hired, more orders are processed etc. This has caused problems within the planning of Company X, for instance, it has caused a lot of backlog throughout the company. Company X has been struggling with these problems and delays occur with increasing frequencies and longer delays. The board of Company X knows that there are problems within their planning, but they are not certain what those deficiencies are, they only have ideas based on experience. For Company X it is essential to have an overview of what those problems are in order to solve the problems and improve the planning. After this research, an overview of the planning problem within a department, which is chosen during the research and a solution for one of the main problems within that department is given.

## 1.3 Action plan

The research is divided into two smaller researches. In the first part of the research, the core problem is found. The core problem is provided by taking a number of steps. Firstly, a relevant department is chosen to make the research more specific. This has been done because when the complete company would be researched, the research would either not be detailed enough, or would take a lot more time than there has been planned for the research. The focus will be to find problems within that specific department, for instance, when the main problems are in the welding department, the welding department will be the department where the focus will be on. Afterwards, an overview of all relevant problems within the planning of that specific department has been made. From all the problems that are found, the core problem is chosen. When the core problem is chosen, the second part of the research starts. In the second part of the research, a solution for the found core problem is provided. To start with, the method of solving the problem is selected. When the method is chosen, the way of implementing is described.



## 2 Making the planning

*In this chapter the planning process is explained. Firstly, it is explained how the planning is started, then the requirements are mentioned, after that the priority rule of Company X is explained and lastly the use of the Green Stream is explained.*

### 2.1 The planning process

First, Company X receives an order from a client. The order contains what products the client wants to receive and the delivery date. The starting date of production is based on the demand date of the client. iMake, the ERP system Company X currently uses, provides a starting date for every order, but does this with assumption of unlimited capacity. This means that infinite hours and infinite personnel are available in iMake, even though in practise, this is not the case. Besides the ERP system, Company X uses LIMIS as their planning system. LIMIS gathers the complete data from iMake, but alters that planning. The planning is being altered because LIMIS considers all limiting factors, like the requirements and the capacity. The requirements are discussed in paragraph 2.2. This means that LIMIS does not use unlimited capacity, but takes the working hours of personnel and machines into account. Because of this, LIMIS gives a different starting date than iMake. All chefs of the departments receive the planning from LIMIS, they do not use the planning of iMake. Practically this means that most of the times, because of the limitations, requirements and current backlog, the planning of LIMIS has a later starting date than the starting date of iMake. Because the starting date of LIMIS is later than the starting date of iMake, the end date is later and the orders are late frequently.

### 2.2 Requirements

To start the order, several requirements have to be met. These requirements are:

- Components have to be available
- There should be enough capacity
- The quality of the components has to be sufficient
- The right engineers have to be available – Every department has a skills matrix, which contains which employee is capable of performing a specific handling or a specific product.

So before every order can start, these requirements have to be met.

### 2.3 Priority

An important aspect in making the planning at Company X, is the level of priority of an order. Company X occasionally receives orders with higher priority than other orders. This happens for instance when PARTNER COMPANY Q, the main customer of Company X, makes an order and needs the order earlier than normally. In LIMIS the priority is taken into account while making the planning, so this order will start earlier than other orders, that might already be there for a longer period of time. This causes that orders with higher priority will be taken care of earlier than orders with a lower priority and the orders with a lower priority will be done even later. This might lead to inconveniences within the planning, since orders with lower priority might be pushed back too far in the planning and are therefore done too late, which causes dissatisfaction amongst the clients with lower priority for Company X.

### 2.4 Green Stream

Company X uses a green stream throughout the company. The green stream indicates producing the same amount of certain products every week, since there is a known weekly demand of these products and Company X wants to produce those at a constant rate. Currently, the green stream (GS)

is still being planned and shown on the planning lists, even though this should not be necessary, because the GS needs to be produced at a constant rate. The GS uses a lot of the capacity of the machines and therefore is a big part of the current planning. The GS has the highest priority and the goal of Company X is to produce the GS constantly, with the same number of products every week. Producing the same amount every week can be done because PARTNER COMPANY Q has their own forecast on their machines and needs the same amount of the frames every week. This means a constant capacity of producing is busy every week with the GS. Company X is already working with this, but it is not working optimally yet. Currently, Company Xs backlog is increasing and the planning is filled with GS orders, because of their high priority. Since not only GS can be done, both because of customer needs and the lack of the necessary components, the SCE is now making an extra planning of what needs to be done every week, without the GS. This is very time consuming and should not be necessary. Because Company X wants to produce the GS constantly, they want to take this out of the planning. The plan is to delete the necessary capacity for the GS from the planning system and not include it in the planning anymore, since it is a weekly job and it is the same for every week. This gives an indication that the planning lists will still be altered, which might influence the planning performance when it is altered.

## 2.5 Summary

In this chapter, the planning process has been described, together with its requirements, the priority rules and an explanation of the GS.

The planning process starts when Company X receives an order. When an order is received, a starting date is made. First in iMake and then in LIMIS. In LIMIS the four requirements are implemented and the priority level is applied. The starting date of LIMIS is being used.

A lot of the capacity is currently used by the Green Stream. Company X wants to remove the GS out of the planning, which would make the planning clearer.

## 3 Choosing the department

*In this chapter the department where the focus will be on is chosen. First of all, the key performance indicators are elucidated, weights and scores are given to three key performance indicators and a conclusion is made from the scores. Afterwards it is explained what procedures are carried out at that department. \*\*\*\*Pictures have been left out for confidentiality reasons\*\*\*\**

### 3.1 Key performance indicators

To determine on what department the focus should be on, the historical data were analysed. The master planner, the head of procurement (HoP) and the supply chain manager have all provided historical data of performances that involve planning. The historical data is tracked well and is all up to date. The problem is that the historical data might reveal problems, but they are not noticed or not taken care of. Therefore, the historical data is analysed and ideas are gained from the personnel who have their own expertise about the problems. In the historical data, the order number, the rule number (the number that indicates on what department it started), the process, planned start date, actual start date, end date and the department of the process are given. From this data, conclusions can be made, but there are no specific KPIs. For every order, every process is planned. In the historical data that has been used, only the first process of the order is taken into account, since delays in the first process will influence all other processes that follow. For instance, when a product has to be drilled first and then assembled, if there is a delay with the drilling process, the assembling process will automatically be delayed. This means that there might not be a problem in the assembling process, even though it has a delay. In the historical data, it is difficult to examine in a follow-up process whether the delay has been caused by the current process or by the previous process. So to prevent using incorrect data, only first processes are taken into account to determine which department will be focused on. From all departments that Company X has, the first process of an order can happen in eight different departments and there are first processes that are not assigned to a department, this has happened because of a change of first department or when the documentation is being done incorrectly. The eight different departments are:

- Finishing  
In the finishing department, various skilled personnel work. In the finishing department different processes take place. These processes contain sawing, drilling, cutting and more.
- Large machining and small machining  
Company X is an expert in both large and small machining. Company X constantly invests in their machine park to stay at top level. In the figures besides the text, the newly installed large machining machine and a small machining machine are shown.
- Welding  
*Part III has been left out for confidential reasons*
- Deep-hole drilling  
Deep-hole drilling is the newest department of the company. The deep-hole drilling still takes on many orders individually, which do not have to be processed in any other department. This makes the deep-hole drilling department less dependent on other departments than other departments.
- Assembly  
Most product arrive at some point in the assembly department. There is a lot of space in the assembly department to fit all the products that have to be assembled at the same time.
- Quality control and quality control large machining

In the two quality control departments, the products are checked whether they meet the quality standards. Advanced measuring machines are used to validate the measures of the materials. Quality control checks both raw materials and already machined materials.

Orders that are not filed correctly, which means the starting date is incorrect or unknown, have a start date of "00-00-00" and these are excluded from data. For the reasons that Company X has been expanding rapidly since the last one and a half year and delays started to occur more frequently since April 2017 the focus of the analysis of data will be on the data from April 2017 until May 2018. To the already known variables, which are the planned start date, the actual start date and the actual end date, some additions have been made to give the KPIs, which will be explained below. A KPI that is provided is the Logistics Performance Index, which will be explained and used in section 4.2.1. The KPIs I have derived from the historical data that are important to make the decision of what department should be focused on. To make the decision on which department to focus on, the situation have been looked at from two perspectives. Firstly *the absolute number of orders too late* is being looked at. This KPI gives a direct indication of the severity of the problems within each department, where severity is the degree of harshness or sternness (Business Dictionary, 2018). The second perspective is a combination of three different KPIs. Firstly, the three KPIs will be explained and afterwards weights will be added to those three KPIs.

First of all, *the average number of days too late per order*. Several steps have been taken to calculate this KPI. In Excel, it has been checked whether the order is too late. Then, the number of days too late is calculated for all orders that were too late. The average number of days is calculated afterwards, for all orders per department and for all orders of the whole company. For this KPI, the orders that were started earlier than the planned date, are neglected. This is done because orders that are starting earlier are not late. When an order that has started earlier than planned would be taken into account, it would influence the average number of days too late per order, making the average delay seem less than it is in reality. This would harm the validity of this KPI. When the average number of days too late is higher, it might indicate that the problems are more severe in that department.

The second KPI is *the percentage of orders which is too late*. When it is checked which orders are too late, the percentage which is too late is calculated in excel. It is essential to see how many orders are too late compared with the total orders. A higher percentage might indicate more severe problems within that specific department.

Lastly, *the number of orders* is of huge importance. Different departments handle more first processes of an order than other departments. For this research, when a department has more orders, it will be more relevant because the total disruption is greater than when a department has fewer orders.

Both perspectives are used because when two perspectives are being looked at, a more complete overview will be provided and the decision of which department to focus on can be made with more certainty.

Together with the Supply Chain manager these KPIs are used to determine the severity of the problems within the departments. Determining the problems will be done in the department where the main problems occur. The orders that are not assigned to a department are still included in the analysis, but further research is not possible, since it is difficult to assess in what department to do further research on.

### 3.2 Weights

Because the three KPIs which are going to be combined are determined, weights have to be given to the three KPIs. Weights are important to attain to the KPIs, since not all KPIs are equally important. The weights are given to the KPIs based on a discussion with the supply chain manager. All of the KPIs



have been looked at individually to discuss critically how important the specific KPI is. The number of orders is the most important factor. This is because the most relevant departments will need enough orders to be useful for research. From this, it has been concluded that a weight of five would be appropriate for this KPI. The percentage too late is second most important. This KPI shows the relative performance of being on time, which is crucial for the planning. This KPI has been given a weight of three. The average number of days too late per order closely follows the percentage too late when it comes to importance. The higher this number is, the more negative this is for the outcome of the product. The weight that has been attached to this KPI is two.

### 3.3 Scores

Scores are given to all eight departments mentioned above. The scores for each KPI are given between one and ten and the total column will be filled with the product of the two previous columns for each KPI. Then the total score will be given underneath, which is the sum of the last column. Below the column, the total number of orders too late will be given.

No department given

Absolute number of orders too late		182	
KPI	Score	Weight	Total
Average # of days too late per order	3	2	6
Percentage too late	2	3	6
Number of orders	7	5	35
			Total score: 47

Finishing department

Absolute number of orders too late		21	
KPI	Score	Weight	Total
Average # of days too late per order	8	2	16
Percentage too late	9	3	27
Number of orders	1	5	5
			Total score: 48

Large machining department

Absolute number of orders too late		33	
KPI	Score	Weight	Total
Average # of days too late per order	3	2	6
Percentage too late	1	3	3
Number of orders	3	5	15
			Total score: 24

Small machining department

Absolute number of orders too late		152	
KPI	Score	Weight	Total
Average # of days too late per order	6	2	12
Percentage too late	6	3	18
Number of orders	3	5	15

Total score: 45

#### Welding department

Absolute number of orders too late	355
------------------------------------	-----

KPI	Score	Weight	Total
Average # of days too late per order	7	2	14
Percentage too late	6	3	18
Number of orders	7	5	35

Total score: 67

#### Deep-hole drilling department

Absolute number of orders too late	3
------------------------------------	---

KPI	Score	Weight	Total
Average # of days too late per order	2	2	4
Percentage too late	3	3	9
Number of orders	1	5	5

Total score: 18

#### Assembly department

Absolute number of orders too late	1330
------------------------------------	------

KPI	Score	Weight	Total
Average # of days too late per order	6	2	12
Percentage too late	9	3	27
Number of orders	10	5	50

Total score: 89

#### Quality control department

Absolute number of orders too late	193
------------------------------------	-----

KPI	Score	Weight	Total
Average # of days too late per order	6	2	12
Percentage too late	6	3	18
Number of orders	8	5	40

Total score: 70

#### Quality control large machining department

Absolute number of orders too late	9
------------------------------------	---

Total score: 55

KPI	Score	Weight	Total
Average # of days too late per order	10	2	20
Percentage too late	10	3	30
Number of orders	1	5	5

From the scores we can see that the highest score is acquainted by the assembly department, the second highest score in the quality control and welding comes in third. Since April 2017, the

assembly department had the most orders and the third highest percentage too late. This means that 1330 orders out of the total 2555 orders were late, this is a shockingly high number, which needs to be solved as soon as possible. This is also the highest number of all departments, this indicates that the impact of the problems is highest in the assembly department. This also means that the assembly department would be chosen either way, because they have the highest total score and the highest absolute number of orders too late. If this is not solved, the errors might become more problematic for Company X and clients might lose trust in Company X, since their clients are also looking critically at Company Xs performances. For instance PARTNER COMPANY Q are constantly pushing Company X for the highest performances on their deliveries, when the performances of Company X would deteriorate, other suppliers would be considered.

### 3.4 What happens at the assembly department?

Before an analysis can be made on the assembly department and its planning performance, it is convenient to understand what actually happens at the planning department. The processes are shown systematically in Appendix A.

A lot of different steps are taken in the assembly department. The whole process in the assembly department starts when the planning orders to start a working order. The first task is to check whether all the components for that order are available at the expedition.

Occasionally, not all components are available. When an order is not complete, it does not automatically mean the order cannot start. It happens that an order is 99% complete, where only the last component is missing. The assembly department still starts with those orders, since it can almost assemble the complete product. When an order cannot be started partially, two steps have to be taken. The assembly department has to communicate with the department(s) that did not deliver the component to acquire information why it not has been delivered. Afterwards, the further departments have to be informed about the delay. The unfinished product will be stored in the assembly department till the last component arrives and the product can be finished.

When an order is complete, a list of all the necessary components is sent to the expedition and it has to be picked there. Currently the assembly engineers have to gather the assembly components, such as screws and bolts, themselves at the storage in their own department. When all necessities are at the assembly department, the product can be assembled. When the product is assembled, there is an option to check or not to check the product. All new products are checked and in addition to that Company X has certain products that always need to be checked. New products are also checked after every process, but certain problems are only found during the assembly process. For example a slanted hole, which is found during the assembly, because the assembly cannot be done. When an order does not have to be checked or it has been checked and the required quality level is met, the order can be packaged and sent back to the expedition.

When the product is checked and it does not reach the specified quality level, the involved departments are informed, the product is disassembled and the individual components are sent back to the departments.

### 3.5 Conclusion

In this chapter, the KPIs are explained, weights and scores are given to three KPIs. From these scores, the assembly department has been chosen and it is explained what is being done in the assembly department.

Two perspectives are used to make a clear decision on what department to focus on. When the first perspective is being looked at, where the absolute number of orders too late is used, the highest score is acquainted by the assembly department. The second perspective uses the combination of three KPIs, namely the average number of days too late per order, percentage too late and the

number of orders. To the three KPIs weights are given to adjust the importance of each KPI. Also from this perspective, the assembly department has the highest score. As a result of these outcomes, the assembly department is the department where the focus is on.

## 4 Finding the core problem

*In this chapter the core problem is determined. To do this, multiple steps have been taken. Firstly, the delta is explained. Secondly, the different problems are being explicated. Lastly the core problem has been chosen.*

### 4.1 Delta

The delta is the number of days between the planned starting date and the actual starting date. The delta is determined from historical data and conversations together with the SCM, the master planner and the chef of the assembly department. The SCM, master planner and chef of the assembly department only had ideas of where problems occurred. With the information from the SCM, the master planner and the chef of the assembly department and the historical data, factors that influence the delta are determined. Also some affecting factors are deliberated based on common sense. For Company X it is important to reduce the delta as much as possible. The factors that increase the delta are:

- Low Logistics Performance Index(LPI)
- Errors internal production
- Planned over capacity
- Defects
- Illness
- Days off
- Current backlog
- Using iMake as a relevant planning system
- Lack of interaction with LIMIS
- Focusing on own department

### 4.2 Factors which increase the delta

All the factors mentioned above will be looked at individually and the problem that comes with that factor is being explained. From these explanations, it is possible to find the factors which have the biggest impact on the delta and at the end of this chapter a conclusion can be made which problem will be focused on. The data has been retrieved from the planners, the HoP and the chefs of the assembly department.

#### 4.2.1 LPI(Suppliers)

The LPI score is the score that Company X uses for the delivery reliability. This is based on the completeness of the order and the quality and the complaints about the order(indirectly the quality of the order). Both indicators are given a score and the product of these indicators is the LPI score as a percentage.

The LPI scores of the suppliers were highest in April and May 2017. In summer 2017 the LPI score dropped significantly and since December 2017 the LPI stabilized around the average. The average score of the LPI IS 75.3%. This means on average 75.3% of all deliveries of the suppliers is complete and on a significant level of quality(see Appendix B). Since 24.7% is not delivered complete or with insufficient quality, this causes delay in different processes.

##### 4.2.1.1 Problem caused by the LPI

The current LPI score is too low, which causes problems within the planning. Aiming for a perfect LPI is a utopia, but Company X is currently working actively on improving the LPI scores of its suppliers. The HoP is adjusting both Company X and its suppliers to working with the LPI and also the

consequences of a low LPI. In the near future, approximately in September 2018, Company X wants all its suppliers to be an A-supplier. This means that all suppliers have to reach an LPI of at least 95%. Company X requires this because Company X wants to be an A-supplier itself and a high LPI from its suppliers is essential to achieve.

The HoP is now since March 2018 working of informing all current suppliers about their LPI scores and the consequences of a low LPI score. A low LPI score from a supplier may lead to Company X letting that specific supplier go and find a new supplier with, hopefully, a higher LPI score.

Implementing this takes some time because both Company X and its suppliers have to get used to this method of using the LPI score as a gauge for the delivery performances of the suppliers.

Moreover, the method of providing the performance score has to be accepted. For instance, Company X can require an unreachable demand date. If Company X keeps that demand date in its system, the LPI score of the supplier will be low, because it was unreachable for the supplier. The correct way for both the supplier and Company X is that a feasible demand date is made, which is also included in the data for the LPI scores. If this date is not changed in the data for acquiring the LPI score, which happened in the past, the LPI score is lower than it actually is with the correct demand date.

#### 4.2.2 Exceeding capacity

LIMIS takes all factors into account, so when all influencing factors are included in LIMIS, over planning will not occur. Unfortunately, with a few processes, the production time is not (correctly) included. Some processes are given a production time of zero hours, which is not possible, and other procedures are not estimated correctly (which can cause both over planning as under planning). Over planning might also occur due to defects, illness and days off. Illness and days off are nearly uncontrollable, therefore these problems will not be taken into account. Defects, illness and days off need to be re-planned and therefore cause delay. Another reason for planning over capacity which happens occasionally is the unavailability of tools. Company X has several machines that use the same tools, but there are not enough tools for all machines, because this is not financially efficient according to Company X, since this only happens occasionally when more than one machine needs to use exactly the same tools. Lastly, Company X uses a skills matrix, but LIMIS does not take the productivity of employees into account. Not all personnel are capable of carrying out all processes in the department and the skills matrix is an overview which shows which employee can carry out what processes. Since Company X is growing rapidly, many new employees are being hired. The new personnel have to be trained and history has shown that the new personnel at first do not produce as fast as the employees who have been working at Company X for a while. This means certain processes might take longer than expected by the planning department. The bigger the differences, the more impact it has on the planning. Moreover, the impact is bigger when the process time is incorrect earlier in the producing process.

##### 4.2.2.1 Problems caused by exceeding capacity

Processes may take longer or shorter than the estimation that is put in LIMIS. This is problematic because processes might be scheduled later or earlier because of the wrong estimation. This can cause lack of products throughout the whole company if the estimation of the process time is longer than the actual process time. When the process time is shorter than expected, it can cause a lack of work in that specific department. Wrong estimation times of processes mainly happen with new products. With the products that are being produced for a period of time already, the process times are accurate.

Secondly, a process time of zero hours can always be included according to the planning, so LIMIS might schedule the process a minute before Company X closes. According to the planning that process can still be carried out, but in reality it cannot. This will automatically cause for delays

because the process will take more time than zero hours and will be ready later, and the processes that were planned immediately after need to start later than actually planned as well. When this occurs, this leads to problems in follow-up departments as well, because the follow-up departments expect a product to be ready, but the necessary product still needs to be produced.

Moreover, the lack of available tools for a certain machine causes that processes are delayed, because processes are being pushed back in the planning when the tools are unavailable.

Also the new personnel not being as productive as the trained personnel is causing problems for the planning. The reduced productivity bring fluctuations in the process times and therefore it is harder to make a correct time estimation for the planning.

#### 4.2.3 Errors during internal production

Some products do not satisfy the quality standard, these products are reported as non-conformance report(NCR). There are several aspects that may cause a product becoming a NCR, products can be damaged, not clean enough or made containing incorrect dimensions.

##### 4.2.3.1 Problems caused by errors internal production

Errors will always happen, since humans can make mistakes. Human errors are hard to anticipate at within the planning(Hartono & Laurence, 2015) Errors cause unavoidable delays for different processes, since NCRs have to be processed again or a new product has to be ordered or produced. There are, since April 2017, 109 NCRs notified by the assembly department, this is only a small number since there are 20000 products being sent through the assembly department.

#### 4.2.4 Current backlog

The current backlog in the assembly department is currently a big issue. The current backlog is caused by multiple problems, where one of them is the planning. Currently the capacity is 984 hours per week, but if Company X wants to do all the work that needs to be done during week 23, 3174 hours have to be worked. This means that there is a demand for more than three weeks for this week. Most of the 3174 hours that have to be worked come from backlog from the previous weeks. From week 22, which contains the work that had to be done in week 22 and the backlog from the weeks before, still 2909 hours have to be done in week 23. Moreover, the backlog is not decreasing but increasing. For instance, the backlog of the assembly department was 'only' 1510 hours in week seven of this year. This is equal to an increase of 92.52% in fifteen weeks.

##### 4.2.4.1 Problems caused by the current backlog

The current backlog is causing problems throughout the company. Several departments, like the assembly department, have a backlog and the backlog is increasing. This means that more products will be delayed. But the backlog is also working the other way around. For instance, machine A cannot produce, because it has to wait for machine B to be done with its product, but machine B cannot produce the product machine A needs because of its backlog.

#### 4.2.5 Still using iMake as a relevant planning system

Since LIMIS has been introduced to Company X, the planning of iMake is not provided anymore to the various departments, only the planning that is constructed by LIMIS. For the employees of the departments this means that they do not know the latest possible starting date in order to meet the demand date of the client, which is provided in iMake, because iMake makes use of unlimited capacity and therefore provides the latest starting date possible. Because they are only provided with the planning and what should be done at what moment, they are unaware whether they start later or earlier than the latest possible starting date and thus they are unaware whether they will reach the demand date. The chefs of the departments do still have access to the data provided by iMake

and some chefs still find it convenient to use the data of iMake, which causes chefs to use the planning provided by iMake and not the planning from LIMIS.

#### *4.2.5.1 Problems caused by using iMake as a relevant planning system*

The question here is whether there is a real problem. The fact is that LIMIS is and remain the leading planning system for all departments within Company X. The personnel still falls back on iMake because they are used to that planning system, since Company X used iMake before LIMIS was introduced and find iMake very clear. The clearance of the overview of the planning has a huge influence on whether the employees will be satisfied with using the planning(Land, 2009). Most likely, it is not convenient for the personnel to know the start date of iMake, because when they do not know the start date of iMake, they can only follow the planning of LIMIS. Moreover, when the department is already later than the planning of iMake, additional pressure for personnel may occur and might make them hurry more. If they are earlier than the start date of iMake, it might cause the personnel to relax, while the LIMIS planning wants the work to be done at that time. But taking away access to the data of iMake might cause dissatisfaction for employees, since taking away privileges or benefits can cause moral dissatisfaction (Frost, 2018).

#### 4.2.6 Lack of interaction from employees with LIMIS

Employees of all departments have to communicate with the planning system. They have to check what orders have to be taken care of and have to fill in the system when they are working on a specific order and when they are ready with the order. It happens too often that employees do not interact enough with the planning system.

#### *4.2.6.1 Problems caused by the lack of interaction from employees with LIMIS*

A common error in the interaction from the employees of the departments with the planning system is that orders are not being set as 'ready'. Even though it is claimed that all chefs know that they have to interact with the system and how the interaction works, it is not done consistently. If an employee does not set the order as finished in the planning system, the panning will still notice the process as not done. When the product is not being set as ready in LIMIS, this has two consequences. Firstly, in their own department, the process will be re-planned and therefore other processes are pushed back in the planning. This means that these orders gain extra delay, while this is unnecessary. Secondly, the follow-up departments might not receive the necessary components to start their processes. This delay will be a malfunction in the complete production process.

#### 4.2.7 Focusing on own department instead of Company X

If Company X wants to produce smoothly, all departments have to work together. It is important that the employees of the departments consider the entire company and not only their own department. All departments are dependent on the departments that produce before. Occasionally departments focus on their own department and produce the wrong products or the wrong quantity, which leads to the fact that the follow-up departments are not able to produce, since they need products from the previous department, which are produced later than planned and therefore also provided later than planned to the follow-up departments.

#### *4.2.7.1 Problems caused by focusing on own department instead of Company X*

Occasionally, departments produce multiple batches at once, while they should only produce one batch according to the planning. This is done without communicating with the subsequent departments. This happens because infrequently the departments only think about their own production. For their own department, it is most convenient to produce higher batches since the department does not have to change the machine, the tools and the programming. This may cause a lack of work for other departments.



### 4.3 Common problems

For a lot of production companies, the sequence of the different processes give struggles within the planning (Krishnamurthy, 2013). It happens often that the sequence is not efficient and causes delay (Barlatt, 2008). Company X has made a standard sequence for all orders. This sequence does not change and therefore does not cause problems within the planning of Company X.

Another common problem within the planning of production companies is the amount of constraints for the planning (Patikarnmonthon, 2018). In LIMIS, all the constraints are included. Constraints therefore are not an issue for Company X.

### 4.4 Choosing the core problem

To choose the core problem, several aspect are taken into account. Firstly, the feasibility is checked. When the problem is too broad or too difficult to solve in this research, it is not useful to focus on that problem. Moreover, the relevance is being looked at. When the problem does barely affect the performances of the planning, fixing the problem would only help by a small margin.

An issue with great importance throughout the whole company is the current backlog. As noted before, the backlog is still increasing rapidly and needs to be reduced as soon as possible. The problem is through the complete company and not just the assembly department. In this research, the focus is on the assembly department and not the complete company. Because more research is necessary throughout the company to tackle this problem, this problem is not the core problem for this research.

The lack of knowledge about reaching the demand date or not for the departments is also a problem, but when the departments gain the knowledge whether they will or will not reach the demand date, will this improve the performance? From a deliberation with the supply chain manager it can be concluded that this is not the case, therefore is this lack of knowledge does not have to be changed according to Company X.

Since the NCR number is very low, namely below 0.5%, this is only a small problem for the planning and it is questionable whether this is preventable. Human errors will unfortunately always occur. Reducing the NCR is therefore not eligible since it would be time consuming and costly to gain only a small profit of reducing NCRs.

The low LPI score probably has the highest impact in terms of planning. The HoP has been working on this problem since March 2018 and the new way of working will be the official way from August 2018. Since the HoP is in the middle of this process and Company X is confident in this new way of working, this problem is not the problem where the focus should be on.

When these problems are excluded, two problems remain. The lack of communication between departments and the lack of interaction between the employees of the departments and the planning system. Both problems have a significant negative influence on the planning and are worth for Company X to solve. In deliberation with the planners it has been conducted that solving the lack of interaction from the employees with LIMIS is most interesting and useful to solve and therefore is this the core problem.



## 5 Solving the problem

In this chapter, the second part of the research is executed, solving the problem. The way of solving the problem is explained, which is done in multiple steps. Firstly three methods have been explained and afterwards the decision has been made of which model to use for solving the problem. Then the steps that have to be taken are explained.

### 5.1 The core problem

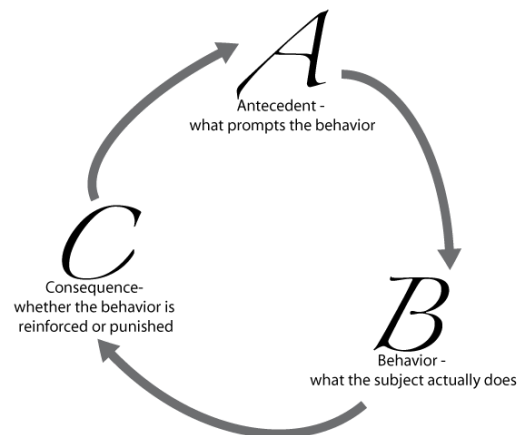
As mentioned in the previous chapter, the lack of interaction between the employees and LIMIS is the core problem in this research. There are two main reasons for not interacting with LIMIS. Firstly, the priority of the employee is with producing and not with both producing and interacting with LIMIS. When the working pressure is high and a process is done, it happens often that an employee just continues with the next task, instead of interacting with LIMIS first. Secondly, employees tend to forget the interaction. Forgetting the action has two main reasons. Firstly, the fact that employees do not have the interaction in their daily routine and furthermore not acknowledging the importance of the interactions.

#### 5.1.1 Improving the current situation

The deficiency is a behavioural problem where the lack of Human-computer interaction(HCI) is the main struggle. In the following sections, three models will be introduced to make behavioural change happen with the employees of Company X. These three models are the ABC-model, the 7E-model and nudging.

### 5.2 ABC-method

The ABC-method is a method created by B.F. Skinner, which comprises the antecedent, behaviour and consequence. The ABC-model is a circular model where the participants go through the loop multiple times to achieve the desired behaviour.



#### 5.2.1 Antecedent

The antecedent refers to anything that is done previous to the behaviour what might contribute to the behaviour. The antecedents are closely related to the consequences of the behaviour. When consequences have occurred, the antecedents might change or antecedents might be added to reduce or deny certain consequences.

#### 5.2.2 Behaviour

The behaviour is what the employee does regarding the activity that is going to be improved. This can be both positive and negative.

#### 5.1.3 Consequence

The consequence is anything that follows from the behaviour. The consequence also affects the probability of repeating the behaviour. There are four different consequences that can change behaviour, namely:

1. Reward

An employee does something and in return he or she receives something he or she desires.

When this consequence is being used, it will lead to employees carrying out that behaviour more often. Rewards can take different forms, like extra money or extra free time.

2. Negative reward

An employee does something to avoid punishment. The employee carries out an action because he has to, not because he wants to. This consequence leads to an increase of this behaviour. An example is where employers tell their employees that they have to work because they are being paid to work

3. Punishment

Punishment leads to a decrease of behaviour. An employee does something and in return he or she receives something he or she would rather avoid. An employee will differ its actions to avoid receiving the punishment. Examples of punishments are getting a fine or working a period of time extra

4. Extinction

Extinction causes employees to reduce their actions. This is done by not providing the reward anymore. This happens for example when an employee gives ideas about change, but nothing is being done with his ideas. Because of this, the employee will stop providing ideas. (Rietdijk, 2009)

### 5.3 7E-model

One model to change the behaviour of the employees is the 7E-model. The 7E-model has been created by Fran Bambust in 2009. The seven E's in the 7E-model stand for the seven steps that have to be taken to achieve the desired behavioural change. The seven steps have to be taken in chronological order to be effective. The seven E's in order are:

1. Enlighten – Gather the necessary information for the employees and know how to inform the employees
2. Enthuse – How to involve and create enthusiasm amongst employees
3. Encourage – How to encourage, reward or help the employees to create the behavioural change
4. Exemplify – What examples can be used to clarify the desired goal towards the employees
5. Enable – What is necessities are there for the employees to behave the desired way
6. Engage – Find role models between the employees and engage them between the employees. Afterwards find ways how the role models can convince the other employees
7. Experience – Let the employees experience positivity when the desired situation is being carried out(Bambust, 2017)

### 5.4 Nudging

Another way to change the behaviour of the employees is called nudging. Nudging stimulates the employees to make choices which are positive for themselves, but also for the state(Thaler and Sunstein, 2009). Nudging is created on the theory that most decisions are made automatically. People do not think about all decisions that they make and the decisions are based on norms, context and signals from the surroundings (Kahneman, 2012). This is what nudging uses. Nudging changes the surroundings and/or context to influence the decision of the decisionmaker.

Nudging is not an easy action to perform, since you never know whether the change you make will have the impact you are aiming for. For instance, it happens that the right thing is not right at all. In the United Kingdom, the government used their tax system to move drivers away from driving petrol cars to diesel cars, because diesel cars would pollute less harmful gasses. But after years of nudging,

the government found out they were not informed correctly and there is a lot more nitrogen oxides in diesel than previously thought. (M. Weaver, 2017)

Nudging is divided into four steps and one step that has to be taken during the complete process, namely:

1. What is the problem and what is the goal?  
Before any action can be taken, a clear definition is necessary of what the problem is and what needs to be achieved with the nudge.
2. Which psychological processes are important for this behaviour?  
It is important to know why people perform or do not perform certain actions.
3. Create the nudge  
A nudge has to be created, a completely new nudge or an old nudge can be altered to be effective for the current problem.
4. Test and evaluate  
The nudge has to be implemented and has to be proven to work. During the nudge, more information needs to be gathered. The extra information may help to improve the nudge when possible.

During the complete nudging process, the moral aspect has to be taken into account. Nudging uses the fact of manipulating people. When this is overdone, it can harm the people who have been nudged.

## 5.5 Choosing the model

To choose which model is most effective 5 criteria are made and the three solutions are all given a score. Based on the scores, it will be decided which model is going to be used to solve the internal problem.

### 5.5.1 Criteria

To make a clear choice which model should be used, five criteria have been made. These are:

1. Feasibility in the situation of Company X  
It is important to make sure the solution fits the situation at Company X. It has to be applicable for a fast growing company with over a 150 employees.
2. Internal acceptance  
Implementing the solution could have negative effects on the working space, because people have to change. When the solution causes too many negative effects, the solution has more chance to fail.
3. Costs  
It is important to know the costs of the implementation of the solution. When the costs of the implementation of the solutions would be too high, the costs might outweigh the eventual profit of the implementation.
4. Level of difficulty to implement  
When a solution is effective and easy to implement, it would help Company X to solve the internal problem efficiently.
5. Duration of implementation  
For Company X it would be most convenient when the solution can be implemented as fast as possible to make sure the problem is solved as soon as possible.

### 5.5.2 Scores

Below a table with the scores for all three models concerning the five criteria. Together with the supply chain manager, I have given scores between -- and ++, with -- being the lowest score, +/- being average and ++ the highest score.

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
ABC-model	++	+/-	+/-	+/-	+
7E-model	+	++	++	+/-	+/-
Nudging	+/-	+/-	+	+/-	-

From the scores in the table, we can conclude that nudging would be the least feasible method to use to solve Company Xs problem and the 7E-model has scored best and therefore is chosen to be used to solve Company Xs internal problem.

### 5.6 Desired situation

Before applying the 7E-model, the desired situation has to be stated clearly. It happens too often that companies want changes, but they do not have a clear vision of the desired situation, which will lead to failure(Icek Ajzen. 1991). Company X needs its employees to correctly interact with LIMIS at all times in order to make optimal use of LIMIS. Interacting correctly will be explained to all employees in the enlighten model of the 7E model. After the 7E-model has been used, Company X desires to see the planning working more fluently without the lacking of interaction through the whole company.

### 5.7 Conditions desired situation

The procedure of interacting with LIMIS is already known by the employees, it is now necessary to make sure the procedures are done consistently. It is extremely difficult to measure how many times these errors occur, but employees from different departments can give feedback every week during the weekly meeting with the planner(which is already being held every week) and the different chefs. The planner and the different chefs can mention when another employee did not fill in the necessities in LIMIS. All chefs and the planner have to be honest towards each other without blaming other employees.

### 5.8 Applying the 7E-model

Applying the 7E-model means using all seven E's step by step in chronological order. All seven E's have to be carried out patiently, because when one step is not done correctly, the 7E-model might not work as effective at it could work.

#### 5.8.1 Enlighten

Firstly, all employees have to be informed once more about the steps that have to be taken to have to be taken with LIMIS. A meeting will be held with the chefs of the different departments and all necessary information will be given. During this meeting, all steps that have to be taken will be explained as detailed as possible, to avoid remaining ambiguity amongst employees. Moreover, the importance of the interactions together with the impact of not interacting needs to be discussed to make the personnel aware of the concerns of the interactions. Furthermore, it has to be very clear for all employees that reminding each other is always helpful. Reminding colleagues of interacting is not automatically blaming or attacking them. It is of huge importance to let all employees know that, so they will remind or confront each other when interactions are not being done. Reminding other employees can be done at any time, during the work time or the breaks. It can also be done in the weekly meeting at Monday morning, where all the chefs of the different departments participate in.

When employees are reminded of interacting when they tend to forget, interacting with LIMIS can become a routine for the employees.

### 5.8.2 Enthuse

To create enthusiasm amongst the employees, it is important to show the employees Company Xs vision, about their willingness to develop and constantly improve. This can create enthusiasm, because it makes the situation more real for the employees. Moreover it helps to imply that the employees are the force to change and make sure Company X develops. Also it helps when the employees have the opportunity to provide ideas and/or solutions to improve the interactions with LIMIS. (Durkin, 2013)

### 5.8.3 Encourage

A useful way to encourage employees is acknowledging their potential. Sometimes it helps to speak about the things employees do not want to hear. Making clear that employees taking the interactions with LIMIS too lightly is one of the things employees might not want to hear. But then also saying that they can think more about the interaction and that they can interact perfectly with LIMIS. Another way of encouraging is naming out good qualities of them and add what they can improve. In Company Xs case, they can inform the employees on the great work that they are delivering, but still need to improve on the interactions with LIMIS. (McGammon, 2015)

When an employee has interacted correctly, a consequence could be given to encourage their current behaviour. An example is by giving points to the specific department every time an interaction has been done correctly. With those points departments can claim money or prizes for their department. The point system can also be used to create a competition and the winner of the competition receives a prize. Making a competition stimulates the employees in two ways. The employees could receive a prize which motivates them and the competitive nature of a competition brings out extra motivation to human beings(Rooksby, 2010). A problem for using this method might be checking when an interaction has been done correctly. It is hard to check and thus it is hard to know when to provide points to somebody.

An effective way of helping the employees is by giving the employees reminders of interacting with LIMIS. This would be similar to what the government does with reminding drivers of the speed limit or showing drivers how fast they are driving. The reminders caused a reduction of 18% in urban areas and 10% outside of urban areas(Wijnen, 2010). At Company X, posters could be attached to machines and walls to remind employees of interacting with LIMIS when necessary. This can be done in all departments. A big plus is that they will be noticeable throughout the company. Also, a reminder could be added to the printing lists. Every day, departments receive new planning lists which will be printed and being used for what activity has to be taken care of at what time. Because the lists are being used all the time at all department, a reminder on the planning lists will be an effective way of reminding employees to interact with LIMIS.

#### 5.8.3.1 The reminder

The reminder needs to be clear for all employees. When the reminder is too long, it is not appealing for the personnel. Captions have to be created for both the posters and the planning lists. Examples for captions are:

- LIMIS needs you to work together
- Help Company X and interact!
- Without your interactions, Company X can NOT perform
- Do not miss out on LIMIS!

A subtle touch to add to the reminders, would be using the colours white, light green and dark blue, which are the colours of LIMIS.

#### 5.8.4 Exemplify

For the planners it is important to imply on a new situation without changes at the last moment and a clearer situation of what processes have to be taken care off. When the new situation is created, fewer orders will be pushed back in the planning and the follow-up departments will not miss any components because the interaction has been done correctly. Because both of these problems will be fixed, a clearer production planning will be created.

#### 5.8.5 Enable

Since the LIMIS program is working correctly, there are no further necessities.

#### 5.8.6 Engage

Within Company X several employees are interacting with LIMIS extremely well. For the planners it is essential to find at least one employee per department who is capable of being a role model. The role model should already be interacting greatly with LIMIS. When every department has one role model, it is easier to engage with the other employees, since they are more available, because they are close by. The role models can show the effectiveness and satisfaction amongst other departments of the proper interaction to give an extra stimulant to the other employees.

#### 5.8.7 Experience

When the 7E-model is implemented, the interaction and therefore the planning should run more smoothly. Both the planners and the production employees will experience the positive impact of the improved interactions.

### 5.9 Evaluating

For Company X it is important to evaluate the changes after a certain period of time. An appropriate period of time would be after half a year. The planners have to keep track of lack of interactions and carefully check whether the numbers are decreasing. When the number decreases, Company X has worked through the seven steps properly. When the number of lack of interactions is not decreasing, a research through the company has to be done which step(s) have not been carried out effectively enough. The panning will need to deliberate this with the chefs of the departments.

### 5.10 Summary

In this chapter, three models are introduced. When the criteria are drafted and the scores are given, the 7E-model is chosen. Then the desired situation is described and the process of the 7E-model is explained.

Company X needs to walk through every step of the 7E-model carefully and chronologically except for the fifth step, enable, since there are no further necessities. To start off with informing the employees about the different steps that have to be taken within LIMIS. Moreover, the employees need to be informed about the importance of the interactions with LIMIS. Also, Company X needs to imply their vision to the employees and that the employees are the force to make their vision reality. Then Company X needs to speak with employees about the lack of interaction, combined with adding a point system to create motivation and competition and reminders for the interactions. Reminders can be given orally by every employee or written on the planning lists and posters on the machines and the walls. Afterwards, a role model per department needs to be chosen which can show the effectiveness of their actions.



### 5.11 Limitations

The 7E-model also contains some limitations. When the 7E-model has not worked effectively, it will only become clear that the process has not been effective after the complete process is being carried out and it is difficult to examine where in the process the mistake has been made and therefore is difficult to improve. When this happens, an analysis where the mistake occurred has to be made.

When the deficiency is found, the phase where the deficiency occurred has to be improved and the 7E-model has to be re-implemented. This would be extra time consuming.

Furthermore, the 7E-model is a model which is focused on the behavioural change of people. The lack of interaction with LIMIS is a behavioural problem, where the behavioural problem is a lack of communication with the planning system. The 7E-model is not specified for HCI problems, even though this is an important factor in the problem. Improving HCI problems could have been done by developing culture-sensitive applications. (Anacleto, 2010)

Also, the 7E-model does not take into account that there are many different people working at Company X, with different characteristics and different norms. In each phase, employees can react differently to the taken actions. This means that certain steps will be more effective for one employee, but less effective for a different employees.



## 6 Conclusions and recommendations

*In this final chapter of the research, the conclusion will be made and recommendations to Company X and for further research.*

### 6.1 Conclusion

Before this research, Company X had ideas what problems occurred, but they were not certain of these problems. Because it is not useful to do this research on the complete company, a department is chosen first. When the four KPIs, absolute number of orders too late, average number of days too late per order, percentage too late and number of orders, are being looked at, the assembly department is chosen to focus on.

From the analysis, several problems are found. The LPI scores are too low, deficiencies lead to planning over capacity, errors in internal production, current backlog, still using iMake, lack of interaction between employees and LIMIS and the focus on employees' own department are all problems that Company X faces in the assembly department.

From these problems, the lack of interaction between the employees and LIMIS is chosen as the core problem of this research. The lack of interaction is mainly caused by not giving enough priority to the interaction with LIMIS and simply forgetting the interaction.

To solve the core problem, the 7E-model is chosen to solve the problem with. When the 7E-model has been applied completely, time will tell the effectiveness of the implementation.

### 6.2 Recommendations

The main recommendation I want to give is carefully take all seven steps from the 7E-model, which are:

1. Enlighten
2. Enthuse
3. Encourage
4. Exemplify
5. Enable
6. Engage
7. Experience

In addition to implementing the 7E-model I want to strongly recommend Company X to improve this model by giving an extra emphasis on the communicational factor of the lack of interaction with the planning system. When this is being done, the 7E-model can work even more effective and Company X will only gain more progress in this problem.

Moreover, I want to recommend on improving the focus of the department. In the Company X company, it happens too often that employees of departments do not follow the planning completely for their own convenience. This is not communicated to other departments and extra delays occur. It is important to imply the focus of the complete company and not just one specific department.

Also, I want to suggest that the actions of the 7E-model can be researched further and improved to make the actions adjustable so the actions suit all employees perfectly. When the actions are suitable for all employees, it would make the 7E-model will get more easily internal acceptance and the model is being used more effectively.

Furthermore, I would recommend to do similar research in the small machining department, the welding department and the quality control department. These three departments also scored high in the determination of the department in chapter three. These high scores indicate that there are also numerous problems in these departments and it is therefore very interesting for Company X to

also make an overview of the problems in these departments.

## Terms and definitions

A-supplier = A supplier with an LPI score of 95% or higher

B-supplier = A supplier with an LPI score between 85% and 95%

C-supplier = A supplier with an LPI score below 85% (There are also D-suppliers, E-suppliers, etc. but Company X only qualifies suppliers as A, B or C suppliers)

Demand date = The date the client wants to receive its order

Green Stream (GS) = Company X uses a green stream throughout the company. The green stream indicates producing the same amount of certain products every week, since there is a known weekly demand of these products and Company X wants to produce those at a constant rate

HoP = Head of Procurement

iMake = the ERP system Company X uses

LIMIS = the planning system Company X uses

Logistics Performance Index (LPI) = An index that Company X uses to show the delivery reliability of the suppliers and clients. This is based on the completeness of the order and the quality and the complaints about the order (indirectly the quality of the order). Both indicators are given a score and the product of these indicators is the LPI score as a percentage

Non-Conformance Report (NCR) = A product that does not satisfy product standards

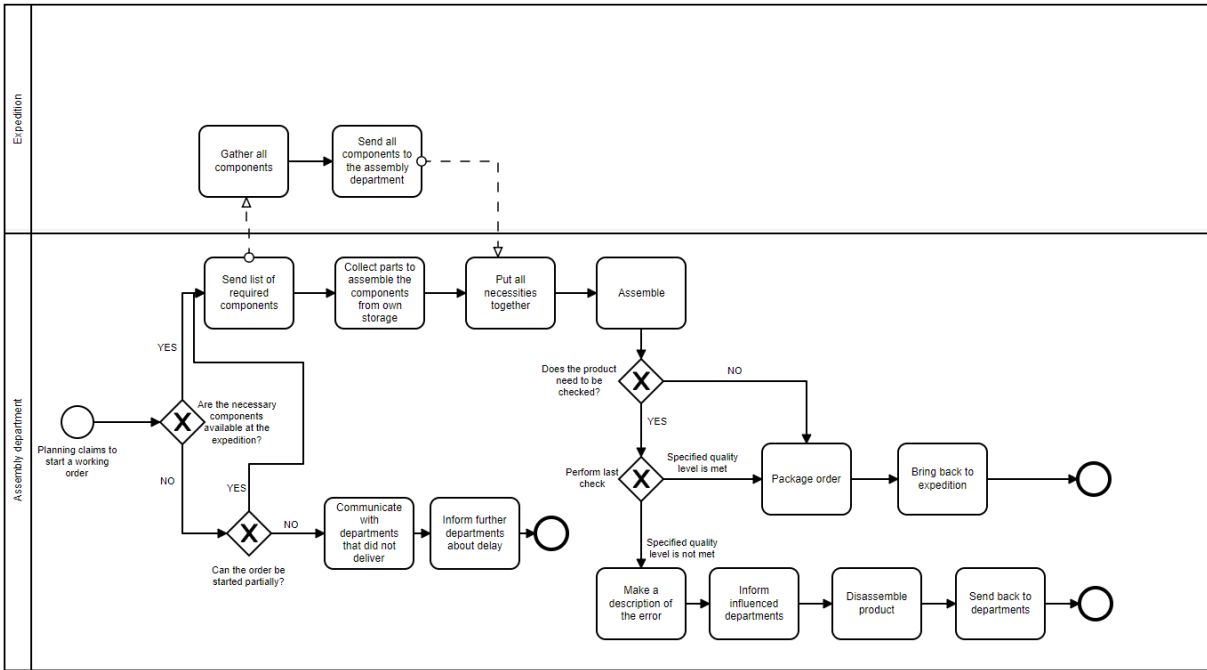
SCE = Supply Chain Engineer

SCM = Supply Chain Manager

## References

- Ajzen, I. (1991). *Organizational Behavior and Human Decision Processes*
- Anacleto, J.C. & de Carvalho, A.F.P. (2010). *Improving Human-Computer Interaction By Developing Culture-Sensitive Applications Based On Common Sense Knowledge*
- Bambust, F. (2017). *Effectief Gedrag Veranderen Met het 7E-Model*
- Boonstra, J.J. & Elving, W.J.L. (2013). *Veranderkunst*
- McCammon, R. (2015). *How and Why to Offer Words of Encouragement*
- Durkin, D. (2013), *How To Create Enthusiastic Employees*
- Frost, S. (2018). *How Employment Benefit Cuts Can Affect Morale. Small Business*
- Hartono, R. & Laurence. (2015). *Gap analysis of required and available capacity'*
- Kahneman, D. (2012). *Thinking, Fast and Slow*
- Land, M.J. & Gaalman, G.J.C. (2009). *Production planning and control in SMEs: Time for a change*
- Rietdijk, M. (2009). *Organisaties Conditioneren*
- Rooksby, E. (2010) *Who's Correct About Human Nature, Left or Right?*
- Skinner, B.F. (1966). *The Behaviour of Organisms*
- Thaler, R.H. & Sunstein, C.R. (2009). *Nudge: Improving Decisions About Health, Wealth and Happiness*
- Weaver, M. (2017). *Fuel Duty Cut For Diesel Cars Was Wrong*
- Wijnen, W, Mesken, J., Vis, M.A. (2010). *Effectiviteit en kosten van verkeersveiligheidsmaatregelen*

# Appendix A



Appendix B

