

The Optimization of the Planning Process of Company X

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Industrial Engineering & Management

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Management Summary

Company X is a merger of three former service partner. The three service partners worked independently over the last years and have therefore a different planning process. The goal is to find a new planning process out of the currently used planning processes. An important consideration is the balance between costs and satisfaction. The goal is obtaining a customer satisfaction as high as possible while spending as little money as possible. The research question is formulated as follows:

“What is the best planning process for Company X?”

To find an answer on this question, first a literature search is performed. Thereafter, the processes of the different service partners are visualized with the BPMN 2.0 notation. The visualization gives a clear view of the differences between the processes. Table 1 shows the differences between the different service partners.

Table 1. Differences Planning Processes

	Location A	Location B	Location C
Customer Approach	Two-Sided, date is proposed	One-Sided, date is proposed	Two-Sided, without proposed date
Reminder	Yes, text message one day before the appointment	Yes, text message one day before the appointment	No
Add extra appointments	No	Yes, up to one week in advance	Yes, up to two weeks in advance
Non-confirmed appointments	FO try to call the customer a maximum of two times (21 and 16 days before the appointment)	Confirmation is not necessary	FO tries to call the customer a maximum of three times

A data analysis is executed to measure three Key Performance Indicators (KPIs). The Customer Effort Score (CES) is calculated to measure the customer satisfaction. The KPI 'Not at Home' is defined as the percentage of work and travel time spent on a customer that is not at home. Lastly, the KPI 'Not Reached' calculates the number of appointments with no response from the customers.

With the data analysis and the different processes, the best practices are determined. The best practices can be found in Table 2.

Table 2. Best Practices

Action	Best Practice
Customer Approach	Two-sided approach, no date proposed
Reminder	Send a text message one day before the appointment
Add Extra Appointments	Schedule extra appointments up to one week in advance
Non-Confirmed Appointments	FO try to call the customer a maximum of two times (21 and 16 days before the appointment date)

The data analysis showed clearly that the two-sided approach has a beneficial effect on the costs and the percentage 'Not at Home'. In general, the company prefers a higher percentage 'Not Reached' instead of 'Not at Home', since a Front-Office employee only tried to call two times when a customer is not reached. A mechanic is sent to a customer that is not at home, which is more expensive than calling two times. The other best practices are determined to increase the efficiency and lower the costs.

The best practices together constitute the new planning process. Implementing the planning process at every location gives the best balance between customer satisfaction and costs. So, the new planning process constituted from the best practices is the best planning process for Company X.

Acknowledgements

Dear reader,

You are about to read the bachelor thesis 'The optimal planning process for Company X. This research is conducted at Company X, as the final assignment for my bachelor Industrial Engineering and Management. The goal of this assignment is to find the optimal planning process for the newly merged company from the currently used planning processes.

First, I would like to thank everyone at Company X for their guidance and involvement in my project. A special thanks to my company supervisor, who was always available and willing to help with issues I ran into. His feedback and advice were always very helpful.

Secondly, I want to thank Renata Guizzardi-Silva Souza, my main supervisor, for guiding me through this process by always giving critical and supportive feedback. I would also like to thank Ipek Seyran-Topan for being my second supervisor.

Lastly, I want to thank my friends and family. They have very much supported me throughout this effort and I would like to thank them for their interest and efforts.

Enjoy reading my thesis!

Merlin Klaassen

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List of Abbreviations

B2B	Business to Business
B2C	Business to Customer
BPM	Business Process Modelling
BPMN	Business Process Modelling Notation
CES	Customer Effort Score
ERP	Enterprise Resource Planning
FO	Front-Office
FTF	First Time Fix
HVAC	Heating, Ventilation & Airconditioning
FTR	First Time Right
KPI	Key Performance Indicator
MPSM	Managerial Problem-Solving Method
NFTF	Not First Time Fix
NTFR	Not First Time Right
S&M	Service and Maintenance

1. Introduction

In this chapter, the reader gets acquainted with the company (1.1). In the problem identification (1.2) the core problem and problem cluster are explained. The Key Performance Indicators are given in section 1.3. In the section research approach (1.4) the reader can find the research question and the process steps which will be taken to find an answer to the research question. Information on the research design is given in section 1.5.

1.1 Company X

This part is removed due to confidentiality.

1.2 Problem Identification

1.2.1 Core Problem

Company X is a merger of three former service partners of a company that provides energy . These service partners worked independently over the last years and have therefore their own planning process. It is evident that the new company requires a central and local planning process. Each original service partner has a different way of planning and uses a distinct Enterprise Resource Planning (ERP) system. The ERP system and the planning must be uniform in the new situation. After the merger, the company will be working towards 15 autonomous locations, each one with a small staff consisting of planning, logistics, and administration.

An important consideration is the balance between costs and customer satisfaction. The goal of Company X is to have customer satisfaction as high as possible with the least work and costs. Currently, Company x is facing a shortage in service and maintenance capacity. Therefore, efficiency and effectiveness in the planning process will be required to optimize the available capacity and to do as many activities as possible.

1.2.2 Motivation of the Core Problem

Next to obtaining high customer satisfaction, an important requirement for a new planning process is that order, cleanliness, and tranquility are guaranteed during different stages. The world of maintenance and malfunctions is dynamic enough by itself and it helps to have a planning- and implementation process that somewhat absorbs these dynamics. Improvement of the standard times set for repairs and installations is not in the scope of this assignment.

The goal of this bachelor's assignment is to find the best planning process for Company X. For the new planning process, the goal is to find the best mix out of the currently used processes. This is done by comparing the KPIs and the processes of every location. The best balance between the KPIs results in the best practices. Best practices can be defined as a procedure that has been shown by research and

experience to produce optimal results and that is established or proposed as a standard suitable for widespread adaption (Merriem-Webster, 2011). In other words, best practices are a way of working that works most efficiently for the employee or gives the best results in terms of Key Performance Indicators.

1.2.3 Problem Cluster

The problem cluster represents the issues faced in this research. In Figure 1, the problem cluster is shown. The three former service partners have different planning processes with all different advantages and disadvantages. The way several activities are executed are different at every location. The main problem to solve is that all different service partners get the same harmonized planning process. The problem cluster shows the different implementations of the service partners.

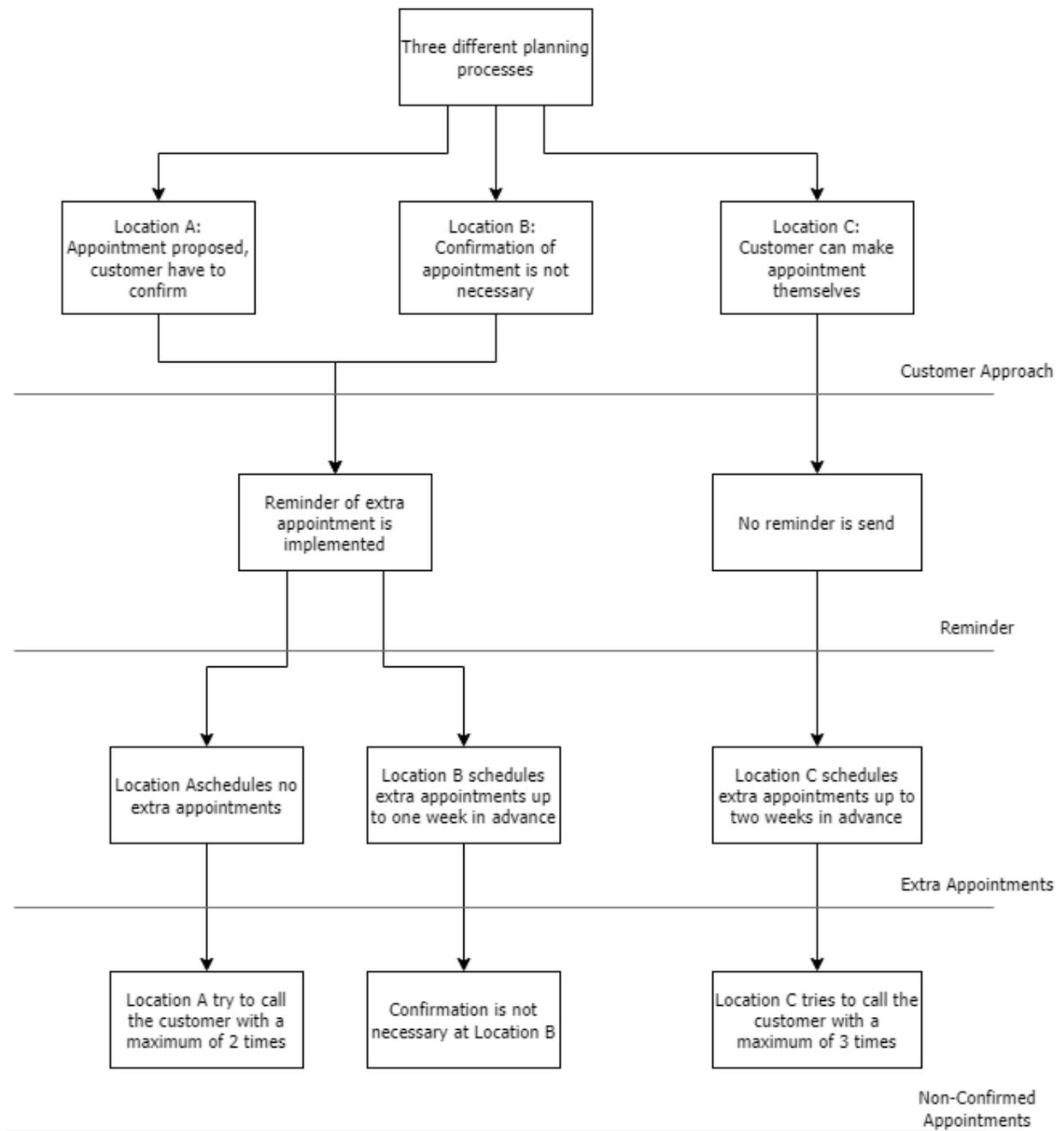


Figure 1. Problem Cluster

1.3 Key Performance Indicators

To make the best decisions for the planning process for Company X, the focus will be on three key performance indicators (KPIs). These KPIs will be used to determine the best practice. The KPIs will be also used to show the differences between the former service partners. An overview of the KPIs is shown in Table 3.

Table 3. Overview KPIs

KPI	Description
CES	The customer effort score (CES) is a single-item metric that measures how much effort a customer has to exert to get an issue resolved, a request fulfilled, a product purchased/returned or a question answered (qualtrics, What is customer effort score (CES) & how do I measure it?, 2022). The CES is based on a single question: "How much effort did you personally have to put forth to handle your request?".
Not at Home	This can be defined as the percentage of work and traveling hours spent in a situation where the customer is not at home and other canceled activities. This is calculated as a percentage by dividing the work and traveling hours spent on a situation where the customer is not at home and other canceled activities by the total work and traveling time.
Not Reached	Not Reached shows the percentage of customers who did not respond to the appointment appeal. At two service partners, it is necessary to respond to the invitation for the appointment. When the customer do not respond within a certain time, the Front-Office will call the customer. If a scheduled appointment is canceled due to the fact the customer is not responding to the invitation, it is seen as not reached.

1.4 Research Approach

1.4.1 Research Questions

Based on the problem identification, the main research question can be formulated as:

"What is the best planning process for Company X?"

By following the systematic approach in section 1.4.2, some sub-research questions are derived. These questions can be formulated in the following way:

1. What is the best business modelling approach for this research?
2. What does the planning process currently used at each service partner look like?
3. What are the differences between the planning processes currently used by each partner?
4. What are the best practices of the different planning processes according to the KPIs?

1.4.2 Systematic Approach

1. Perform literature research

Find the best business modelling approach and possible useful information on existing methodologies.

2. Visualize the planning processes currently used by each partner

Make a visualization of the planning process of each partner to have a clear overview of the processes and the differences.

3. Determine the differences between the planning processes that are currently used

Use the visualization to find the differences that occur in between different processes.

4. Ask each partner for data on their appointments

Data analysis will be used on received data about the appointments from a specific period, to measure the KPIs at each service partner. With these outcomes, a relation between a difference in the processes and a difference in the outcome of the KPIs for a service partner can be found.

5. Get in contact with employees to discuss the outcome of the data analysis

The steps above are based on theoretical information. It is important to discuss this with the experience of the planners of each service partner.

6. Give an overview of the possible options to be made in the new planning process

Possibilities for the new planning process will be given. This will be an overview of the different possibilities at the different steps and their advantages and disadvantages.

7. Draw conclusions

With an overview of possibilities for the new planning process in place, a trade off will be made to decide what the best possible design of the new planning process will look like.

8. Give recommendations

After making conclusions, recommendations will be given to Company X in the form of a newly designed planning process and an advice on possible further research.

1.4.3 Deliverables

The steps taken in the systematic approach in paragraph 1.4.2 will be worked out in a report. The report will be used by Company X as a recommendation for the new planning process. In the report, all the gained information can be found and, a proposal for the new planning process will be given. This newly designed planning process can be used to improve the planning process.

1.5 Research Design

1.5.1 Type of Research

This bachelor assignment will be a scientific research. The goal of the research is to find the optimal planning process. Scientific research can be classified in several ways (Caparlar & Dönmez, 2016). This research can be seen as theoretical research, where data collection is used to generate new general concepts for a better understanding of a particular field or to answer a theoretical research question (DiscoverPhDs, 2020). The research will be done according to the Managerial Problem-Solving Method (MPSM) Cycle. This is a systematic problem-solving approach that consists of seven steps (Heerkens, 2017).

The research questions in paragraph 1.4.1 are derived from the systematic approach. These research questions can be divided into two categories, namely explanatory and descriptive research. The first question, about the literature research, can be seen as explanatory research. Explanatory research allows for increased understanding of a specific topic and used secondary research as a source of information (QuestionPro, sd). To answer the other three sub-research questions, descriptive research will be performed. Descriptive research can be defined as a research method that describes the characteristics of the population or phenomenon studied (Pro, 2021). These research questions are about the design of the currently used planning processes, the newly designed planning process, and about measurements done into these planning processes.

1.5.2 Choice of Data Gathering Method

For the choice of the data gathering method, a distinction between qualitative data and quantitative data will be made. Qualitative data is data that describes qualities or characteristics. It can be collected by for example questionnaires and interviews (Mac Dewitt Wallace Library, 2021). Quantitative data is defined as the value of data in the form of counts or numbers where each data set has a unique numerical value associated with it (Question Pro, 2021).

In the new planning process, several decisions have to be made. The data that is required to support these decisions will be both qualitative and quantitative. Quantitative data is used for the data analysis, which will give an insight into the KPIs and advice on the best practices. The data analysis will be the main point of view but needs to be supported by the opinion of the planners.

To find the differences between the processes of the three former service partners, interviews will be performed. These interviews give more knowledge about the exact way of working of the planners. During workshops on all three locations, a discussion will be held on what the best practices are for planners. These workshops and interviews are the qualitative data that will be gathered.

1.5.3 Choice of Data Analysis Method

For the data analysis, a descriptive analysis will be performed. With the available data files, information regarding the KPIs will be gained. This way of analyzing data is a descriptive analysis. Descriptive analysis aims to answer the question of what happened. It does this by ordering and interpreting raw data into valuable insights into the business (Calzon, 2021).

To support the data analysis and find out what the best practices are for the planners, a diagnostic analysis is needed. Diagnostic data analytics empowers analysts by helping them gain a firm contextual understanding of why something happened (Calzon, 2021). This will be provided in the form of interviews and workshops.

2. Theoretical Background

This chapter provides the necessary theoretical background for this research. First, more about the Service and Maintenance department is explained (2.1). In section 2.2, the different types of customers are explained. Thereafter, business process modelling is explained (2.3). The notation that will be used in this research is described in 2.4.

2.1 Service and Maintenance

Company X has two types of orders: maintenance orders and malfunction orders. The agreements about maintenance periods are documented in contracts with homeowners (individuals or landlords, especially housing associations) and determined for the moment when maintenance needs to be executed. The agreements of such contracts are stored in ERP systems. Because the integration of the three companies is still in progress, Company X currently uses three different ERP systems. A malfunction order comes from customers who experience failures in their heating, ventilation, or airconditioning (HVAC).

The goal of Company X is to complete a malfunction order within at least two days after the customer's complaint. Not only the ERP systems but also the planning systems are different. Location A and Location B both use Visitour, but in a different way. Location C has a whole different planning system. The challenge for the near future is that there has to come one planning system for all three locations.

As mentioned before, this assignment is focused on the Service & Maintenance side of the new company. This department can be seen from two different points of view: the central and local point.

From the central point, the appointments from the demand side will be guided. Every year, the strategical planner makes, together with the location manager, a prediction of the number of maintenance orders that should be done monthly. This planning takes into account the expected percentage of orders that are malfunctioning orders. During the winter more people make use of the HVAC, so the number of malfunction orders is always higher during that time. For the central point, there are two planners, namely the tactical planner and the strategical planner. The strategic planner is responsible for the year planning and the tactical planner is for the monthly planning. These two planners work closely together. The tactical planner uses the year planning to make a month planning and with the feedback and measurement of a month planning, the strategic planner can improve the forecast for the next year.

On the local level, an influence on the capacity of available mechanics is exerted. This must comply with the market demand and should be corrected in case the reality is deviating or is going to deviate compared to the original plan. The location planner receives a week of planning for the coming week on Wednesday. From that moment, the location planner is responsible for the distribution of the mechanics to customers. The location planner is responsible for changing the schedule when a mechanic falls away due to for example illness.

2.2 Housing Associations and Private Customers

Company X has two types of customers, namely private customers and housing associations. Private customers are individuals who own the house and therefore signed a maintenance contract. Housing associations provide rental homes for people with a low income. In the Netherlands, housing associations are obliged to rent 80% of their houses to people with a low income (Rijksoverheid, 2022). The housing association has to maintain the houses. Therefore, housing associations have contracts with Company X to outsource the maintenance of the HVAC.

The customers are divided into two segments. 'Business to consumer' (B2C) means that the contract is sold directly to the customer. 'Business to business' (B2B) refers to the situation where the company sells its services to other businesses (Weatherwax, 2022). For Company X, the B2C-customers are the private customers. The B2B customers are the housing associations and companies in other sectors that have a contract with Company X about the service and maintenance of the HVAC in their buildings.

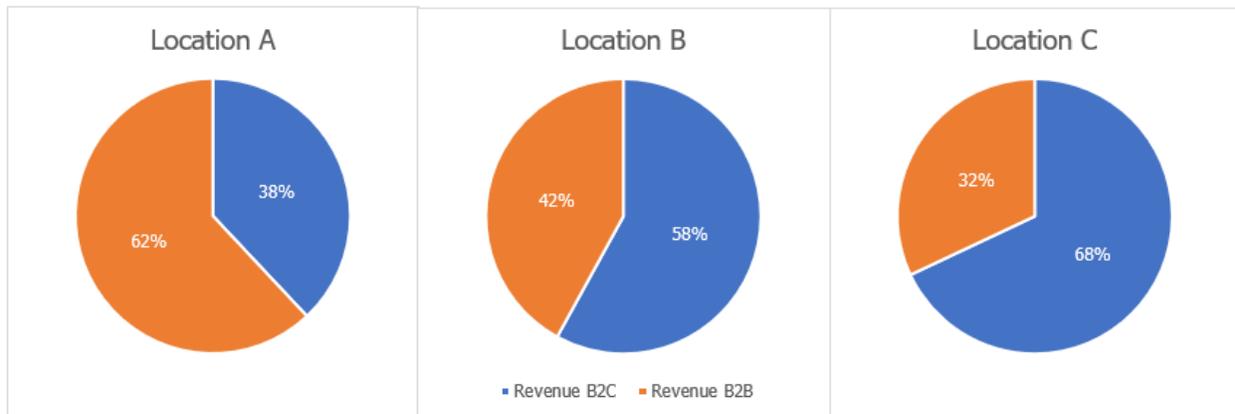


Figure 2. Overview Division Revenues per Location

The division of revenues of every location can be found in Figure 2. Location A is, compared to Location B and Location C, the only location with a higher revenue from B2B- customers than B2C-customers. The total revenue of B2B customers is 61% from housing associations at Location A. Location C gets, compared to Location A, only 32% of the revenue from B2B customers. 48% of the B2B revenue is received from housing associations.

Location B and Location C have a higher revenue from the private customers. Purely based on the number of customers, more than 60% of the customers of Location B and C are private customers. At Location A, more than 60% of the customers are from housing associations.

Private customers own the contract themselves. It is their HVAC installation, so it is more important for them that maintenance is executed. Their contact information is known at the company, which makes the private customers easier to contact.

The housing association can be seen as the intermediary. The housing association is the contract owner, but the appointment goes straight to the resident of the rental house. The residents of a house of the housing associations change more often and the personal information has to be retrieved via the housing association. Not all personal information is known at Company X, which makes it more difficult to reach the resident of the house. The resident is not the owner of the house and therefore not the owner of the HVAC. Therefore, they have often less interest in the execution of maintenance.

2.3 Business Process Modelling

Business process modeling is considered as the most important step in the improvement of business processes. Business process modeling is a means of representing the business, activities, the information flow and decision logic in business processes (Guizani & Ghannouchi, 2021). Business Process Management is often employed to cross the boundaries of business functions and improve integration. Improved integration can lead to high levels of effectiveness and efficiency, but also to a better structure of processes that are the basis for flexibility in operations (Erasmus, Vanderfeesten, Traganos, & Grefen, 2020).

2.4 Business Process Modelling Notation

The processes will be visualized according to the Business Process Modelling Language (BPMN) 2.0 method. The BPMN facilitates the understanding of the process modeled (Franca, Netto, Barradas, Santoro, & Baiao, 2013). It is a powerful modeling language for defining, documenting, and executing business processes (Lübke, Ahrens, & Schneider, 2021).

An overview of the elements of the BPMN 2.0 notation can be found in Figure 3. Activities with no further definition are called tasks or activities. A subprocess is defined as an activity with an internal structure. With a subprocess, the modeler can decide to hide the complexity of the subprocess by using the plus symbol (Weske, 2019).

A splitting exclusive gateway chooses one of several outgoing sequence flows (Kossak, et al., 2014). At an exclusive gateway, only one of the outgoing flows can be chosen. An exclusive join pattern is a point in the process where two or more threads come together without synchronization. It is an assumption of this pattern that exactly one of the alternative branches is executed (Weske, 2019).

The drawn circles are events. These circles are used to represent something that can happen. A start event represents the point from which the process starts. An end event represents the process termination (Flavio, et al., 2020). The message start events can be used to start a process instance using a named message (Camunda Docs, 2021).

Data objects may represent documents used in a process, both in physical and digital form (Zbigniew, 2019).

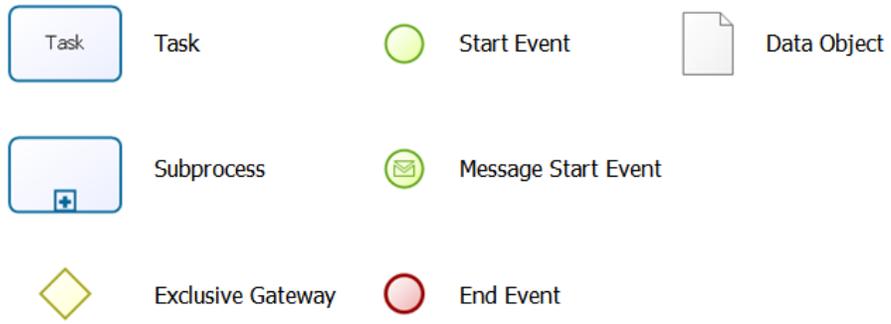


Figure 3. Elements BPMN 2.0 Notation

3. Current Processes

This chapter will take a closer look into the processes that are currently used by the different locations. Different planning processes are separately explained in paragraph 3.1. The central planning process of the different locations contains subprocesses. The subprocesses are the same for every location and are explained in 3.2. The differences between the planning processes are explained in 3.3.

3.1 Central Planning Process

3.1.1 Location A

The first central planning process that will be discussed is the planning process of Location A. The visualization of this planning process can be found in Figure 4. First, the next year will be forecasted, based on the reference date. In the contracts with the housing associations and private customers is determined in how many months maintenance will be executed. The reference date is based on the date of the last maintenance plus the number of months captured in the contract. After the determination of the year forecast, the subprocess "*Decentralized Planning Process*" takes place. This subprocess is further explained in section 3.2.2. Hereafter, the capacity requirements are determined. The non-available hours like illness, holiday and training courses are blocked in this step. When the capacity requirements are determined, the concept maintenance schedule is made. The appointment cards can send to the customer when this maintenance planning is agreed upon, otherwise the concept planning will be adjusted.

Location A uses a two-sided approach to make an appointment with the customer. For Location A this means that the planners make an appointment and send an appointment card or email to the customer. This is done in the step "*Send appointment card to the customer*" after the concept maintenance planning is agreed upon. The customer must confirm the appointment, or when the customer is not available at that moment, reschedule the appointment. If the customer does not reply to the appointment card, the front-office will call those customers up to a maximum of two times. If the customer is still not replying to the calls or the appointment card, the customer will receive a "not-reached" email or letter. If the customer does not reply to the "not-reached" email or letter as well and has the home via a housing association, Location A will inform the housing associations through reporting. The housing association can send a letter to the resident, after which the resident can contact Location A for an appointment. Location A will close the order after the housing association is informed.

If the customer confirms the appointment, the location planner will process the appointment in the weekly planning. The customer will receive a text message the day before the appointment is scheduled. The location planner will change the week planning during the week when there is too much idle time or when there is a lack of capacity. This is done in the subprocess "*Local Plan Process*", which is further explained in 3.2.3.

When the central planning process reached its end event, maintenance can take place. The process of the maintenance execution is described in 3.2.1.

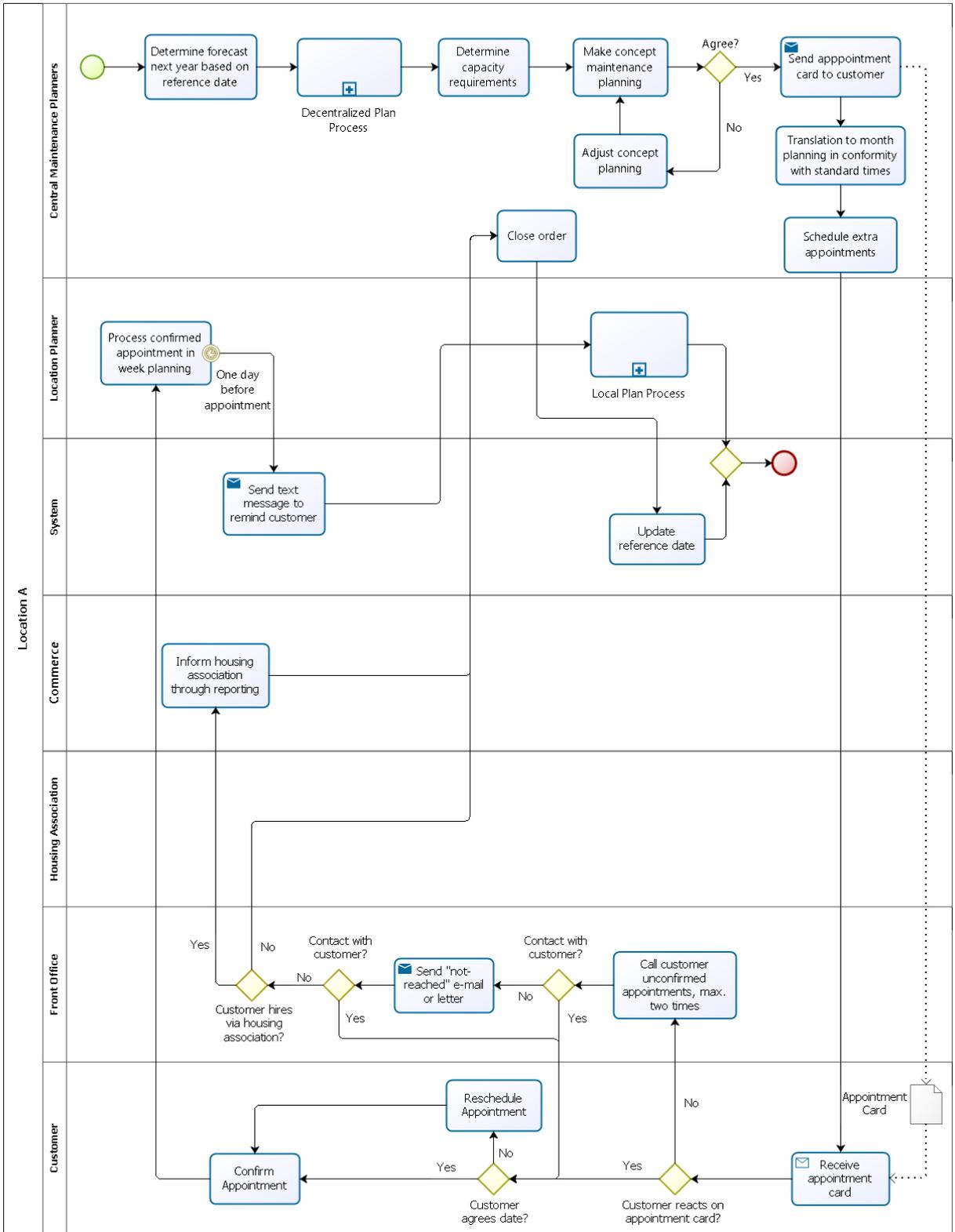


Figure 4. Central Planning Process Location A

3.1.2 Location B

The second location is Location B. A visualization of their central planning process can be found in Figure 5. The year planning of Location B is also forecasted based on the reference date. The reference date at Location B is based on the postcode area and the frequency captured in the contract. After that, the "*Decentralized Planning Process*" takes place. When the capacity requirements are determined, the concept maintenance planning is made.

The way Location B contacts the customer is a one-sided approach. The maintenance planner drafts a week-to-week planning 4 weeks in advance. An appointment card to the customers after the concept maintenance planning is made. The customer does not have to respond to the appointment card. There is always a possibility to reschedule the appointment. Because there is no confirmation necessary, Location B can easily add extra appointments to the planning. The extra appointments that are included are added at least one week in advance. The location planner processes the appointments in the weekly planning. The material needs are determined through a consultation with the location manager and the logistics department. The customer receives a reminder on the day before the appointment date is scheduled. On a certain day, the location planner can change the planning, when necessary, due to too much idle time or a lack of capacity. This is done in the subprocess "*Local Planning Process*"

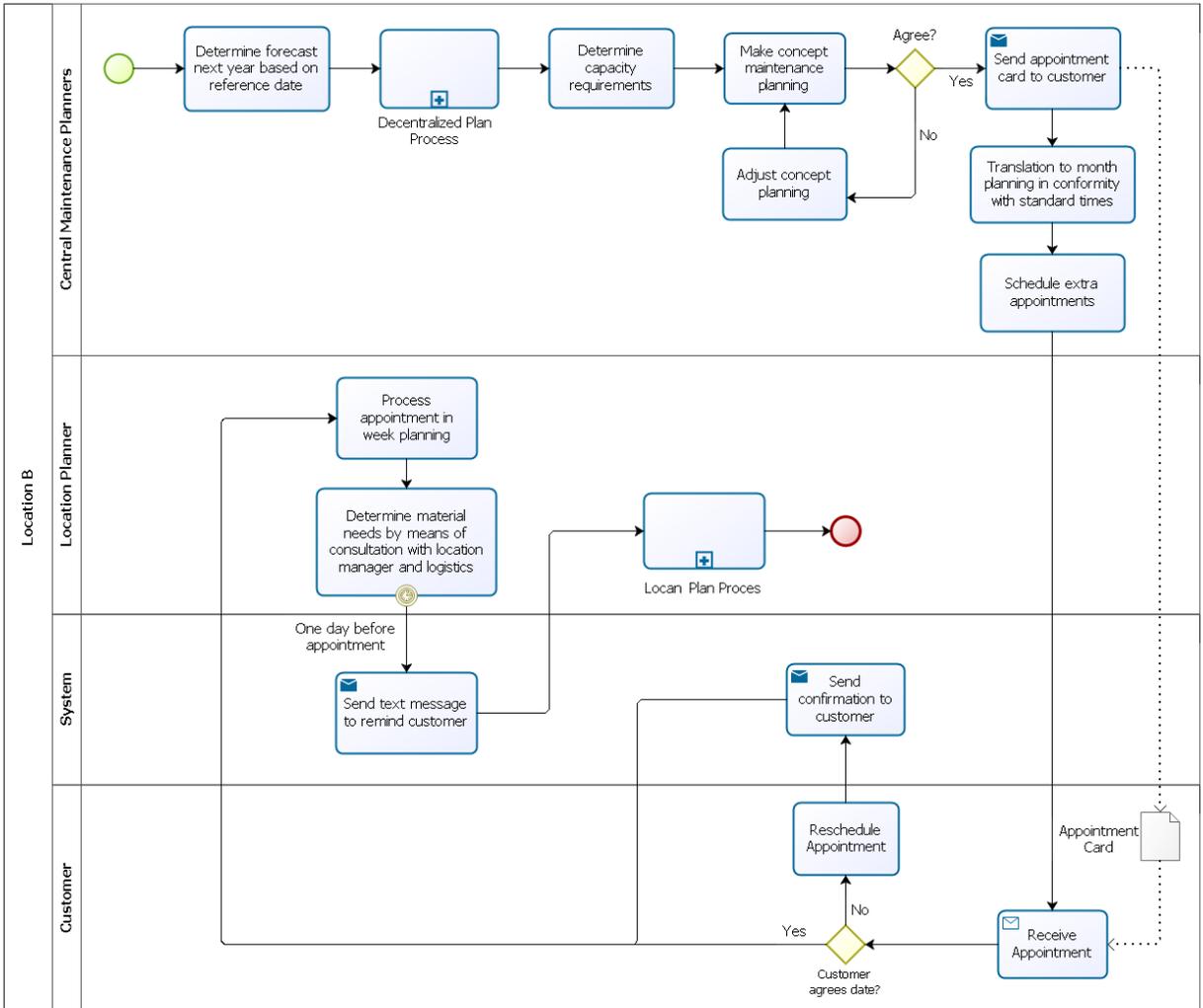


Figure 5. Central Planning Process Location B

3.1.3 Location C

The planning process of the third location, Location C, can be found in Figure 6. The forecast for the next year is based on the reference date. The reference date is based on the date the contract is started. After the decentralized plan process, the capacity requirements are determined. The hours which are not available have to be enclosed in the planning system. When the capacity requirements are determined, the customer receives a request to make an appointment, which can be done by call or via an online portal. The translation of the month planning is done by using the average maintenance orders per year, based on the capacity. If there is some margin, extra appointment cards will be sent to customers. The appointment cards are sent at last two weeks in advance.

As mentioned before, the customer gets an appointment card with an invitation to make an appointment. The letter or email contains a personal code, which can be used by the customer to log in to the online portal. The customer can choose a date and time according to his preference. The location planner will process the confirmed appointment in the weekly planning. The local planner is responsible for the planning on the day itself. It is the task of the location planner to change the original planning if that is necessary. This is executed in the Local Planning Process.

If the customer does not react to the appointment card, the Front-Office will try to call up to three times to get in contact with the customer. If there is still no contact with the customer, a "not-reached" letter will be sent. Every month, Location C informs the housing association through reporting. This contains all information on the maintenance orders that are done, and which are not. The housing association can try to get contact with the resident who not responded. The resident can call Location C to make a new appointment. Location C closes the order after the housing association is informed.

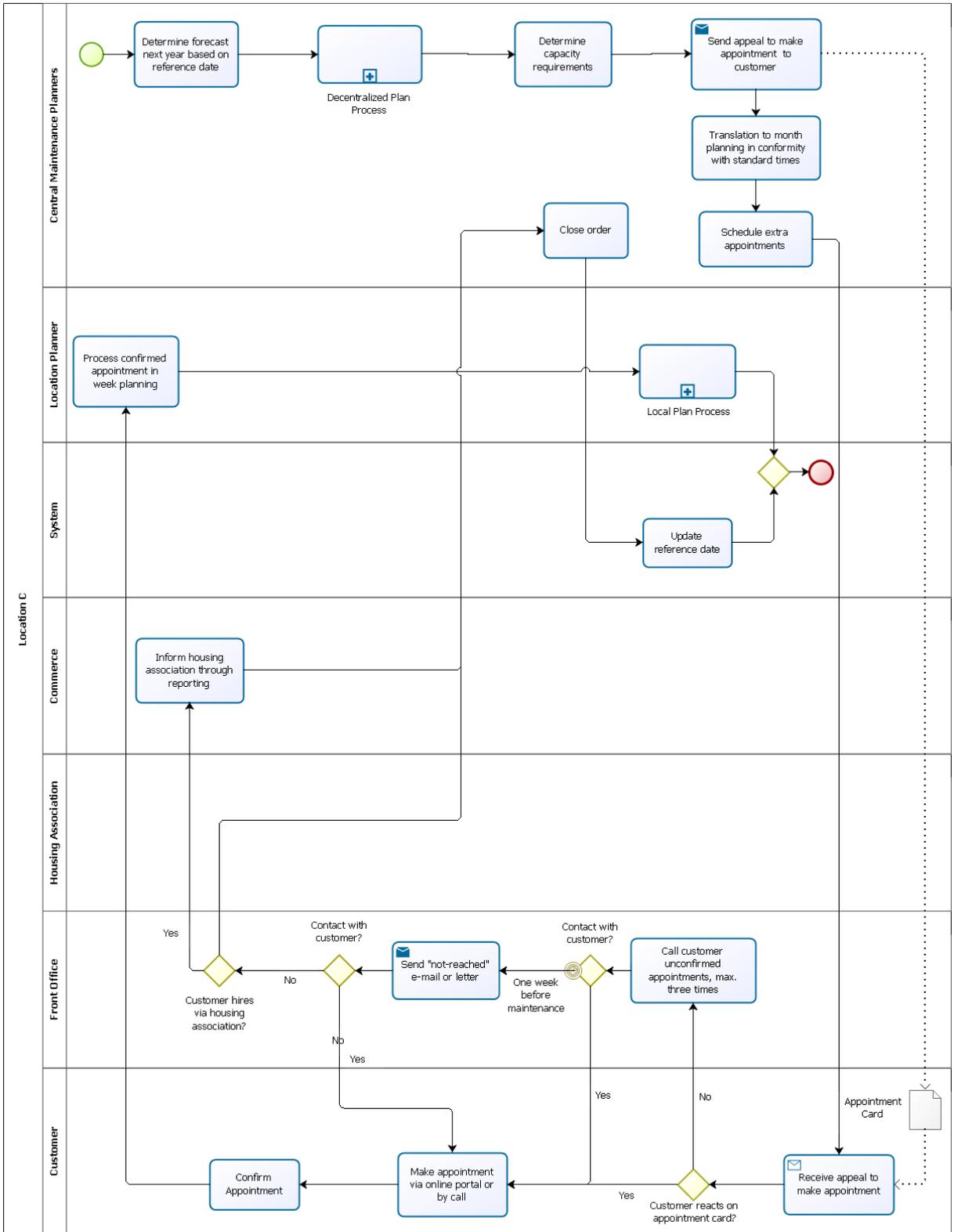


Figure 6. Central Planning Process Location C

3.2 Subprocesses

3.2.1 Maintenance Execution Process

When the appointment takes place, the maintenance execution process will be executed. The visualization of this process can be found in Figure 7. The process starts with a message event, where customers receive a reminder one day before the appointment at Location A and B. The mechanic arrives at the appointed time and will execute the maintenance.

The mechanic will close the order when the customer is at home and maintenance is completed. When the mechanic closes the order, the system will close the maintenance folder automatically and update the reference date. If maintenance cannot be completed, the Business Administration Process will be executed.

The not completed maintenance orders will be resolved in the Business Administration Process. This process will investigate why a maintenance order could not be completed. Once the reason has been found, follow up steps can be implemented. This could include the use of special components or the use of a third party. With the follow up actions in place, the Front-Office will arrange a new appointment and the mechanic will perform the corrective maintenance.

If the customer is not at home, despite the confirmation of the appointment, a card is shouted to the mailbox, whereafter the order is closed. If the maintenance is completed, the mechanic closed the order and the maintenance folder. At last, the reference date will be updated.

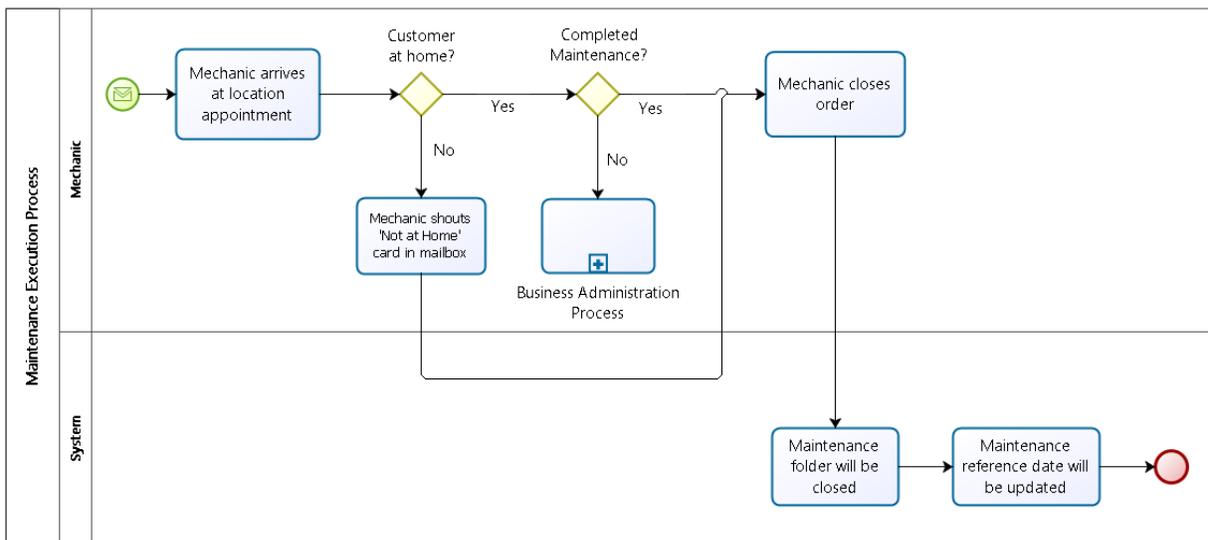


Figure 7. Maintenance Execution Process

3.2.2 Decentralized Planning Process

In the central planning process, the generating of the year planning is the only activity that is executed before the subprocess of the decentralized planning process is executed. The subprocess starts when the year planning is generated and is shown in Figure 8. First, the location manager has to determine the capacity. The non-available hours have to be blocked in the planning system. This can be for example long term illness, holidays and training courses. After, that the central planner will “*Fill free spaces with proposed maintenance date for customers*”. This planning is made four weeks before the appointment and is based on the standard times. Hereafter, a month of planning can be made. This planning will be discussed in triangular meetings with the central planner, location planner and location manager. Lastly, the location manager prepares the progress report and discusses this with the location planner. This is as well looking forward to the next week as evaluate the previous week.

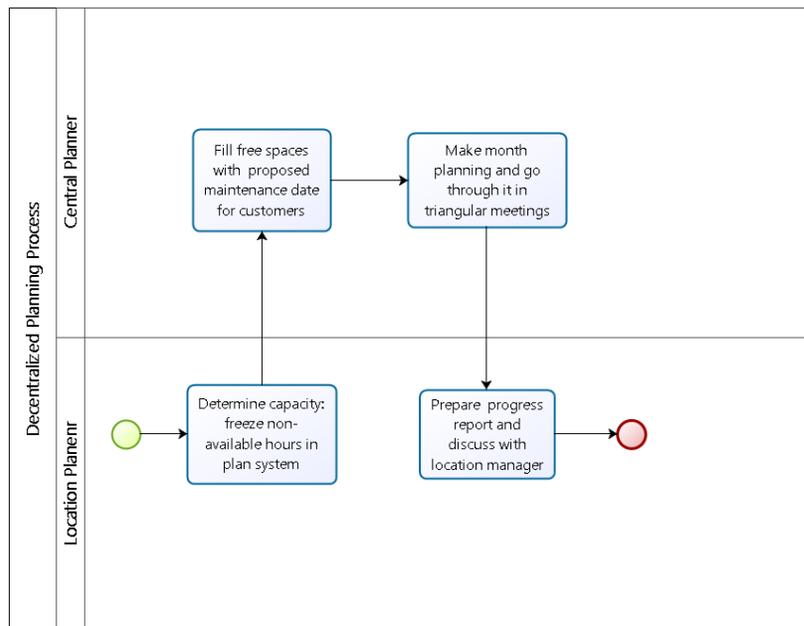


Figure 8. Decentralized Planning Process

3.2.3 Local Planning Process

The location planner is responsible for the daily planning and is in touch with the mechanics all the time. In Figure 9, the local planning process for daily planning is visualized. This process is executed every day to keep the utilization at the highest possible level. The location manager has to react to last-minute changes and is therefore responsible to keep the idle time as low as possible.

Every mechanic is having a tablet with them. First, the system sends the first appointment for the next day to the mechanic. The mechanic will go to the location of the appointment and starts the activity. If the mechanic can complete the maintenance within the standard time, no further action has to be taken and the mechanic can close the order.

It can occur that an appointment cannot be completed within the standard time. There is a possibility that maintenance is delayed through an issue with components or parts. If the appointment takes remarkably longer than the given standard time, the mechanic can call the location manager. The appointment order has to be extended or a new order has to be made when the appointment takes longer than the standard time. The location planner can call the customers of the upcoming order if necessary. If the mechanic is not able to complete the maintenance due to a shortage of materials, it is his job to communicate the material requirements to the logistics department. The last event is "*monitoring planning: cancel customer/call extra with capacity shortage*". In this step, the location planner will take care of the daily planning by rescheduling appointments when appointments are taking much longer. Another possibility is that the location manager brings appointments forward.

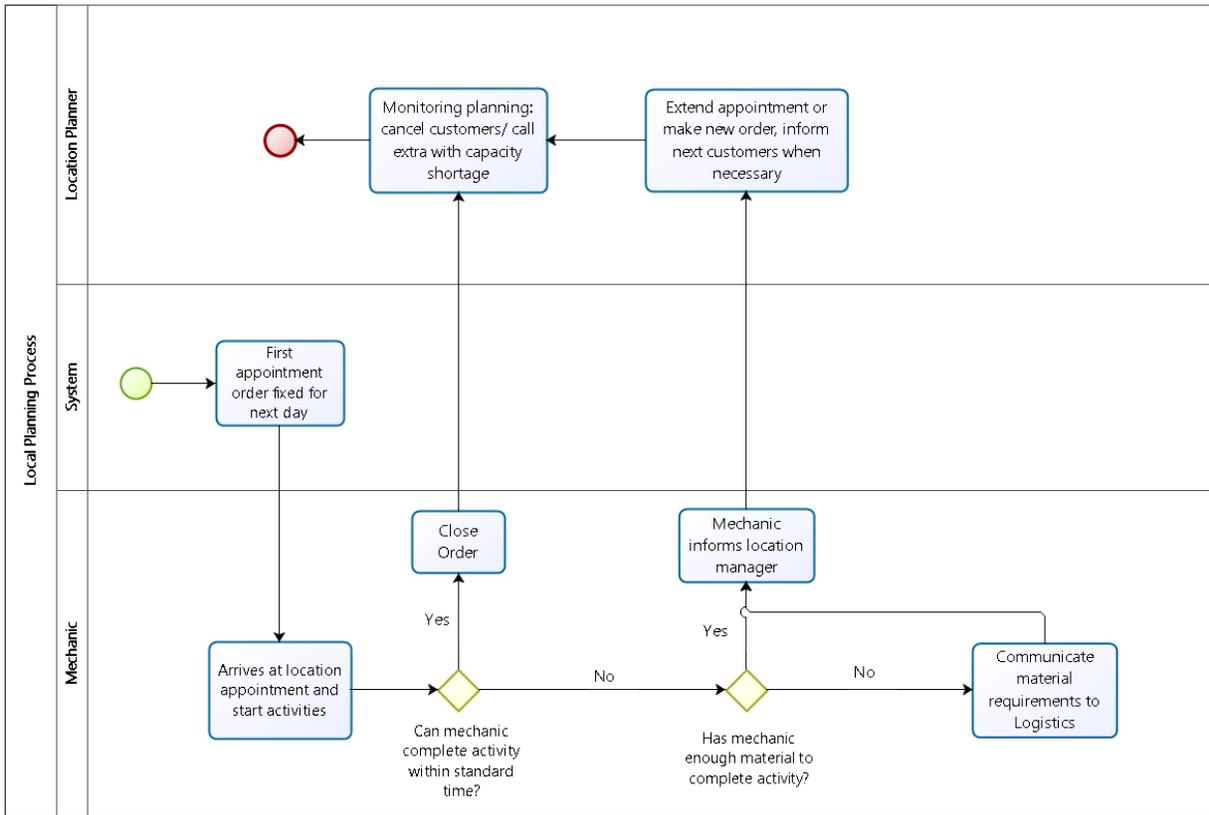


Figure 9. Local Planning Process

3.3 Differences between Processes

To design a new planning process out of three existing processes, it is important to have clear the differences between the currently used processes. An overview of the differences can be found in Table 4.

Comparing the processes described in section 3.1, the biggest difference is the way the locations have contact with the customer for a maintenance appointment. Location B has a one-sided approach, where the customer does not need to confirm the appointment. If the customer is not available and does not reschedule the appointment, the mechanic will arrive at a closed door. An advantage is that few Front-Office hours are required because it is not needed to call customers that did not respond to the appointment request. Location A and C both have a two-sided approach. This means that also action from the customer is required. Location A makes an appointment for the customer and the customer can confirm this, or when necessary, reschedule the appointment. When the customer does not confirm the appointment, the appointment will be removed and there will be no mechanic visiting that appointment. At Location C, the customer gets a letter or email with the request to make an appointment via the online portal or by calling. So, the customer can choose an appointment date at his or her preference. A disadvantage could be that there is a lot of travel time between different appointments since the customer can choose an appointment of their preference.

The three locations have also differences regarding to the extra appointments that can be scheduled. Location A does not add extra appointments when possible. The customer needs to confirm the appointment and the time is too short to do that when there is only a short time between the invitation and the appointment. At Location B, extra appointments are scheduled up to one week in advance. A confirmation of the appointment is not required and therefore it is a lot easier to send extra appointment cards to customers a short time before the appointment date. Location C adds extra appointments up to two weeks in advance. Because the customer must make an appointment via the portal or online, the maximum time that an extra appointment can be scheduled is two weeks.

Another difference in the processes is how the locations cope with unconfirmed appointments. The Front-Office is responsible for this step in the process. This is not relevant for Location B, because there is no need to confirm the appointment. When a customer is not at home, the "Not at Home" process is started. The Front-Office of Location A tries to call the customer no more than two times. When the customer does not react to the invitation, a call will be made on the 21st and 11th days before the appointment is scheduled. Location C tries to get in contact with the customer up to three times. For Location A and C, it means that more FO-hours are required.

Table 4. Differences between Service Partners

	Location A	Location B	Location C
Customer Approach	Two-Sided, date is proposed	One-Sided, date is proposed	Two-Sided, without proposed date
Reminder	Yes, text message one day before the appointment	Yes, text message one day before the appointment	No
Add extra appointments	No	Yes, up to one week in advance	Yes, up to two weeks in advance
Non-confirmed appointments	FO try to call the customer a maximum of two times (21 and 16 days before the appointment)	Confirmation is not necessary	FO tries to call the customer a maximum of three times

4. Data Analysis

4.1 Data Sources

This part is removed due to confidentiality.

4.2 Performance Analysis

4.2.1 Customer Effort Score

Customer satisfaction is measured in terms of the Customer Effort Score (CES). To measure the CES, the customer is asked one question: "How much effort did you personally have to put forth to handle your request"? In terms of Company X, it measures how much effort a customer has to put forth to get an appointment.

After an appointment is executed, the customer is asked how much effort is done to arrange the appointment. The customer can choose from seven answer choices ranging from 1 to 5, where 1 is extremely easy and 5 extremely difficult. At Company X, making an appointment is agreed easy when the customer rated a 1 or 2. The CES is calculated as follows (qualtrics, 2022):

$$\frac{\text{Total Number of "agree" responses (rating 1 or 2)}}{\text{Total number of responses}} * 100$$

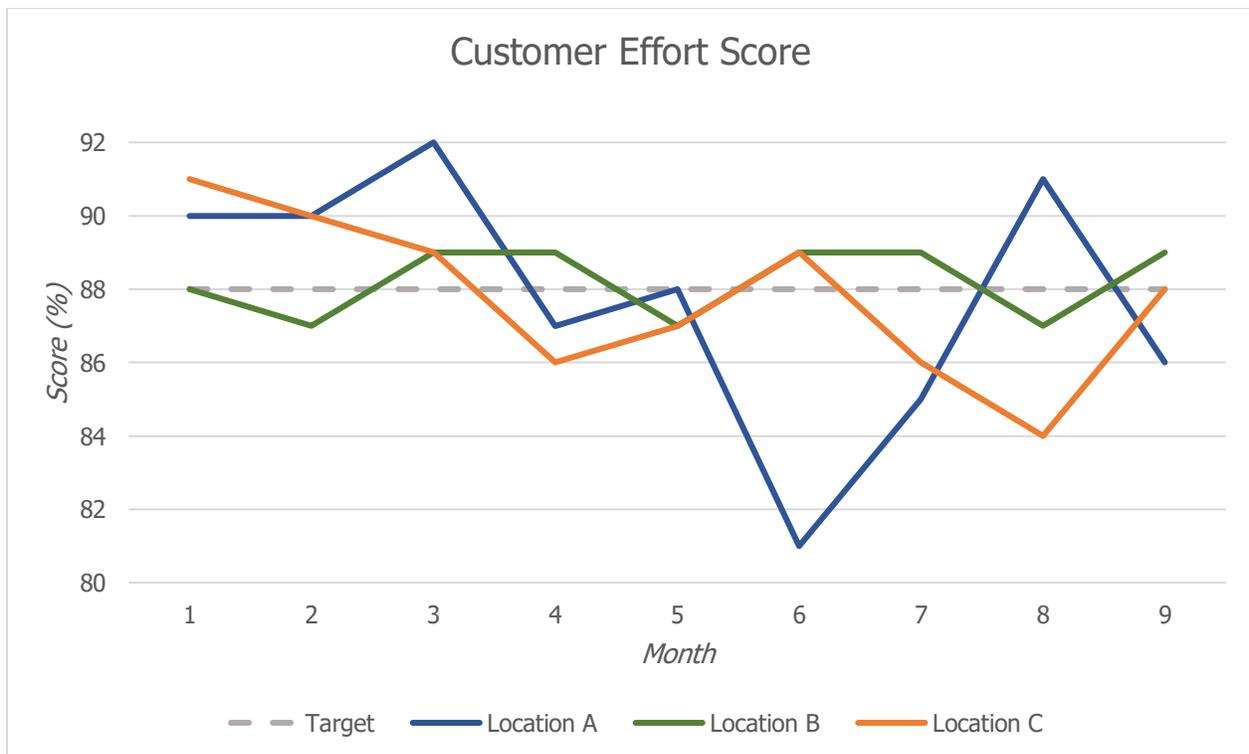


Figure 10. Customer Effort Score 2021

Figure 10 shows the CES scores of the service partners in 2021. The target for the service partners is a CES score of 88%. The CES of Location B is fluctuating close to the target. The CES of Location A and C fluctuates more with a negative outlier for Location A in June.

Location A and B purposes a date for the appointment. This is assumed to be easy since a customer has not put any effort in it. Difficulties can appear when the customer wants to reschedule the appointment. At Location A, it could also possible that confirmation of the appointment is experienced as difficult.

4.2.2 Not at Home

The KPI Not at Home is defined as the percentage of work and travel time spent on a Not at Home situation. The mechanic has to enter in their tablet when the customer of an order is Not at Home. The work and travel hours spent on this order are used to calculate the percentage Not at Home. All time spent on Not at Home situations is divided by the total hours to find the outcome of the KPI.

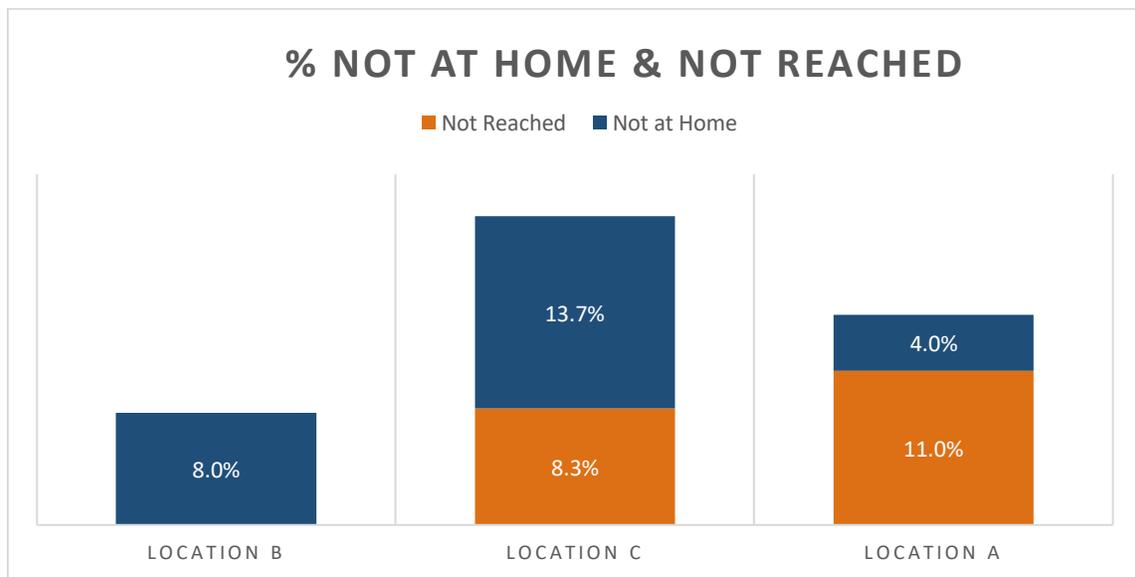


Figure 11. Unweighted Average Not at Home & Not Reached in week 20, 2020 - week 20, 2021

Company X executed intern research to the percentages of the KPI 'Not at Home' and 'Not reached'. Figure 11 gives a representation of the percentage of Not at Home and Not Reached in the period week 20, 2020 to week 21, 2021. There is a slight difference with the measurement of Not at Home in this graph compared to the other measurements of the KPI. The KPI 'Not at Home' calculates the percentage of time spent on appointments when the customer is not at home. In this graph, the Not at Home is the percentage of the appointments where customers were not at home. It seems obvious that the percentage Not at Home calculated of the number of appointments is higher than when calculated over the time since the total time

spent on a Not at Home is shorter than an appointment where maintenance occurs for example. This time is not considered when calculating the percentage of appointments.

Figure 14 shows that Location A has the lowest Not at Home with 4.0%. Followed by Location B and C. It is an unweighted average over the period of one year, so it gives a little bit a distorted view at Location C. During this year, Location C changed from a one-sided approach to a two-sided approach. Customers first received an appointment date and confirmation was not necessary. After the two-sided approach was implemented, the customer received a letter with which the customer can make online an appointment themselves.

The mother company did their own research for the merger and made a benchmark. In Figure 12, the outcomes of the KPI Not at Home of the benchmark can be found. In this graph, there can be seen that the green line of Location A is the lowest, except for the last two weeks of 2019. The purple line, Location C, is the highest except for two weeks. The table shows clearly the decrease of Location C due to the previously mentioned change from the one-sided to the two-side approach. A decrease in the percentage can be seen for Location B and C after week 20 of 2021.

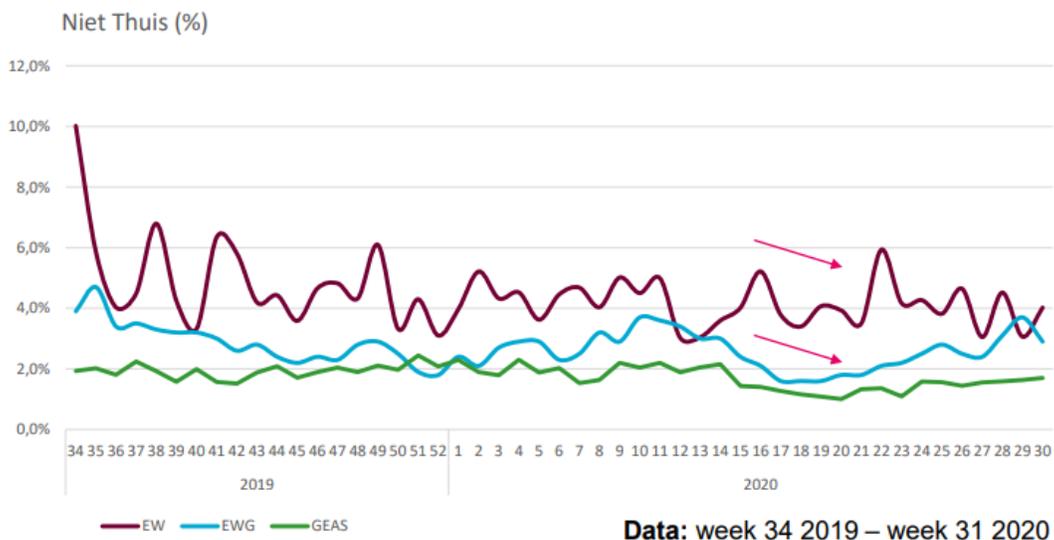


Figure 12. Outcomes Intern Research Not at Home

A closer look at the Not at Home percentages of Location C is taken in Figure 13. The graph shows really well the decrease of the percentage. The significantly decrease of the percentage is the result of the change from the one-side approach to the two-sided approach. First, Location C has a Not at Home percentage of 30%. In 2021, this is changed to a percentage between 5% and 10%.

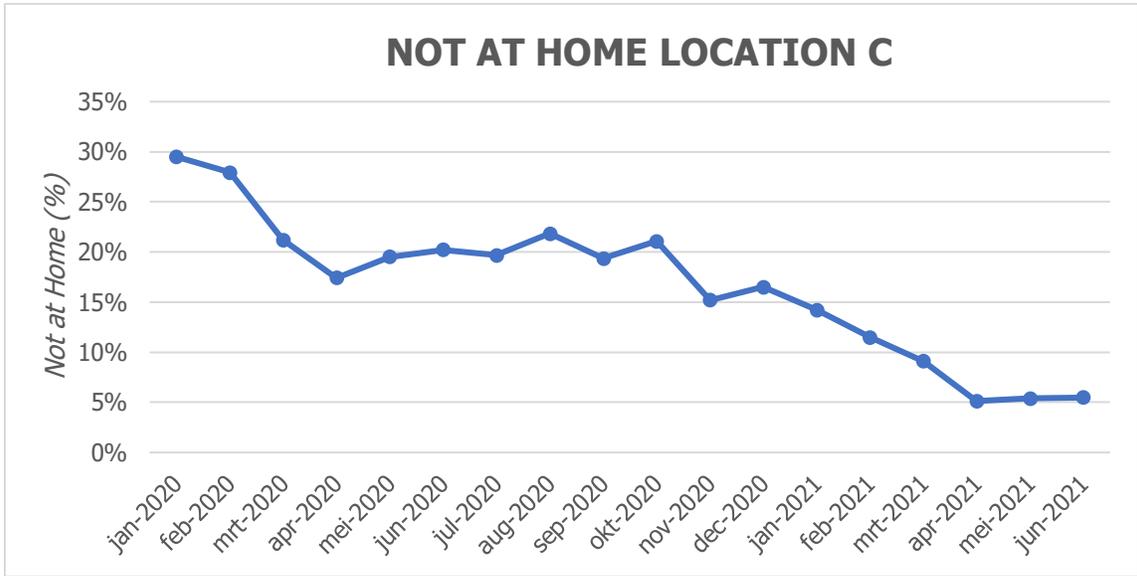


Figure 13. Not at Home Location C

More recent research is shown in Figure 14. This table shows the Not at Home percentages of the week 1 to 22 in 2021. The weekly percentages of Location C are the highest. In weeks 13 and 16 it is equal to Location A, but in all other weeks Location C has the highest percentage Not at Home. In the first 8 weeks, the Not at Home percentage of Location A and B are almost equal. After week 8, the percentage of Location A is increasing.

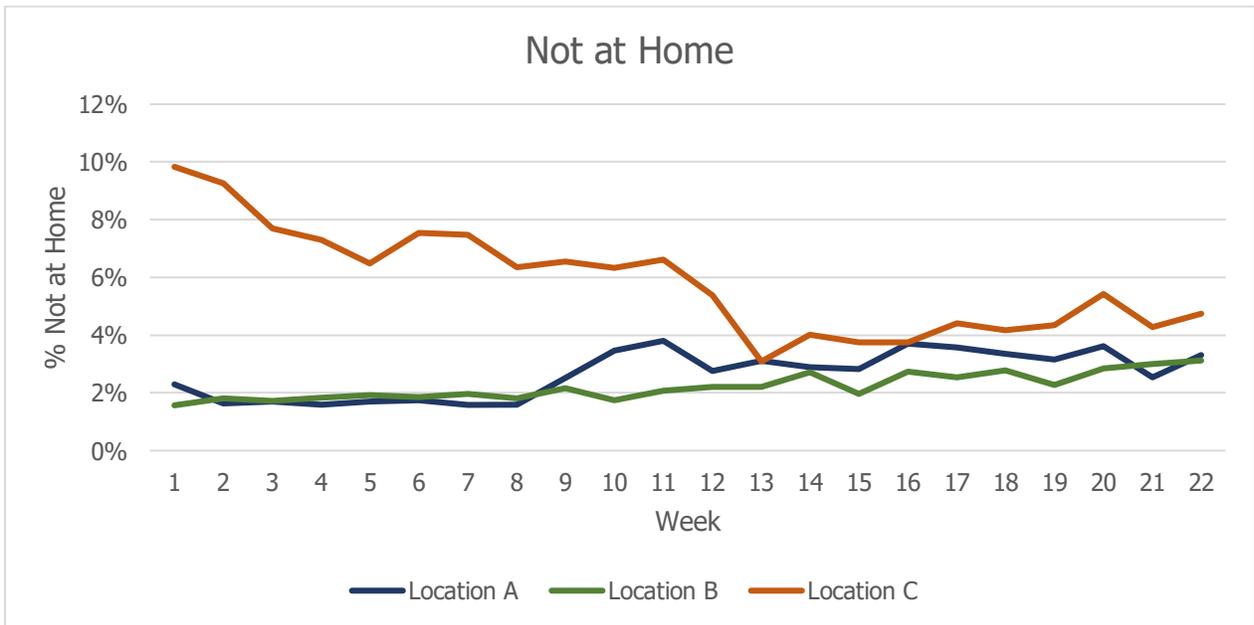


Figure 14. Weekly Percentage Not at Home 2021

There is a small difference between Location A and B. There can be seen a huge decrease in percentage at Location C. The most important reason for the decrease is that Location C changed the way of scheduling appointments from a one-sided approach to a two-sided approach. This is a confirmation that the two-sided approach is a better approach than the one-sided approach. The customers from Location C receive a message with a code. With this code, an appointment at their preferred moment can be made. This results in a lower percentage of customers that are not at home since the customer can schedule the appointment at the moment they prefer.

The data used to measure the KPI Not at Home is over the years 2020 and 2021. In this period, the world had to deal with the COVID-19 pandemic. The advice of the Dutch government was to work from home as much as possible during almost the whole period. TNO is a Dutch independent research organization (TNO, De impact van COVID-19 pandemie op werknemers, 2021). This organization researched the impact of the COVID-19 pandemic on employees (TNO, De Impact van de COVID-19 Pandemie op Werknemers, 2021). According to this research, 71% of the employees worked from home during the summer of 2020. Of these employees, 78% are working at home completely. In the autumn of 2020 and the beginning of 2021, still 65% of the employees are working from home.

4.2.3 Not Reached

The KPI Not Reached calculates the number of appointments with no response from the customers. This KPI can only be calculated from Location A and C since Location B has a one-sided approach where a response from the customer is not necessary. The KPI can be defined as the percentage of scheduled appointments that have not received any response from the customer.

Figure 20 shows the monthly percentages Not Reached in Location A. In the first three months of the year, the percentage customers that is not reached is under 2.5%. This percentage is above 10% from April onwards. A reason for this can be that during this period more maintenance orders are scheduled. Location A has a lot of customers via housing associations. These customers are more difficult to reach and, in this period, there was a slow relaxation of the COVID-19 measures. The combination of the relaxation of measurements and the holiday period could be a reason for the increase of the percentage Not Reached.



Figure 15. Percentage Not Reached 2021

Figure 11 gives a representation of the percentage of Not at Home and Not Reached in the period week 20, 2020 to week 21, 2021. In this graph, the percentage Not Reached for Location C and A is respectively, 8.3% and 11%. Location A has more contracts with housing associations and Location C has more private customers. One of the reasons for the difference between both locations can be declared that it is more beneficial for private customers that maintenance occurs. At housing associations, there are a lot more changes in terms of residents of the houses, since housing associations rent out mainly. As explained in section 2.2, it is more difficult to get in contact with residents that hired a house via the housing association than with private customers. Since the housing association is the intermediary,

The situation of Location C shown in Figure 11 is frankly what is ideal. Location C maybe has the highest percentage Not Reached and Not at Home in total but in comparison a low percentage Not at Home and higher Not Reached. It is very costly to let an expensive and valuable mechanic drive to a customer who is afterward not at home. A Front-Office employee who calls two times costs less effort and is a lot more affordable.

4.3 Best Practices

Customer Approach

Currently, Location B sends a mechanic to every appointment scheduled, since confirmation of the appointment is not necessary. Location B has annually more appointments, but this is probably more expensive than the two-sided approach of Location A and C. The most expensive part of an appointment is the mechanic. The mechanic at Location B can drive to an appointment where the customer is not at home. With the two-sided approach, the mechanic is not sent to an appointment where the customer is not reached. The drive of the mechanic is more expensive than a Front-Office employee that calls two times.

According to Figure 14, the most recent research to the Not at Home percentage, Location B has the lowest Not at Home percentage. Above 60% of the customers in Location B are private customers. As mentioned earlier, private customers are more interested in the execution of maintenance. The data from Figure 14 is from 2021, a period when was strongly advised to work from home. Therefore, the chance is higher that someone is at home when a mechanic arrives. Figure 13 shows that the change from a one-sided to a two-sided approach has a significant impact on the percentage Not at Home. The conclusion can be made that a two-sided approach has a beneficial effect on the percentage Not at Home. Therefore, a two-sided approach is seen as best practice.

Since Location C changed to the two-sided approach, the KPI Not at Home decreased to almost the same level as Location A. The difference between the approaches is that Location A proposes the appointment and at Location C, the customer can schedule an appointment themselves. The CES of Location A and C are comparable, with positive and negative outliers. At Location A, an appointment date is proposed, which is assumed to be easy since any effort is not requested from the customer. The problems regarding the CES at Location A are determined through difficulties in confirmation and rescheduling of the appointment. Let the customer make the appointment themselves, is a customer-centric process. Appointment dates are less changed when the customer made the appointment themselves, instead of the company giving a purposed appointment data. So, customers are more content with their date. Therefore, there will be fewer gaps in the planning schedule. This makes it easier for the planners to be flexible because it is easier to determine when upscaling or downscaling is necessary. So, the best practice in terms of the customer approach is the two-sided approach where the customer can make the appointment themselves.

Reminder

This part of the process is not the most difficult one, but Location A and B perceive it as a useful tool. Since it is not difficult to implement it and it is an easy way to remind the customer, the text message one day before the appointment is seen as the best practice.

Add Extra Appointments

To optimize the schedule as much as possible, there is an opportunity to add extra appointments. With these extra appointments, gaps arise due to rescheduling, or appointments that are removed since the customer did not respond, can be filled with the extra appointments. Location A is not scheduling extra appointments, Location B and C up to respectively one and two weeks in advance. Scheduling extra appointments as late as possible is the most ideal situation, but it must be feasible. Therefore, Location B has the best practice of scheduling extra appointments up to one week in advance.

Non-Confirmed Appointments

Location A has the intermediate Not at Home percentage, while most customers are from housing associations. These customers are usually less concerned about maintenance and harder to get in contact with. Figure 11 shows that the Not Reached percentage is higher than in Location C, but the Not at Home percentage is quite lower. To have fewer gaps and more clearance in the planning, the practice of Location A is seen as the best practice. Location A knows two weeks before the appointment date if the customer is reached or not. Customers are called at different days and times, to make the change bigger to get contact with them. When the customer is not reached after the two calls, the order is closed and no further effort has to be done towards that customer.

Overview

The differences between the processes are given in paragraph 3.3. Table 5 is a copy of the table with the differences between the locations. The practices chosen as best practices are highlighted in Table 5. It gives a clear overview of which practice from which location is chosen as best practice.

Table 5. Overview Differences and Best Practices

	Location A	Location B	Location C
Customer Approach	Two-Sided, date is proposed	One-Sided, date is proposed	Two-Sided, no date proposed
Reminder	Yes, text message one day before the appointment	Yes, text message one day before the appointment	No
Add extra appointments	No	Yes, up to one week in advance	Yes, up to two weeks in advance
Non-confirmed appointments	FO try to call the customer a maximum of two times (21 and 16 days before the appointment)	Confirmation is not necessary	FO tries to call the customer a maximum of three times

5. Conclusion & Recommendations

5.1 Conclusion

The main research question in this research is:

"What is the best planning process for Company X?"

The three service partners are currently using different planning processes. The biggest difference in the planning processes is the way the service partners approach the customer. At Location B, the customer receives an appointment date and confirmation is not necessary. At Location A and C, a two-sided approach is implemented. At Location A, a date is proposed and needs to be confirmed by the customer. Location C sends a letter to the customer with which the customer can make an appointment themselves.

The data analysis showed that a two-sided approach has a beneficial effect on the Not at Home percentage. Figure 13 shows that the Not at Home percentage from Location C decreases from 30% to lower than 10%. Despite there is no data available about it, the reminder a day before the appointment is perceived as a useful tool at Location A and B.

The division of the percentages 'Not at Home' and 'Not Reached' at Location C (Figure 14) is exactly what is preferred. The sum of these percentages is the customers where no maintenance is executed. Sending a mechanic to an appointment where the customer is not at home is very expensive. It is way cheaper to try to call two times and then close the order instead of sending a mechanic to that address.

To get the best balance between efficiency, costs and customer satisfaction, Company X should harmonize the planning processes by implementing the new planning process at every location. The new planning process is derived from the best practices shown in Table 6. A visualization of the new planning process is given in Figure 16.

Table 6. Overview Best Practices

Action	Best Practice
Customer Approach	Two-sided approach, no date proposed
Reminder	Send a text message one day before the appointment
Add Extra Appointments	Schedule extra appointments up to one week in advance
Non-Confirmed Appointments	FO try to call the customer a maximum of two times (21 and 16 days before the appointment date)

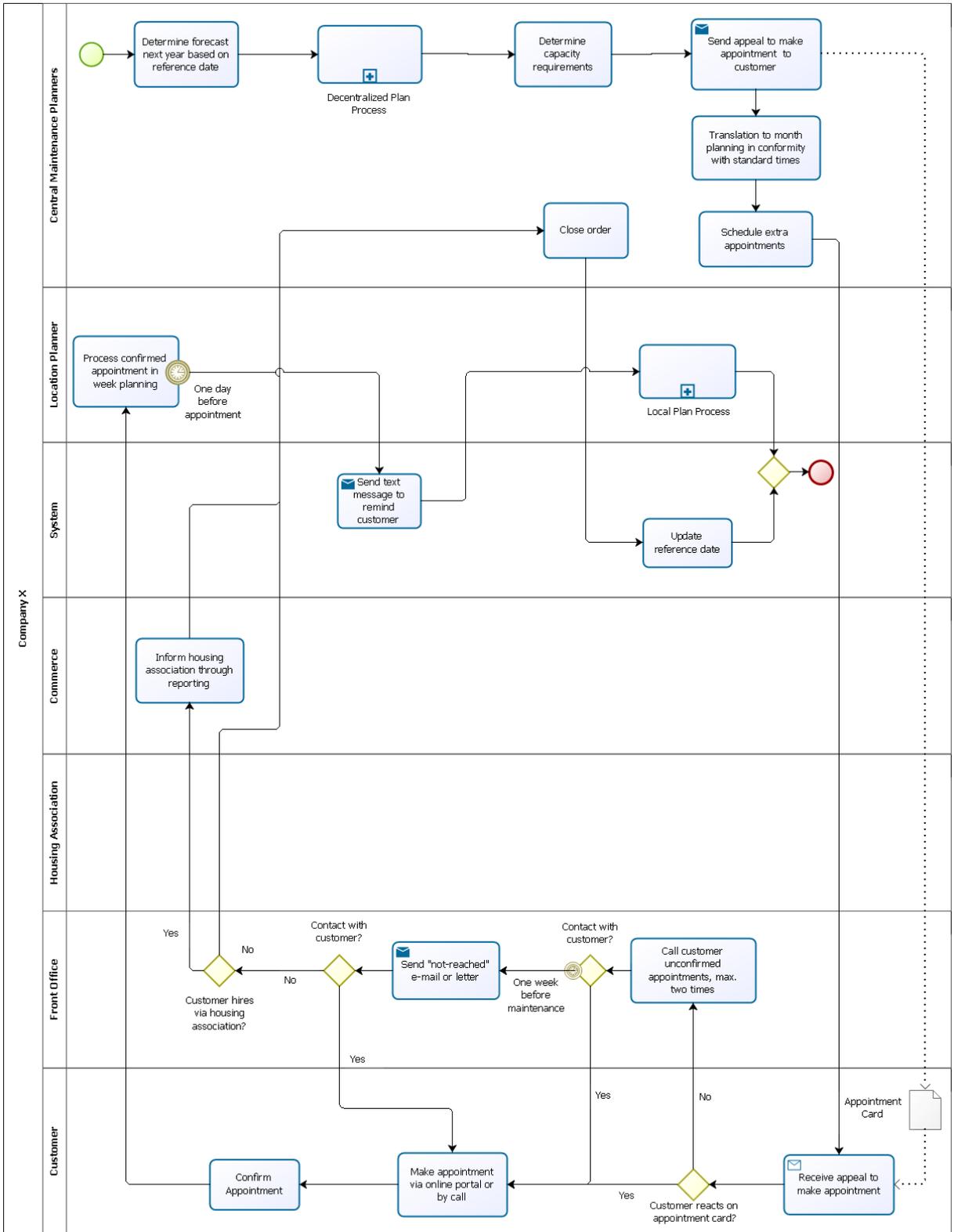


Figure 16. New Planning Process Company X

5.2 Recommendations and Discussion

First, I would recommend performing the research on the KPIs again next year. Due to the COVID-19 pandemic, most employees worked from home. Therefore, the percentage of KPIs Not at Home obviously decreased. According to the research of TNO about the impact of the COVID-19 pandemic on employees, almost one quarter (21%) wants to work completely after the pandemic. Approximately 40% of the employees state that he or she wants to work partly from home and partly on location (TNO, De Impact van de COVID-19 Pandemie op Werknemers, 2021). So, the expectation is that more people will be at home, and this could lead to a permanent change in the outcomes of the KPIs.

Secondly, my recommendation is to implement one ERP system as soon as possible. Due to the different ERP systems currently used, there is a difference in the registration of data. This can influence the outcomes of the data. The definition of some KPIs is also different at the locations. Unless Company X tried to make them as equal as possible, there might be some differences in the outcome of the data. With one ERP system, data can be registered in the same way. Therefore, the definition and calculation of KPIs can also be the same at every location.

The data per KPI is from the same period. Some KPIs consist of data from the first 25 weeks of 2021. There is a difference in the maintenance/failure ratio throughout the year. This makes sense since more people use their central heating in the winter for example. The different locations can have different strategies in terms of doing maintenance orders. To have a more appropriate view, it could be better to use the data for a whole year. This makes it easier to see if the locations met their annual goals and remove the change of optional changes in outcomes due to different strategies in terms of the weather.

The working hours plus traveling hours are currently used for some KPIs. For further research, it would be an idea to investigate what time of the total appointment time are traveling hours. Implicit, the company is not earning money during that time, and it is now seen as used time. There is a good possibility that outcomes are misleading because the work hours plus traveling hours are high. But what if that is high through the travel time? Then it would still be not very efficient. So, for further research, I would do more calculations on the travel time.

Lastly, I would recommend researching the capabilities of the mechanics. There is a shortage in terms of mechanics already and more broadly skilled mechanics will help increase the efficiency and effectiveness of the planning. The HVAC consists of multiple devices of multiple brands. Some mechanics are specialized in a certain brand or type. This makes it more difficult to schedule them. There are so many different devices that are acceptable that a mechanic executes maintenance or reparation to every device, but the more mechanics are skilled for different devices, the easier it is to make a schedule. More all-around skilled makes it also easier to possible reschedule appointments. This will lead to an increase in the efficiency and effectiveness of the planning.

Bibliography

- Calzon, B. (2021, March 25). *Your Modern Business Guide to Data Analysis Methods and Techniques*. Retrieved from <https://www.datapine.com/blog/data-analysis-methods-and-techniques/>
- Camunda Docs. (2021). *Message Events*. Retrieved from <https://docs.camunda.org/manual/7.15/reference/bpmn20/events/message-events/#message-start-event>
- Caparlar, C. Ö., & Dönmez, A. (2016). *What is Scientific Research and How Can it be Done?* Ankara.
- DiscoverPhDs. (2020, October 2). *Types of Research*. Retrieved from <https://www.discoverphds.com/blog/types-of-research>
- Easy Excel. (n.d.). *Pivot Tables*. Retrieved from <https://www.excel-easy.com/data-analysis/pivot-tables.html>
- Erasmus, J., Vanderfeesten, I., Traganos, K., & Grefen, P. (2020). Using business process models for the specification of manufacturing operations. *Computers in Industry*.
- Flavio, Corradini, Morichetta, A., Polini, A., Re, B., Rossi, L., & Tiezzi, F. (2020). Correctness checking for BPMN collaborations with sub-processes. *Journal of Systems and Software*.
- Franca, J. B., Netto, J. M., Barradas, R. G., Santoro, F., & Baiao, F. A. (2013). Towards Knowledge-Intensive Processes Representation. *Lecture Notes in Business Information Processing, volume 132*, 126-136.
- Guizani, K., & Ghannouchi, S. A. (2021). An approach for selecting a business process modeling language that best meets the requirements of a modeler. *Procedia Computer Sciences*, 843-851.
- Heerkens, H. (2017). *Solving Managerial Problems Systematically*. Groningen: Noordhoff Uitgevers.
- Kossak, F., Illibauer, C., Geist, V., Kubovy, J., Natschläger, C., Ziebermayr, T., . . . Schewe, K.-D. (2014). *A Rigorous Semantics for BPMN 2.0 Diagrams*. Springer International Publishing Switzerland.
- Lübke, D., Ahrens, M., & Schneider, K. (2021). Influence of diagram layout and scrolling on understandability of BPMN processes: an eye tracking experiment with BPMN diagrams. *Information Technology and Management*, 99-131.
- Ludvik Eger, M. M. (2017). Customer-oriented communication in retail and Net Promoter Score. *Journal of Retailing and Customer Services*, 142-149.
- Mac Dewitt Wallace Library. (2021, March 9). *Research Guides*. Retrieved from Data Model #1: What is research data?: <https://libguides.macalester.edu/data1>

- Merriem-Webster. (2011, May). *Best Practice*. Retrieved from <https://www.merriam-webster.com/dictionary/best%20practice>
- Microsoft. (2021). *Create a PivotTable to Analyze worksheet data*. Retrieved from <https://support.microsoft.com/en-us/office/create-a-pivottable-to-analyze-worksheet-data-a9a84538-bfe9-40a9-a8e9-f99134456576>
- Mircosoft. (2022). *Create a PivotTable to analyze worksheet data*. Retrieved from <https://support.microsoft.com/en-us/office/create-a-pivottable-to-analyze-worksheet-data-a9a84538-bfe9-40a9-a8e9-f99134456576>
- Pro, Q. (2021). *Descriptive Research: Definition, Characteristics, Methods, Examples and Advantages*. Retrieved from <https://www.questionpro.com/blog/descriptive-research/>
- qualtrics. (2022). *What is customer effort score (CES) & how do I measure it?* Retrieved from <https://www.qualtrics.com/experience-management/customer/customer-effort-score/>
- qualtrics. (2022). *What is Customer Effort Score(CES)?* Retrieved from <https://delighted.com/what-is-customer-effort-score>
- Question Pro. (2021). *Quantitative Data: Definition, Types, Analysis and Examples*. Retrieved from https://www.questionpro.com/blog/quantitative-data/#Quantitative_Data_Definition
- QuestionPro. (n.d.). *Explanatory research: Definition and characteristics*. Retrieved from <https://www.questionpro.com/blog/explanatory-research/>
- Rijksoverheid. (2022, June 8). *Woningwet: regels voor woningcorporaties*. Retrieved from <https://www.rijksoverheid.nl/onderwerpen/woning-verhuren/woningwet-regels-voor-woningcorporaties>
- TNO. (2021). *De impact van COVID-19 pandemie op werknemers*. Retrieved from <https://www.monitorarbeid.tno.nl/nl-nl/publicaties/de-impact-van-de-covid-19-pandemie-op-werknemers-een-jaar-in-de-crisis/>
- TNO. (2021). *De Impact van de COVID-19 Pandemie op Werknemers*. Leiden.
- Weatherwax, J. (2022, June 9). *B2B vs. B2C: Definition and Examples*. Retrieved from <https://www.bluecart.com/blog/b2b-vs-b2c>
- Weske, M. (2019). *Business Process Management*. Berlin: Springer-Verlag GmbH Germany.
- Zbigniew. (2019, March 21). *BPMN MIWG demonstration 2018 – (nearly) everything you always wanted to know about Data Objects, but were afraid to ask*. Retrieved from <https://bpmtips.com/bpmn-miwg->

demonstration-2018-nearly-everything-you-always-wanted-to-know-about-data-objects-but-were-afraid-to-ask/

Appendices

Appendix A: Systematic Literature Review

Knowledge Problem and Research Question

In this Appendix there will be searched for literature on a scientific way for the knowledge question

"What methodologies for the improving of a (planning)process already exists?"

This knowledge might be very broad. In every sector, there are a lot of processes that can be improved. Because I am afraid there is not specific information for the improvement of a planning process, I formulated this question not too specific. And if there is not much information about planning process, maybe another methodology will help in this research.

First, there the key concepts will be determined. We can see that "(planning) process" is present in every key concept. Removing this word, the essence of the question deviates too much. So, the following search terms are derived from these constructs:

Constructs	Related Terms	Broader Terms	Narrower Terms
Planning Process	Planning Methods	Planning, Process	Planning Process Methods
Business Process Management	BPM, Business Process Improvement	Business Process	BPM Improvement
Process Improvement	Redesign Processes, Changing Processes	Improvement Methods	Planning Process Improvement

Table 7. Search Terms SLR

Inclusion and Exclusion Criteria

In this section, the inclusion and exclusion criteria will be numerated. The goal with these criteria is that the search is more efficient and effective.

Inclusion Criteria	Exclusion Criteria
The literature must be accessible	The article is not published in either English or Dutch
The article should be about business processes	Articles about the improvement of an operational process
Article shows how a business process is improved	Article is about a too specific process, which very much deviates from the essence

Table 8. Including and Exclusion Criteria SLR

The University of Twente offers an enormous database, with access to a massive number of articles. An inclusion criteria is that is accessible for everyone of with the license of the UT. The second inclusion criteria is that the article have information about business processes. As mentioned earlier, there are a lot of processes that can be improved, but most of them are not appropriate for this research. For example, this research has nothing to do with the improvement of process of producing a car. When it is about business processes, there might be a methodology that I can use for my planning process. Therefore, the last inclusion criteria is that the article shows an example. This might give more information about the way a method is applied to a process.

An exclusion criteria is that the article is not published in English or Dutch. I do not understand other languages sufficient and translating articles could give the wrong translating, which means that the information used is not right. As mentioned in the inclusion criteria, it is important that it is about business processes. So, the second exclusion criteria are articles about the improvement of operational processes. These have nothing to do with this research and there is applied another method that is not appropriate for this research. The last exclusion criteria are about a too specific process. The process in my research is not very specific and quite similar in other sectors. But when there are too much specific things that have to keep in mind, it is too much deviating from the essence.

Databases

The databases that will be used are:

- Scopus
- Business Source Elite
- Web of Science

These databases are chosen because they are large databases for searching articles and citations. The chosen databases contain information about all disciplines.

Conduct Research

From the key concepts, the following synonyms are created:

Concept	Synonyms
Process	Procedure, system, method, activity
Improvement	Development, upgrade, advancement, revision
Planning	Schedule, roster, appointments

Table 9. Synonyms SLR

The first database that will be used is Scopus. It has an enormous number of articles. In the tables below, the scope and entries will also be shown.

Search String	Database	Scope	Entries
"Planning Process"	Scopus	Article Title, Abstract, Keyword	8946
"Planning Process" AND "Improve"	Scopus	Article Title, Abstract, Keyword	911
"Planning Process" AND "Improve" AND "business"	Scopus	Article Title, Abstract, Keyword	196
"Planning Process" AND "Improve" AND "business" AND "methodology"	Scopus	Article Title, Abstract, Keyword	96

Table 10. Search Terms and Results SLR (1)

Looking to all these numbers, it is clear that you have to be very specific to find results I am looking for. With three constraints, there are still 96 entries. The most of these entries are about operational processes and that is not what I am looking for. Therefore, some changes are made in the strings used. I also applied this string in the database Web of Science.

Search String	Database	Scope	Entries
"Planning Process Improvement"	Scopus	Article Title, Abstract, Keyword	4
"Business Process Improvement"	Scopus	Article Title, Abstract, Keyword	697
"Business Process Improvement" AND "management" AND "Planning Process"	Scopus	Article Title, Abstract, Keyword	13
"Process Management" AND "Redesign" and "development"	Scopus	Article Title, Abstract, Keyword	560
"Process Management" AND "Redesign" and "development" AND "planning process"	Scopus	Article Title, Abstract, Keyword	7
"Business Process Management"	Web of Science	Article, Abstract, Keyword	3359
"Business Process Management" AND "improvement"	Web of Science	Article, Abstract, Keyword	398
"Business Process Management" AND "improvement" AND "planning process"	Web of Science	Article, Abstract, Keyword	1
"Appointment schedule"	Web of Science	Article, Abstract, Keyword	58
"Appointment schedule" AND "process"	Web of Science	Article, Abstract, Keyword	11

"Appointment Schedule" AND "improvement"	Web of Science	Article, Abstract, Keyword	6
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Table 11. Search Terms and Results SLR (2)

There can be seen in the tables that adding keywords as "improvement" and "business process" do not lead to a significantly decrease of the number of articles. Using synonyms give way less articles. Some of them are useful for my research.

With the results of the previous strings, there will be searched in the last database, namely: Business Source Elite.

Search String	Database	Scope	Entries
"Business Management" AND "Improvement" AND "Planning Process"	Business Source Elite	Article Title, Abstract, Keyword	19
"Business Process Management" AND "Improvement" AND "Planning Process"	Business Source Elite	Article Title, Abstract, Keyword	10
"Planning Process" AND "Development" AND "Effective"	Business Source Elite	Article Title, Abstract, Keyword	185
"Method" AND "Improvement Strategy" AND "planning"	Business Source Elite	Article Title, Abstract, Keyword	10
"Business Process Improvement" AND "Planning Process"	Business Source Elite	Article Title, Abstract, Keyword	291
"Process Planning Improvement" AND "Business Process" AND "Decision Making"	Business Source Elite	Article Title, Abstract, Keyword	94

Table 12. Search Terms and Results SLR (3)

Because the question is quite broad, there still will be a lot of articles available. When there are less than 20 entries, I will look to the title of the article if it is useful for me.

Final Articles

Looking to the titles gives me to following useful articles:

1. Innovation and technology in process industry: a process management perspective on technology strategy planning
 - Author: Andreas Larsson
 - Year: 2018
 - Keywords: strategic planning, process management
 - Main Finding: technology related matters have nothing to do with the business strategy content

2. Process design principles in service firms: universal or context dependent/ A literature review and new research directions
 - Author: F. Ponsignon, P.A. Smart and R.S. Maull
 - Year: 2012
 - Keywords: Best practices, service operations management, business process management
 - Main Finding: There is not one process design that works for all kinds of services. It depends on the conditions

3. Business Process Reengineering: An approach for process mapping
 - Author: T.A. Aldowaisan, L.K. Gaafar
 - Year: 1999
 - Keywords: Business Process Reengineering, BPM
 - Main Finding: With structured phased and some LP calculations it is possible to redesign a business process

4. Implementation of a strategic planning process oriented towards promoting business process management (BPM) at a clinical research center (CRC)
 - Author: Victor Cattani Rents and Silvia Ines Dallavalle de Padua, Eduardo Barbosa Coelho, Monica Akissue de Camargo Teixeira Cintra and Gabriela Gimenez Faustino Ilana
 - Year: 2018
 - Keywords: Strategic Planning Process, Business Process Management,
 - Main Finding: the as-is/to-be step is really helping in the research cycle

5. Understanding the nature of processes: an information-processing perspective
 - Author: Sarah Zelt, Theresa Schmiedel, Jan vom Brocke

- Year: 2017
- Keywords: Process Management, BPM, Process Engineering
- Main Findings: It is important understand applied theories when understanding the differences between processes.

Conclusion

There is a lot of information available about Business Process Management, the nature of it and the improvement of processes. But there are not particular methodologies that can be followed to fin

Appendix B: Screenshots Data

This part is removed due to confidentiality.