The implementation of a cost price model in an ERP system

Industrial Engineering and Management | University of Twente

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Preface and reading guide

All of the data provided in this document is fictional and does therefore not reflect reality.

This thesis is written in order to complete the bachelor Industrial Engineering and Management at the University of Twente. The assignment is performed over the course of ten weeks from the 16th of April to the 29th of June 2018.

There are a number of people that we would like to thank for their contribution to this research. First of all, we would like to thank Company X. We have been welcomed with arms wide open, which made us feel at ease from the very start. Furthermore, they provided a strong foundation for us to work on. Whenever we were in need of help, we could always swing by and our questions would be appropriately answered. In particular, we would like to thank the first supervisor. We had daily conversations with him on the progress and he managed to guide us in a great manor. Next to the first supervisor, the BI-specialist has played a big part in this research. He was the first person we would go to if we had any questions and he always did his best to provide the answers that we were looking for. Furthermore, our thanks go to the controller, who had the function of second supervisor. We had meetings with the first supervisor, the BI-specialist and the controller on the progress every two weeks. These meetings were very useful as they provided us with more information on the subject each time. Furthermore, we would like to thank the supervisor from the University of Twente Reinoud Joosten for his efforts. Next to that, we thank Berend Roorda for his role as second reader.

This reading guide is provided for the reader in order to give an overview of what he can expect to encounter during our research. The executive summary provides an overview of the main findings of our research. This is translated into Dutch in the 'management samenvatting' to make sure that Dutch non-English speakers can understand the most important takeaways as well. Section 1 deals with the research design, which is a summary of the extensive project plan. Section 2 discusses the definitions of the costs that come into play when designing the cost price model. More specifically, the income statement is extensively assessed on whether it is sound from both a theoretical and a practical perspective. Section 3 focusses on the premium service models. Among others, the premium services that should individually be modelled are identified, indicators are determined and the construction of the model itself is discussed as well. Section 4 assesses whether the current method is the most suitable one for Company X by consulting the literature and having a critical look at the company itself. The implementation of the cost price model in ERP system XY is provided in Section 5. In Section 6, all of the deliverables as mentioned in the research design are provided. This includes financial models, such as the income statement and the production cost price model. The advisory report is discussed in Section 7. This section deals with our recommendations concerning future research by Company X. Section 8 provides the conclusions and a discussion on the executed research.

Research information

General information

Research title:	The implementation of a cost price model in an ERP system.
Description:	The old system is not able to cope with significant growth of the company during recent years. A new ERP system has been implemented to solve this issue, but some financial control models can only be implemented in a limited way at this moment. Our research focusses on the cost price model because this is prioritized by the company.

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Executive summary

We conducted our research at a company called Company X. Company X used to implement a stand-alone system focussed on production called ERP system X and an accounting package to cope with the constantly changing market and the unique customer needs. There is a problem however. ERP system X has been used since the 00's and has become too static to cope with the current market, which constantly changes. This has led to the purchase of a multi-location package in 2009. However, Company X was the only major company to which the package was sold. Therefore, the company lost interest in developing this particular package.

Company X started to implement ERP system Y during the last five years. Once the ERP system was finally implemented, ERP system Y was not fully ready to be implemented yet because several functions of ERP system X were not altered significantly enough to be implemented effectively. A part of the unfinished functions consists of the financial control models. Some of these models can only be implemented in a limited way as they are not altered enough to ERP system XY. This especially holds true for the cost price model. Our research therefore focusses on shaping the new cost price model in order to effectively be integrated into ERP system XY. The cost price model has not been updated pro-actively for five years. One could argue that it is quite unusual not to update the cost price model for that amount of time. However, the company was constantly focussing on the implementation of ERP system Y. At first, the deadline of implementation was set at nine months after purchase. The company failed to meet this deadline by a long stretch however. New deadlines were constantly set from then on. Company X was not able to meet any of these deadlines. It was not until five years from purchase that the implementation finally occurred. Therefore, the cost price model was not prioritised and neglected. We define our problem as follows:

The current cost price model does not satisfy Company X's needs

We intended to solve this problem by doing research on the following topics:

- The definition of the cost price.
- The method of the cost price.
- The insight in the premium services.
- The integration between the cost price model and the other financial control models.
- The implementation of the cost price model in ERP system XY.

These topics resulted in the following deliverables:

The income statement

Company X wanted to have a document in which all of the aspects of the cost price are defined in terms of cost objects. The old model did not use the theory as described in some books. In contrast, the model was made without theory whatsoever. Our analysis showed that the model already contained elements as described in the theory like the operating expenses and non-operating income, but they were not mentioned explicitly in the model. Our research resulted in a model, which is in line with the theory.

The results per department

The results per department are crucial in the calculation of the cost price model. We critically assessed this model and made the following changes:

- **Departments**: the update on the departments greatly contributed to the quality of the results per department. The company has changed so much that the departments did not represent the company anymore. We added new distribution departments, production departments and supporting departments to the model.
- **Sales departments**: in the previous results per department, the revenue was used to determine the results per department. This has changed because of ERP system XY. Currently, all of the revenue of a location is transferred to an individual sales department. Instead of the revenue, a coverage is used to calculate the results per department. The company does not want to have internal profits or losses within the company. Therefore, the coverage is used to deal with the costs associated with the department as well. Ideally, subtracting the costs from the coverage amounts to zero. In this case, the coverage equals the costs and no internal profit nor loss is made.
- **Allocation bases**: the direct costs are very easy to attribute to the cost centres. This is however not the case for the indirect costs and therefore, allocation bases have to be used. Allocation bases are usually based on the cost driver of the specific cost centre. We managed to find an allocation base for every cost centre.

The results per location

The step towards the results per location is rather small because the current results per department make use of sales departments. By subtracting the internal gross profit and the cost price of goods sold from the revenue per sales department, we obtained the result per sales department. This was not the final value however. We still needed to deal with the other departments. The results per department were added to the corresponding sales department (for example Cooler Location A is linked to Sales Location A). When all of the results were added, we obtained the results per location.

The functional/technical design of a new production cost price model/distribution cost price model

The company wanted us to look critically at the method that was used for the old cost price model and whether a different method should be used when creating the new cost price model. This resulted in a choice of method and an explanation on why this method was chosen. After an extensive literature research, we concluded that Company X should use the absorption method when constructing the new cost price model. This method offers an average level of accuracy, but this can be altered by applying more specific cost centres. Furthermore, the method is easy to put into practice and is suitable for this type of company.

The functional/technical design of the premium service models

The lack of insight into how the premium services that Company X provides translate into costs and benefits was seen as a problem by the company. The common factor of these services is that they provide a varying level of detail, while they do not incur additional costs for the customer. The improved insight and the application of additional costs for premium services were obtained by modelling the premium services of the company. The services that are modelled are the distribution, quality, project management, administration, and ICT services. These costs have to be removed from the cost centres they are currently assigned to. Next, the costs should be added to the service department.

This means that we first had to identify which costs are associated with the different services. This was done by going through all of the cost objects and then assigning it to one of the services if possible. For example, the cost object logistics/transportation of goods was assigned to the service distribution. Once this was established, these cost objects were further analysed to see which costs it consisted of. The main purpose of this analysis, was to identify which costs had to be removed from which cost centres. Next to that, if we were able to notice a cost driver that was significantly higher than all of the other costs, we had an indication of a possible indicator that we could use for the premium service model. The last step was to subtract the costs from the associated cost centres and add these to the services.

The advisory report

We were able to construct the model, but we are not present once the model is implemented. We recommend the following actions to be performed in the future:

- Remove the premium service from the cost price model.
- Construct more premium service models.
- Obtain the missing data needed to calculate the models.
- Update the data with which the indirect variable costs are calculated.
- Ask for an extra fee for the premium services by applying vendor lock-in/dependency.
- Analyse the results as described in our research.
- Design a new method to calculate the distribution cost price model.

Management samenvatting

Het onderzoek werd gedaan bij een bedrijf genaamd Company X. Company X implementeerde een systeem gefocust op productie genaamd ERP system X en een boekhoud pakket om met de constant veranderende markt en de unieke eisen van de klant om te kunnen gaan. Er is echter een probleem. ERP system X is gebruikt sinds de jaren 00 en is te statisch geworden. Dit heeft geleid tot het kopen van een pakket voor verschillende locaties in 2009. Company X was echter het enige grote bedrijf naar wie het pakket verkocht werd. Daarom verloor het bedrijf interesse in het ontwikkelen van dit specifieke pakket.

Company X begon met het implementeren van ERP system Y gedurende de laatste vijf jaar. Toen het systeem eenmaal werd geïmplementeerd, was het systeem was nog niet klaar om volledig geïmplementeerd te worden, omdat sommige functies van ERP system X niet dermate veranderd zijn zodat ze volledig geïmplementeerd kunnen worden. Een deel van de onvolledige functies bestaat uit de financiële beheersingsmodellen. Een aantal van deze modellen kunnen alleen gedeeltelijk geïmplementeerd worden. Dit geldt vooral voor het kostprijs model. Het onderzoek zal zich dan ook focussen op het modelleren van het nieuwe kostprijs model zodat deze effectief geïntegreerd kan worden in het ERP systeem. Het kostprijs model is niet proactief geüpdatet sinds 5 jaar. Zoiets komt niet vaak voor in een groot bedrijf. De reden hiervoor is dat het bedrijf constant aan het focussen was op de implementatie van ERP system Y. De deadline van implementatie was initieel gesteld op negen maanden na de aankoop van het systeem. Het bedrijf was niet in staat om aan de deadlines voldoen. Er werden constant nieuwe deadlines gezet vanaf dat moment. Het bedrijf was echter telkens niet in staat om deze deadlines te halen. Pas na vijf jaar na aankoop werd het systeem dan eindelijk geïmplementeerd. Dit is de reden dat het kostprijs model geen prioriteit had. We definiëren het probleem als volgt:

Het huidige kostprijsmodel voldoet niet aan de eisen van Company X

We wilden dit probleem oplossen door onderzoek te doen naar de volgende onderwerpen:

- De definitie van de kostprijs.
- De methode van de kostprijs.
- Het inzicht in de premium services.
- De integratie tussen het kostprijs model en de andere financiële beheermodellen.
- De implementatie van het kostprijs model in ERP system XY.

Deze onderwerpen resulteerden in de volgende documenten:

De winst-en-verlies rekening

Company X wilde een document hebben waarin alle aspecten van de kostprijs gedefinieerd zijn in kosten. Het oude model gebruikte niet de theorie zoals beschreven in de boeken. In tegenstelling, het model was juist gemaakt zonder enige hulp van de theorie. Onze analyse heeft aangetoond dat de rekening al veel elementen zoals beschreven in de theorie bevatte, maar ze niet expliciet benoemd werden. Ons onderzoek heeft geresulteerd in een model dat aansluit met de theorie.

De resultaten per afdeling

De resultaten per afdeling zijn cruciaal in het berekenen van het kostprijs model. We hebben kritisch het model bekeken en hebben de volgende veranderingen doorgevoerd:

- **Afdelingen**: de update van de afdelingen dragen voor een groot deel bij aan de verbetering van de resultaten per afdeling. Het bedrijf is zo drastisch veranderd dat de afdelingen het bedrijf niet meer vertegenwoordigen. We hebben nieuwe distributieafdelingen, productieafdelingen en ondersteunende afdelingen aan het model toegevoegd.
- **Verkoopafdelingen**: in de vorige resultaten per afdeling, werd de omzet gebruikt om de resultaten per afdelingen te bepalen. Dit is echter veranderd door ERP system XY. Tegenwoordig wordt alle omzet van een locatie toegewezen aan een individuele verkoopafdeling. In plaats van omzet, wordt er nu een dekking gebruikt om de resultaten per afdeling te bepalen. Het bedrijf wil geen interne winsten of verliezen hebben. Daarom, wordt er een dekking gebruikt om met de kosten van de afdelingen om te kunnen gaan.
- **Verdeelsleutels**: de directe kosten kunnen zeer gemakkelijk gelinkt worden aan de kostenplaatsen. Dit is echter niet het geval voor de indirecte kosten en daarom worden er verdeelsleutels gebruikt. Deze sleutels zijn meestal gebaseerd op de meest prominente kosten object dat gelinkt is aan de specifieke kostenplaats. We hebben een verdeelsleutel voor elke kostenplaats kunnen vinden.

De resultaten per locatie

Omdat de huidige resultaten per afdeling gebruik maken van verkoopafdelingen is de stap naar de resultaten per locatie erg klein. Door de interne winst en de kosten voor het verkopen van goederen af te trekken van de omzet per verkoopafdeling, verkregen we het resultaat per verkoopafdeling. Dit was echter niet de laatste stap. We moesten nog steeds de andere afdelingen bij de calculatie betrekken. De resultaten per afdeling werden toegevoegd aan de corresponderende verkoopafdelingen. Toen alle resultaten bij elkaar opgeteld werden, verkregen we de resultaten per locatie.

Het functioneel/technisch ontwerp voor het nieuwe productie/distributie kostprijs model

Het bedrijf wilde dat we kritisch keken naar de methode die zij op dat moment gebruikten om het oude kostprijs model mee te berekenen. Dit resulteerde in een keuze en een uitleg waarom deze keuze gemaakt werd. Na een literatuurstudie, waren we in staat om te concluderen dat Company X de kostenplaatsenmethode toe moest passen. Deze methode biedt een gemiddelde accuraatheid, maar dit veranderd worden door meer specifieke kostenplaatsen te gebruiken. Daarnaast is de methode makkelijk om in de praktijk te brengen en past hij bij het type bedrijf.

De dekkingen van het productie kostprijs model werden gecalculeerd door de indirecte kosten berekend in de resultaten per afdeling te gebruiken. De dekkingen worden gebruikt om de indirecte kosten van iedere afdeling te dekken. We onderscheiden twee typen kostprijzen: de productie kostprijs en de integrale kostprijs. De productie kostprijs bevat alle kosten die gerelateerd zijn aan het product voordat het product het bedrijf verlaat, terwijl de integrale kostprijs alle kosten bevat die gerelateerd zijn aan het produceren en leveren van het product.

We zijn erin geslaagd om de dekkingen te berekenen en dit resulteerde in een significante verbetering van het productie kostprijs model door de geüpdatet data waarop het gebouwd was. We zijn het niet eens met de huidige calculatie, maar het bedrijf besliste dat we geen onderzoek zouden doen in deze calculatie door een tekort aan tijd.

Het functioneel/technisch ontwerp voor de premium servicemodellen

Het gebrek aan inzicht in hoe de premium service die Company X aanbiedt zich vertalen naar kosten en baten werd gezien als een probleem. Het gemeenschappelijke kenmerk van deze services is dat ze allemaal een verschillend niveau van detail aanbieden, terwijl ze geen extra kosten in rekening brengen. Dit verbeterde inzicht en het in rekening brengen van extra kosten voor deze services kunnen verkregen worden door de services te modelleren. De services die gemodelleerd worden zijn distributie, kwaliteit, projectmanagement, administratie en ICT services. Deze kosten moeten verwijderd worden van de kostenplaatsen waar ze op dit moment aan toegewezen zijn. Daarna moeten deze kosten toegevoegd worden aan de serviceafdelingen.

Dit betekent dat we eerst moesten identificeren welke kosten geassocieerd worden met de verschillende services. Dit is gedaan door alle kost objecten te analyseren en ze toe te wijzen aan een van de services indien mogelijk. Bijvoorbeeld, het kost object logistiek/transport van goederen werd toegewezen naar de service distributie. Toen dit gedaan was, werden deze kost objecten verder geanalyseerd om te zien uit welke kosten ze bestonden. De belangrijkste functie van deze analyse was om erachter te komen welke kosten verwijderd moest worden van welke kostenplaatsen. Als we zagen dat een prominent kost object significant hoger was dan alle andere kosten, dan hadden we een indicatie van een mogelijke indicator die we konden gebruiken in het premium servicemodel. De laatste stap was het verwijderen van de kosten van de kostenplaatsen en deze toe te voegen aan de services.

Het adviesrapport

We zijn in staat gebleken om het model te maken, maar we zijn niet aanwezig wanneer het model geïmplementeerd wordt. We raden de volgende acties aan om in de toekomst uitgevoerd te worden:

- Verwijder de premium services van het kostprijs model.
- Ontwikkel het distributie premium servicemodel verder en maak de premium servicemodellen.
- Verkrijg de benodigde data voor het calculeren van de modellen.
- Update de data waarmee de indirecte variabele kosten berekend worden.
- Eis een extra vergoeding voor het aanbieden van de premium services door vendor lock-in/dependency.
- Analyseer de resultaten zoals beschreven in ons onderzoek.
- Ontwerp een nieuwe methode waarop het distributie kostprijs model wordt berekend.

List of figures

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List of concepts

Table/figure	Description
Advisory report	A report on the recommendations on future research and advice in general.
Cost object	Any item for which costs are being separately measured.
ERP system	An IT system that helps businesses run important processes, such as financials, materials planning and human resources.
Functional/technical design	A detailed description of the way in which a system satisfies all of the needs and how these needs are implemented in real life.
Income statement	A financial statement that reports a company's financial performance over a specific accounting period.
Integral cost price	A cost price that equals all of the costs involved from manufacturing to delivering the product.
Problem cluster	A tool that illustrates problems and their relationships to create coherence between the different problems and to identify the core problem.
Production cost price	A cost price that equals all of the costs, which are incurred when the product leaves the company.
QlikView	A business intelligence tool that provides the ability to analyse data.

Content

1. The research design

Section 1 can be seen as a brief summary of the project plan. We the problem context, the problem identification, the research design, the research questions, the deliverables and the financial models.

1.1 The problem context

Company X used to implement a stand-alone product focussed on production called ERP system X and an accounting package to cope with the constantly changing market and the unique customer needs. There is a problem however. ERP system X has been used since the 00's and has become too static. This has led to the purchase of a multi-location package in 2009. However, Company X was the only major company to which it was sold. Therefore, the company lost interest in developing this particular package. Figure 1.1 shows the timeline.

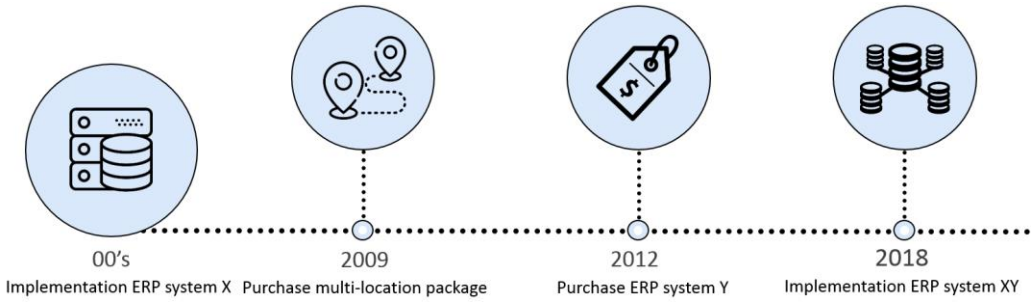

Figure 1.1: the timeline of the ERP system development.

Company X started to implement ERP system Y during the last five years. Once implemented, ERP system Y was not fully ready to be implemented yet because several functions of ERP system X were not altered significantly enough to be implemented effectively. Therefore, Company X first applies the system ERP system XY. This means that ERP system Y is implemented, but the production segment of ERP system X is still used. The final version of ERP system Y will be implemented once ERP system XY is running consistently and the unfinished parts have been dealt with appropriately.

The financial control models are a part of the unfinished models. Some of these models can only be implemented in a limited way as they are not altered enough to ERP system XY. This especially holds true for the cost price model. The research therefore focusses on shaping the new cost price model in order to effectively be integrated into ERP system XY. The cost price model has not been updated pro-actively for five years. This means that the model has been indexed from time to time, but the model has not thoroughly been assessed and altered. The cost price model has only been used as a control measure when margins were seen as unusual. One could argue that it is quite unusual not to update the cost price model for that amount of time. However, the company was constantly focussing on the implementation of ERP system Y. At first, the deadline of implementation was set at nine months after purchase. The company however failed to meet this deadline by a long stretch. New deadlines were constantly set from there on. The company was not able to meet any of these deadlines. It was not until five years from purchase that the implementation finally occurred. Therefore, the cost price model was not prioritised and neglected during this period of time.

1.2 The problem identification

Company X wants to know how the cost price model should take shape in order to be effectively integrated into ERP system XY. This problem is however very vague because it does not state which causes underlie the problem. Therefore, we use a Problem Cluster to identify the core problem. A Problem Cluster illustrates the different problems and their relationships. It is used to create coherence between the different problems and to identify the core problem. It is based on the information provided by Company X. The Problem Cluster is visualized in Figure 1.2.

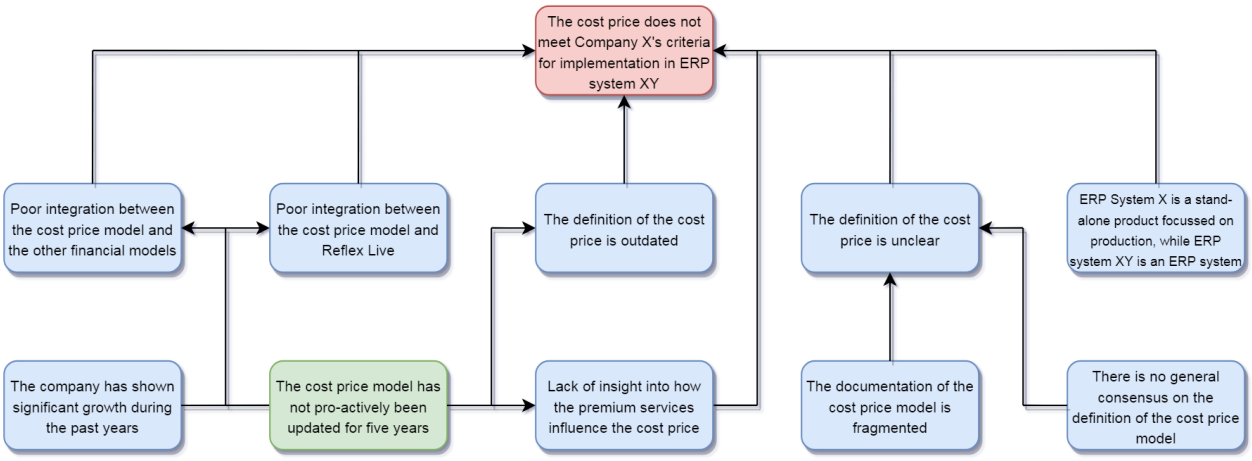

Figure 1.2: the Problem Cluster.

Company X states that the cost price model does not meet its criteria for implementation in ERP system XY. The Problem Cluster shows that this is caused by six problems:

- Poor integration between the cost price model and the other financial models.
- Poor integration between the cost price model and ERP system X.
- Lack of insight into how the premium services influence the cost price.
- The definition of the cost price is outdated.
- The definition of the cost price is unclear.
- ERP system X is a stand-alone system focussed on production, while ERP system XY is an ERP system.

We define the core problem of the research in this section. Problems that cannot be solved, cannot be seen as a core problem. The causes ‘ERP system X is very different in comparison to ERP system XY’ and ‘the company has shown significant growth’ cannot be changed by us and are therefore not the core problem. Pro-actively updating the cost price model solves the poor integration of the cost price model with both ERP system X and the other financial models, while this also deals with the outdated definition of the cost price. Defining the cost price model more clearly is an integral part of updating the definition. This means that all of the solvable problems will be dealt with when updating the cost price model pro-actively. The cost price model not pro-actively being updated for five years is therefore seen as the core problem as it solves all of the solvable problems according to the problem cluster. We define our problem as:

The current cost price model does not satisfy Company X's needs

The problem statement does not clearly state which needs the model does not comply to. Therefore, indicators are used to gain insight and concretise the variable 'satisfaction of Company X's needs'. The Problem Cluster states the problems that have to be dealt with to obtain the new cost price model. The poor integration between the old cost price model and ERP system X will not be dealt with in the implementation of the new cost price model because ERP system XY is used instead of ERP system X. The problems are shortly elaborated upon in order to alter them into insightful indicators:

- **The definition of the cost price**: Company X wants to have a document in which all the aspects of the cost price are defined in terms of cost objects.
- **The method of the cost price**: the company wants us to have a critical look at the method that is used to construct the old cost price model and whether a different method should be used when creating the new cost price model. This results in a choice of method and an explanation on why this method is chosen.
- **The insight in the premium services**: Company X wants us to give more insight into how the premium services affect the company.
- **The integration between the cost price model and the other financial control models**: we will clearly state how the new cost price model affects the other financial models or vice versa and how possible issues can be solved accordingly.
- **The implementation of the cost price model in ERP system XY**: the company wants the model to become directive in ERP system XY. This involves adding a couple of implementations to the cost price model. The cost price model should still be able to be used as a control measure as was already the case in ERP system X. Furthermore, the cost price model should be used when calculating the results per department of the company. Lastly, the model should be able to be implemented into the net added value per organisation model. Although budgeting by using the cost price model is one of Company X' ambitions as well, this is not prioritised at this moment and is therefore not focussed on.

1.3 The research design

Before the research questions can be defined, the research is divided into the five phases visualized in Figure 1.3.

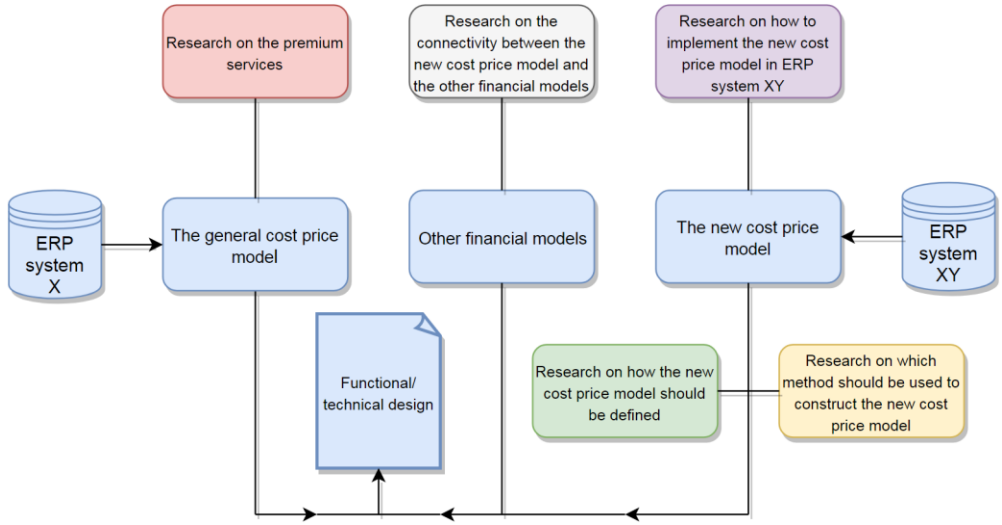

Figure 1.3: the five different parts of the research.

The questions related to the five phases are described in Figure 1.4. The phases and questions can be matched by the corresponding colours.

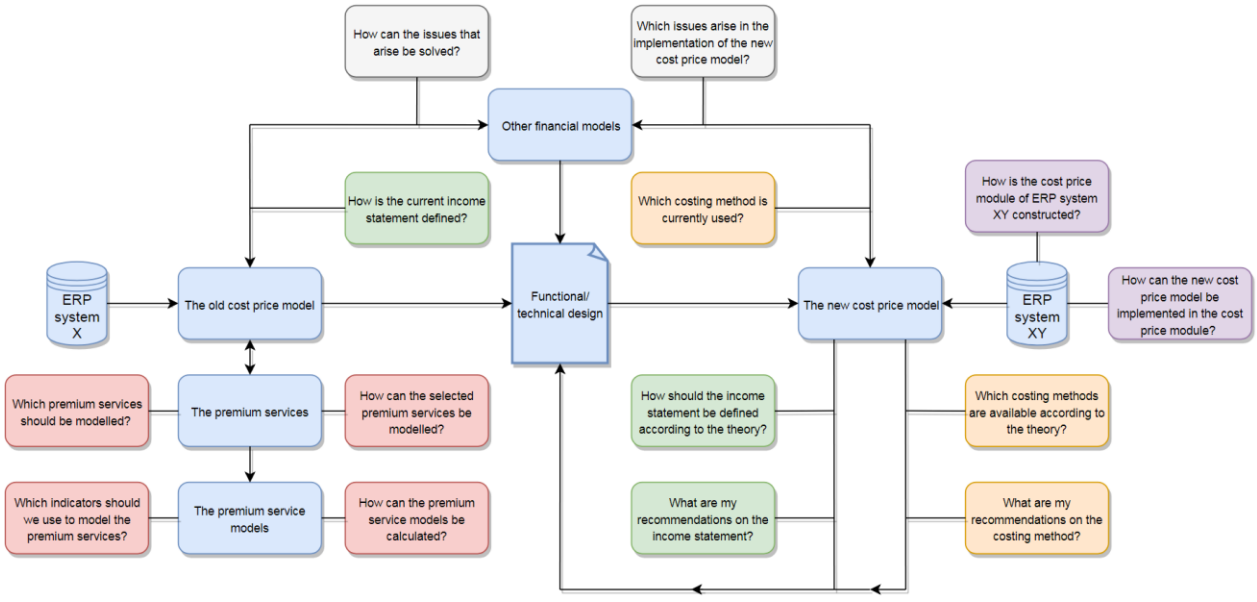

Figure 1.4: a detailed representation of the different components involved in the research and their relationships.

1.4 The deliverables

At the end of the research, we provide the following deliverables:

- **The income statement**: as the income statement is a vital part of the cost price model, we have to make sure that this model is well defined. We therefore deliver an income statement, which is built up logically and contains clear definitions.
- **The results per department**: these are essential for the cost price model as well. Therefore, we want to create an updated model. This is possible because of the new way in which the hierarchy in ERP system XY is modelled.
- **The results per location**: the results per location are not necessary for the construction of the cost price model. However, this is one of the financial models that Company X wants to gain more insight in. Next to that, the step from the results per department to the results per location is quite small.
- **A functional/technical design of the new distribution cost price model**: such a design can be seen as the blueprint to build a cost price model. We will not actually build the cost price model into ERP system XY, due to time constraints and a lack of skills. Therefore, the design will be implemented by the BI-specialist. This research would probably be too extensive to conduct within the timeframe of ten weeks if we conduct research on all products of Company X. There are three types of products that Company X sells: distribution goods, production goods and exceptions. We choose to not conduct research into the exceptions because these are too arbitrary.
- **A functional/technical design of the new production cost price model**: once the functional/technical design of the distribution cost price model has been developed, we continue by creating a similar design for the production cost price model.
- **A functional/technical design of the premium service models**: these models should become the foundation upon which the added value per customer model can be built.
- **An advisory report:** it is unknown if we are able to finish the design because the research could become quite extensive. Therefore, we write an additional advisory report in which recommendations on future research are discussed.

1.5 The financial models

The research can be divided into three parts. The first part is Section 1 and is a summary of the project plan, which discusses the research design. The second part consists of Section 2 to 5 in which the current situation, the theory and the recommended actions are discussed. The last part consists of Section 6 to 8, which presents the deliverables, the advisory report, and the conclusion and discussion. Although the financial models are an essential part of the research, there is no individual section dedicated to the financial models. This decision is made because the financial models are discussed during the course of the other sections. The income statement for example is discussed to quite some extent in the section on definitions because the definitions arise from the statement. Furthermore, the results per department are already analysed in the section on the methods because the current method makes use of the results per department.

Figure 1.5 shows the different parts involved in the cost price model. It shows that the income statement is the base upon which the whole model is built. This means that if we do not critically assess the definitions, the whole model will come crumbling down.

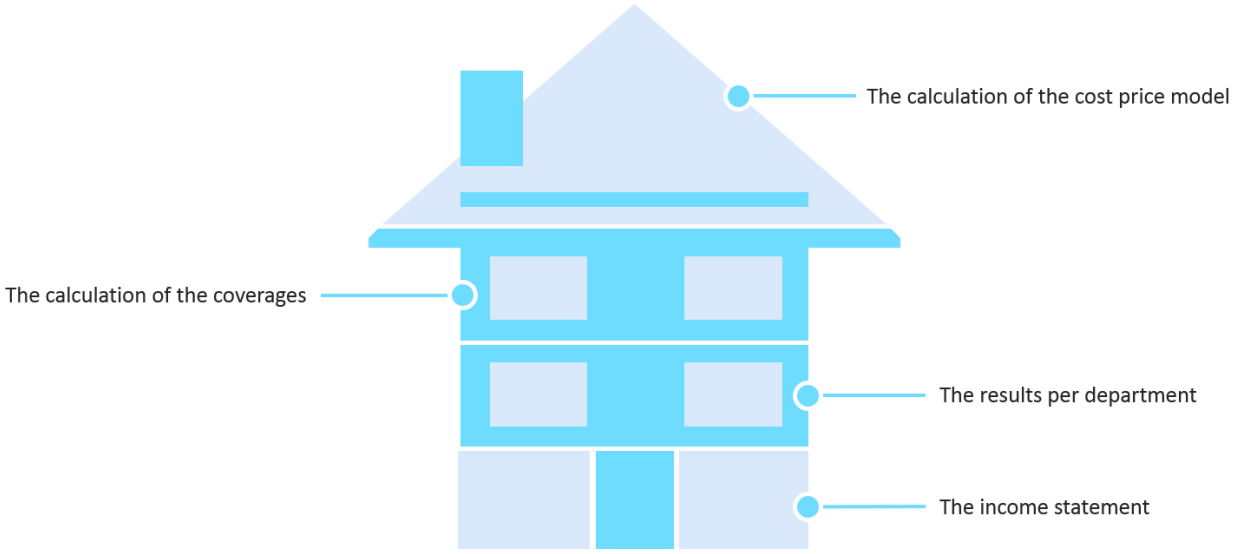

Figure 1.5: the foundation on which the cost price model is built.

2. The definitions of the general cost price model

In this section, the definitions of the costs of Company X are discussed. All of the costs are stated in the income statement of the company. First, the theory on the income statement is covered. Next, the current income statement is discussed, after which the recommendations are discussed.

2.1 The theory on the income statement

According to Averkamp (2018), there are two ways to compute an income statement. The single-step method uses only one subtraction to come to the net income, while the multiple-step method uses multiple subtractions to obtain the net income. The multiple-step method is generally preferred over the single-step method because the multiple-step method clearly states the gross profit amount, the operating income and the net amount for all the items stated on the income statement.

The income statement reports on making and selling activities of a business over a period of time. The income for the period equals what is sold in the period minus what it costs to make minus selling and general expenses for the period. There is no standard way in which the income statement should be computed. There are a number of cost objects that tend to be implemented in such a statement however. A differentiation between revenue and expenses is made. Table 2.1 shows this differentiation.

Object	Definition
Revenue	Income that flows into the organization
• Operating revenues	Only those revenues derived from the provision of sales or services depending on the nature of the organization
• Non-operating revenues	Revenues that an organization earns outside of selling goods and services
Expenses	All of the costs incurred during the period
• Operating expenses	The costs incurred in order to earn normal operating revenues
• Non-operating expenses	Costs that are not associated with the primary activities of buying and selling goods or services

Table 2.1: the definitions of revenue and expenses.

Next, the multiple-step method calculates a number of different financial metrics. The cost of goods sold is not explained yet, but it is used in the calculation of the gross profit and equals the costs that go into creating the products, which are sold by the organization. The data in Table 2.2 were obtained from FME (2013).

Object	Definition	Calculation
Gross margin	Gross margin is obtained by subtracting the COGS from the operating revenue	Operating revenues – cost of goods sold
Operating income	Operating expenses are subtracted from the gross profit to come to the operating income	Gross profit – operating expenses
Non-operating income	Non-operating income is obtained by subtracting the non-operating expenses from the non-operating revenues	Non-operating revenues – non-operating expenses
Net income	Adding the operating income to the non-operating income results in the net income	Operating income + non-operating income

Table 2.2: the calculation of the financial metrics.

The tables provide a general overview of what the income statement should contain and how the statement is calculated. These terms can however become more accurate when more costs are added to them. This is entirely up to the company as long as all of the costs are covered by the statement. An example of how this can be done is given by Ittelson (2009). Table 2.3 provides this example. It shows that the operating expenses are divided into sales and marketing, research and development and general and administrative, while the non-operating income consists of the interest income and the income taxes.

Object	Calculation
Net sales	1
Cost of goods sold	2
Gross margin	1 – 2 = 3
Sales & marketing	4
Research & development	5
General & administrative	6
Operating expenses	4 + 5 + 6 = 7
Income from operations	3 – 7 = 8
Interest income	9
Income taxes	10
Net income	8 + 9 – 10 = 11

Table 2.3: an example of an income statement.

2.2 The current income statement

All of the costs that apply to Company X are stated in ERP system XY. We created an overview of the data in ERP system XY for ourselves. This document divides the costs into different cost objects by using different levels. The income statement is categorized in direct and indirect costs. The direct costs can directly be attributed to a department in a certain period. This is not the case for indirect costs however. These costs have to be attributed to a department by using allocation bases. This division is used because it makes sure that all of the costs are applied when calculating the net result of a department in a certain period of time.

2.3 The recommendations on the income statement

Now that the way in which the income statement is currently implemented, and the literature on the subject is known, we can move on to the recommendations. First, all of the costs involved in the statement should be defined according to the literature. This is done by researching the definitions in a search engine. Next to that, these definitions are critically assessed on whether the theoretical definitions comply with the practical use of the costs. Furthermore, the income statement is analysed on whether the current application is in line with the theory of income statements. Questions and remarks that we make as a means of feedback shall in a later stage be answered by the controller. His feedback is then implemented, which results in the final income statement.

3. The premium service models

This section introduces the idea of constructing individual models for the premium services, after which the premium services are provided. Next, indicators of the premium service costs are discussed. The construction of the premium service models is dealt with next.

3.1 The problem identification of the premium services

Company X adheres to a unique mission: the customer is king. It complies to this mission extremely well, in contrast to many other companies who claim to do so. This mission implies that every wish can be fulfilled. The level in which Company X serves its customers is quite astonishing.

On the one hand, this can be seen as the unique selling point of Company X. On the other hand, however, one could wonder whether the company overdoes its mission. Is it profitable to provide this level of detail? Do customers really want to pay a premium for these services? The company is not able to answer these questions at the moment. Why is this the case?

The lack of insight into how the premium services that Company X provides translate into costs and benefits is the main reason as to why the questions cannot be answered. The common factor of these services is that they provide a varying level of detail from extremely basic to very extensive, while they do not incur additional costs for the customer.

One could argue that it is quite unusual for customers to pay the same price for such different services. Company X has no other choice however because of the implementation of an integral cost price. This means that one cost price is used to determine the costs of a product, no matter the level of additional services. The improved insight and the application of additional costs for premium services can be obtained by modelling the premium services that the company provides.

Company X could offer more options to the customer. Not in terms of premium services, but the contrary actually. Let us consider a situation in which we identify two premium services: distribution and administration. The customer should then have four basic choices: the full package (the product, accurate distribution and detailed administration), the product and accurate distribution, the product and detailed administration and the basic package (the product and a pickup point). The prices for these packages vary significantly on the basis of their level of service. The example is shown in Figure 3.1.

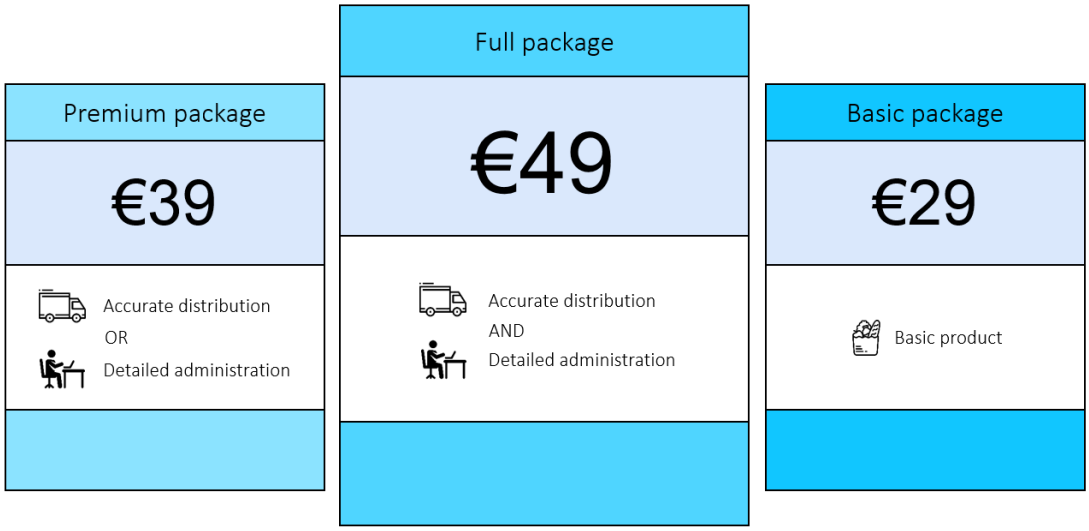

Figure 3.1: examples of premium pricing.

Premium service pricing does not only result in more insight, but perhaps even more beneficial, provides a larger market for the company to operate in. Instead of just appealing to the high segment of the market, the company can compete with companies that focus on the lower segment of the market because of the relatively low price. Furthermore, the company will not lose any of their existing clientele. Instead, the company is able to grow significantly due to the added market segment.

To offer some more insight in as to how this can be applied, let us take a look at another company, which offers premium services next to their product as well. Bol.com offers three options: delivery tonight (additional costs of €3,49), delivery tomorrow and delivery tomorrow night (additional costs of €0,99). The customer is able to customize the order according to its preferences, but might have to pay a premium when an option is chosen that involves additional costs for the company.

The customer is able to wrap the product in wrapping paper as well. Wrapping their product incurs an additional cost of €1,99. If applied correctly, the additional costs account for the process of wrapping the product and hopefully a margin of profit. The examples show that major firms apply the same principle as Company X will be able to apply if the premium services are modelled individually.

3.2 The premium services

This section first describes which premium services should be modelled. Next, these services are defined in terms of costs. Furthermore, we identify which costs are associated with the premium services and what to do with these costs.

3.2.1 Which premium services should be modelled?

To determine which premium services should be modelled, two criteria are used. The first criterion is the variability of the service. This shows how much the level of detail differentiates between customers. It is not valuable to model services that do not significantly show differences between customers because this implies that an integral cost price can offer an accurate calculation as well. The second criterion is the contribution to the costs of the company. If a service does not significantly contribute to the total amount of costs, modelling this service adds little value.

It is not up to us to decide which premium services should be modelled because we do not have enough insight into these services. We therefore consult Company X to determine the premium services. On the one hand, Company X does not want to model too many services because this will cause the process to become uncontrollable. On the other hand, the more services are modelled individually, the more insight is obtained. According to the criteria, the following premium services should be modelled:

- **Project management**: the day-to-day operations are concerned with managing the projects. It involves starting projects, while also maintaining the quality of the projects. This service should be modelled individually because one customer asks for projects specific for that customer, while another customer does not need this special treatment.
- **Quality**: managing quality means constantly pursuing excellence; making sure that what the company does is fit for purpose, and not only stays that way, but constantly keeps improving. The demanded quality varies significantly between different customers. For example, a certain customer can have such specific wishes that the product range may have to change. Next to that, a customer may want to get more information on product information in comparison to other customers.
- **Logistics**: logistics is concerned with delivering the products to the customer. This entails the whole process; from moving the products to the truck to delivering the product on the doorstep of the customer. This first reason as to why the logistics should be modelled is because it greatly contributes to the overall costs. It is actually one of the main cost objects of the company. Next to that, the level of distribution varies greatly between customers as aspects like the order quantity, the number of deliveries and the number of delivery points all affect the profitability of the service.
- **Management information**: this term refers to the systems and people that collect, process, store and disseminate information. Customers demand varying levels of management information. For example, one customer wishes to obtain ten management information reports, while another does not want any report at all.
- **ICT (information and communications technology) services**: the ICT services comprise all of the services that have to do with the infrastructure and components that enable the communication of people and organization in the digital world. Company X has many different systems that can be used to place an order. Some of the customers ask for a link between these systems. This is a very specific request, which induces many costs.

The descriptions of the premium services confirm that all of them are applied in different levels of detail, while every customer pays the same price for the services. Some services however incur more costs than others. Most notably, the logistics service that Company X provides is a very large part of the total amount of costs.

3.2.2 How can the selected premium services be modelled?

The premium service costs are part of the results per department. The results per department are used in the calculation of the general cost price model. Removing the services from the results per department would result in these costs not being covered in the cost price model. Therefore, a new model has to be made that uses the results per department, but removes the service costs from the departments and adds them to the services. The model is altered by adding mutations for the cost centres that affect the premium services. This mutation will remove the costs of the department and then add them to the services. The total costs will remain the same as the same amount is subtracted as added.

3.3 The relationship between the customer and the premium service models

This section describes how the customers and the premium service models are related. This is done by assigning an indicator to the relationship between the premium service and the customer. Next, the costs per unit of the indicator are determined. In the last part, the calculation of the premium service models is given.

3.3.1 The indicators

An indicator can be used to describe the relationship between the premium services and the customers. We want to achieve a model in which the costs can accurately be assigned to a certain customer. This could lead to a model in which the costs and benefits of each customer are obtained. All of the premium services are now related to an indicator:

- **Project management**: number of hours spent on a project for an individual or some customers.
- **Quality**: number of hours spent on quality.
- **Logistics**: delivery address, delivery points, route and number of times per week.
- **Management information**: number of MI reports.
- **ICT services**: number of hours spent on linking systems on behalf of customer(s).

Because of its extremely high level of costs in comparison to the other services, logistics is the prioritized service by the company. We will conduct an in depth analysis of this service, but we will first shortly elaborate upon the other indicators.

Project management, quality and ICT services

While the company does want to gain more insight into these services, they are not prioritized at this point in time. This is mainly because of a lack of data. All of the indicators refer to a certain number of hours spent on a certain activity. It would take a considerable amount of time to gain data because this would involve the employees to constantly monitor how much time they spend on a certain activity. Although this is possible, the company wants us to focus on other parts of the research as valuable data would not be obtained until after the research is finished.

Management information

There are nine different management information reports (MIR) that a company can obtain. Building such a report takes time and this differs for each report. Once the report is up and running, filing a new report is just a matter of data conversion. Data is available on how many reports are delivered on a yearly basis. More specifically, data is available on how many reports are sent to specific customers. We also know how much costs delivering these reports incur on a yearly basis. We use the following formulas in this model:

$$Costs\ per\ report = \frac{total\ amount\ of\ costs}{total\ amount\ of\ reports}$$

$$Costs\ of\ management\ information = costs\ per\ report * number\ of\ reports$$

By dividing the costs by the total number of reports, we achieve the costs involved in one report. When we multiply this value by the number of reports sent to a specific customer, we achieve the costs of management information concerning that customer. As mentioned, the costs per report differ. This is caused by the level of detail of the report. If more time has to be spent on building a report, more costs are incurred. Unfortunately, no data are available on how much time is spent on a certain kind of report. If we want to gain more insight into the costs, we should measure how long it takes someone to build a report on average. We can then attribute a factor to the calculation of the costs. If a specific report takes 15 minutes to build for example, while the average time equals 10 minutes, then the costs should be multiplied by a factor of 1,5.

Preferably, these costs are compared to the revenue that the service creates. This service cannot be described in terms of revenue because the company does not apply a premium for the service. One could argue that some customers choose the company because of how far-reaching this service is applied. We agree, but we are not able to attribute a part of the revenue to the service because we are not sure whether this is the case. The company could however choose to budget on the basis of the costs.

Logistics

The main problem in constructing a distribution service model is the number of factors that are involved in the delivery of the products. The delivery varies in number and price of products (revenue), size of products (order quantity), distance, number of customers and delivery points (time). This makes it very hard to determine one indicator for all of these aspects. The time aspect is too hard to model. There is no common denominator because the variables vary too much. Let us take distance for instance. This depends on both the number of customers (direct route is faster than a route with several customers) and the number of delivery points (unknown how much more distance another delivery point takes). We could use distance from the location to the customer, but this does not reflect the reality. Next to that, should we use the distance as the crow flies or the distance travelled by road? We discuss the process by using an example, which is shown in Figure 3.2.

There are two options in the way in which the products are delivered. The first option is to have the products transported to the delivery address. The second option is to have the products transported to the delivery address, after which Company X transports the products to one or more delivery points. A delivery point is a more detailed form of the delivery address. To illustrate this, let us take a look at DA (delivery address) I, which contains two houses. If the order is delivered to the front desk of DA I, then the customer just uses the delivery address. If the delivery is sent to the individual houses of DA I (DP (delivery point) I and DP II), then the customer makes use of several delivery points. The costs incurred with distributing to several delivery points is higher in comparison to the costs incurred in transportation to the delivery address. Furthermore, the route that the truck has to drive affects the costs as well. More costs are incurred when the delivery has to cover more distance because of an increase in fuel and wage costs. If DA I would be removed from this route for example, then the delivery would take less time because the direct route towards DA II could be taken. This would result in a decrease in costs. Next to that, the customers differ in how many times per week products are delivered. More costs per week are of course incurred if a customer needs delivery every day instead of five times per week. The costs of DA II would decrease if 6 deliveries instead of 7 deliveries per week were made. To summarize, the deliveries differ in terms of addresses, points, route and the number of deliveries per week.

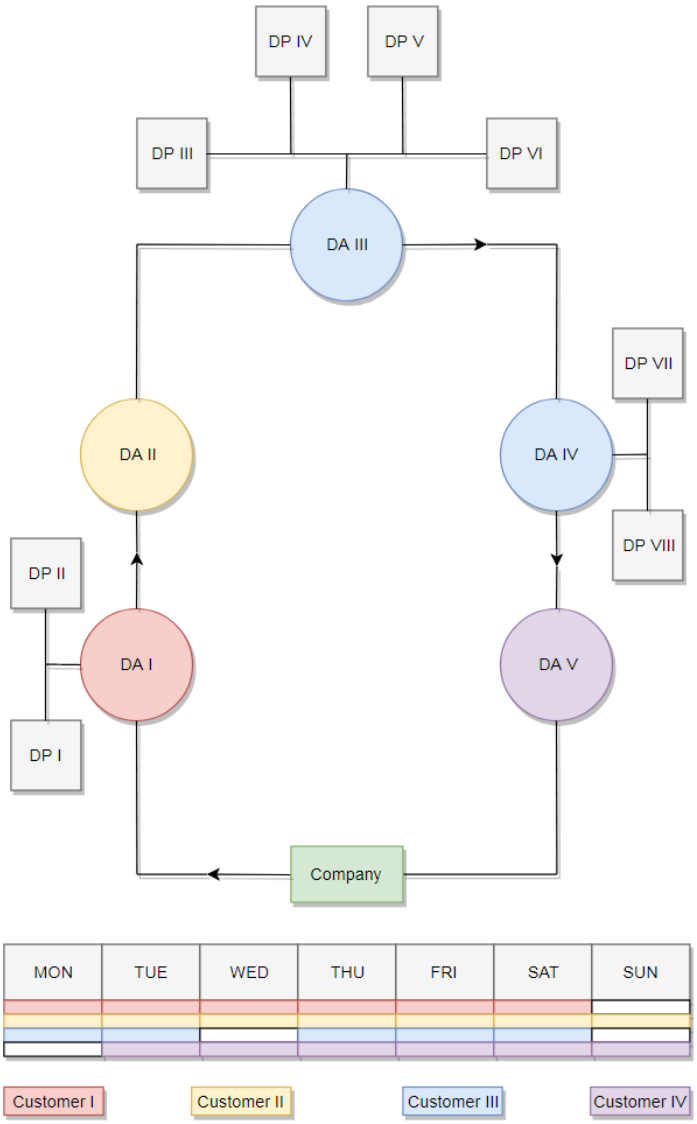

Figure 3.2: the example of delivering products.

3.3.2 The calculation of the value

We strive to construct a model in which all of the factors are taken into account. The calculation consists of three parts: location logistics, customer logistics and lease/maintenance. We use an example accompanied by a general explanation to show how we calculate the added value per customer. The data in Table 3.1 is known regarding our example.

Location A --> logistics centre --> Customer x	
Item	**Value**
Total costs of expedition	€ 90.000,00
% Location A of expedition costs	40%
Volume of delivery	20
Total volume of location	100.000
Utilization rate	75%
Volume of truck	96
Hours	Differs
Salary per hour	€ 14
Fuel	Differs
Fuel price	€ 1,27
Total costs of lease and maintenance	€ 380.000
Total amount of hours	58.400
Revenue	500
% costs of revenue	8%

Table 3.1: the data of the example.

Every time a delivery leaves a location, the following formula is applied:

$$Sub\ route\ cost = x\ (location\ expedition\ costs + location\ logistsics\ costs) + y\ (customer\ expedition\ costs + direct\ logistics\ costs + indirect\ logistics\ costs + lease\ and\ maintenance\ costs)$$

$$For\ x = 0 \vee x = 1$$

$$y = 0 \vee y = 1$$

$$x + y = 1$$

The formula shows that two options are available: the goods are delivered to another location, or directly to the customer. The sub route is seen as the route from one location to another or from a location to a customer. The costs when the goods are delivered to a location equal the location expedition costs + the location logistics costs. The costs when the goods are delivered to the customer equal the customer expedition costs + direct logistics costs + indirect logistics costs + lease and maintenance costs. The lease and maintenance costs are attributed to the customer delivery costs, because they should be incurred only once. The total costs of the route equal the summation of all of the sub routes. An example is used to elaborate on how the model can be put into practice.

Location logistics costs

These calculations only apply if the goods are delivered to another location. There are 7 locations to which goods can be transported: Location A, Location B, Location C, Location D, Location D, Location E and the logistics centre. It is possible to ride to every location from a certain location. There are 42 routes because there are 21 possibilities to ride from one location to the other, but it is also possible to go the other way around. We are able to calculate the costs for each route. This exists of two calculations.

The first calculation provides the expedition costs. In our example, the delivery is transported from Location A to the logistics centre. When delivering goods from Location A to the logistics centre, the expedition costs are calculated over Location A because this is the location where the expedition takes place. These costs are calculated by the following formula:

$$Expedition\ costs =$$

$$(\%\ of\ expedition\ costs * total\ costs\ of\ expedition) * \frac{volume\ of\ delivery}{total\ volume\ of\ location}$$

$$Expedition\ costs = (0{,}40 * €90.000) * \frac{20}{100.000} = €7{,}20$$

By multiplying the percentage of costs that should be attributed to the location at hand by the total costs of expedition, we know how many costs are part of that location. We can assign the costs to the delivery by using the ratio between the volume of delivery and the total volume of the location. The second part exists of the logistics costs. We use the following formula to calculate these costs:

$$Logistics\ costs =$$

$$\frac{volume\ of\ delivery}{utilization\ rate * volume\ of\ truck} * (hours * salary\ per\ hour + fuel * fuel\ price)$$

$$Logistics\ costs = \frac{20}{0{,}75\ *\ 96} * (0{,}30 * €14 + 5 * €1{,}27) = €2{,}93$$

The logistics costs of a truck are calculated by multiplying the hours by the salary per hour and adding this to the multiplication of the fuel and the fuel price. We however do not need the costs of the whole truck, but we wish to obtain the costs assigned to the delivery itself. Therefore, the ratio is used. When we add these costs, we obtain the total location costs.

Customer logistics costs

Once again, there are two options: the goods can be transported to another location or to the customer. If the delivery is transported to another location, the same formulas as stated earlier are applied once again. If the delivery however is transported to the customer, as is the case in our example, we have to calculate the costs involved in this process.

The calculation of the costs of the route to the customer consists of three parts. The first part equals the formula that was used for the calculation of the expedition costs:

$$Expedition\ costs = (0{,}20 * €90.000) * \frac{20}{60.000} = €6{,}00$$

The second part is the same for each customer that is on the route. We have to use several assumptions to be able to calculate the costs, because there are so many factors that affect the process. Table 3.2 shows the distance and time that it takes to drive from point A to point B.

Point A	Point B	Distance (km)	Time (min)	Time (hour)
A	B	92,21	74	1,23
B	C	3,77	8	0,13
C	D	7,94	13	0,22
D	E	4,03	9	0,15
E	F	5,4	10	0,17
F	G	2,6	8	0,13
G	H	2,31	7	0,12
H	I	7,62	15	0,25
I	J	1,26	7	0,12
J	K	1,49	7	0,12
K	L	1,05	3	0,05
L	M	14,71	26	0,43
M	N	3,02	7	0,12
N	O	11,6	20	0,33
O	P	92,9	79	1,32

Table 3.2: the distance and time between point A and point B.

The table shows that the distance between customers is relatively small compared to the distance between the location and the first and last customer. If we would use the distance between arrivals, this would not reflect reality because the first and last customer will have much more costs. Because of the relatively small distance between customers, we choose to equally distribute the distance and therefore fuel over all of the customers. The costs are calculated by the same formula as the calculation of the logistics costs. If we fill this in for our example, we obtain the following:

$$Direct\ logistics\ costs = \frac{20}{0{,}75 * 50} * (0{,}35 * €14 + 3{,}92 * €1{,}27) = €9{,}85$$

The third part is specific for each customer because this depends on the time that is used at the delivery address. When we subtract the time of arrival from the time of departure, we obtain the time that the chauffeur to deliver the order at the address itself. The longer he is at the address; the more costs should be incurred as he receives wage during this period of time. We calculate the costs by the following formula:

$$Indirect\ logistics\ costs = number\ of\ hours * salary\ per\ hour$$

$$Indirect\ logistics\ costs = 0{,}88 * €14 = €12{,}37$$

This formula is very straightforward and should not need any more explanation. All of the costs that are directly related to the delivery are now identified. The costs of lease and maintenance should however be included as well. The following formula is used to calculate this:

$$Costs\ of\ lease\ and\ maintance = \frac{Total\ costs\ of\ lease\ and\ maintance}{Total\ amount\ of\ hours} * number\ of\ hours$$

$$Costs\ of\ lease\ and\ maintance = \frac{€380.000}{58.400} * 1{,}23 = €8{,}01$$

We calculate the amount of costs per hour by dividing the costs of lease and maintenance by the total amount of hours. If we multiply this value by the number of hours that the truck is utilized during the delivery, then we obtain the costs of lease and maintenance. The total amount of costs is calculated by the following formula:

$$Total\ costs = expedition\ costs + logistics\ costs + expedition\ costs + direct\ logistics\ costs + indirect\ logistics\ costs + costs\ of\ lease\ and\ maintance$$

$$Total\ costs = €7{,}20 + €2{,}93 + €6{,}00 + €9{,}85 + €12{,}37 + €8{,}01 = €46{,}36$$

The costs have to be compared to the revenue. The company always uses 8% of the revenue as the logistics costs. Historical data shows that this percentage reflects reality very well and remains steady over time. The maximum amount of costs can be calculated by the following formula:

$$Maximum\ amount\ of\ costs = revenue * 0{,}08$$

$$Maximum\ amount\ of\ costs = €500 * 0{,}08 = €40{,}00$$

The calculated costs exceed the maximum amount of costs, which means that it is not profitable to deliver the goods to this customer in the current construction.

We stated that the deliveries differ in terms of addresses, points, route and the number of deliveries per week. The factor routes and number of deliveries are taken into account because the model is calculated for each sub route that is covered by the order. The factor addresses is dealt with by the simplification that the distance is equally distributed. The factor delivery points is taken into account by the time that the truck does not move once it has arrived at its destination. We conclude that the model deals with all of the factors that affect the costs involved in the process.

4. The costing method

In this section, the costing method is described. The available methods according to the theory are described first, after which the current situation is described. Next, the recommendations are discussed.

4.1 The theory on the costing method

There are many different ways in which the cost price model can be constructed. We can however not discuss every method because this would take too much time. Therefore, we identified the main methods by a small literature study. These methods are now discussed in depth.

The mark-up method

When using the mark-up method, the indirect costs are attributed to the products to the extent in which they cause direct costs. This method assumes that the amount of indirect costs is proportional to the direct costs that cause the indirect costs. There are two methods that can be used when calculating the cost price by using the mark-up method: the primitive mark-up method and the sophisticated mark-up method. By applying the primitive mark-up method, the cost price is calculated by adding a percentage to the direct costs of a product. MKB (2015) states the steps in Figure 4.1.

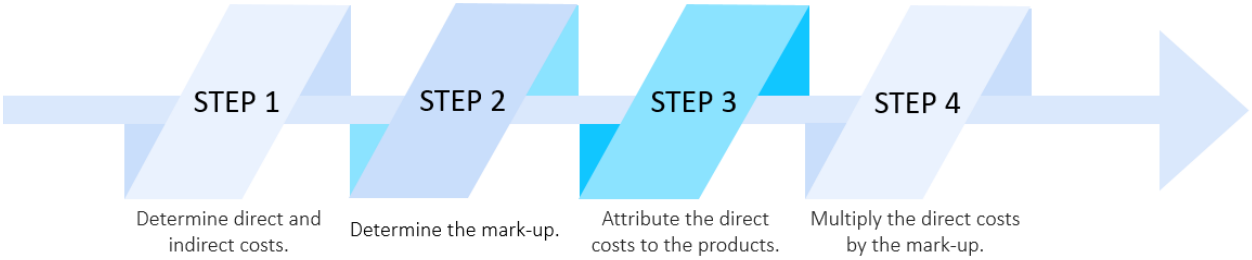

Figure 4.1: the steps involved in the primitive mark-up method.

The steps described in Figure 4.1 are implemented in an example in Table 4.1.

Primitive mark-up method	Amount	Mark-up	Direct costs	Indirect costs	Total costs
Amount of products	10.000				
Raw material	4.000		0,40		
Direct wages	2.000		0,20		
Total direct costs	6.000				
Total indirect costs	1.500				
Total costs		25%	0,60	0,15	0,75

Table 4.1: the example of the primitive mark-up method.

The mark-up is calculated by the following formula:

$$Mark - up = \frac{Total\ indirect\ costs}{Total\ direct\ costs}$$

Applying this formula to our example results in a mark-up of 25%. The direct costs per product are calculated by dividing the costs by the amount of products. When multiplying the mark-up with the direct costs per product, we obtain the indirect costs per product. The total costs simply equal the direct costs added by the indirect costs.

According to Nevi (n.d.), the primitive mark-up method has its flaws. The calculation heavily relies on the basis on which the mark-up is based. Therefore, the cost price can vary strongly if a different basis is used. Furthermore, the mark-up is based on the ratio of data of the whole company.

Therefore, some products may use a percentage that is not representative. Instead of determining one mark-up for the whole company, the sophisticated mark-up method determines a percentage for each individual group of costs. Therefore, this method is more detailed and more accurate than the primitive mark-up method. Figure 4.2 describes the steps used in the sophisticated mark-up method.

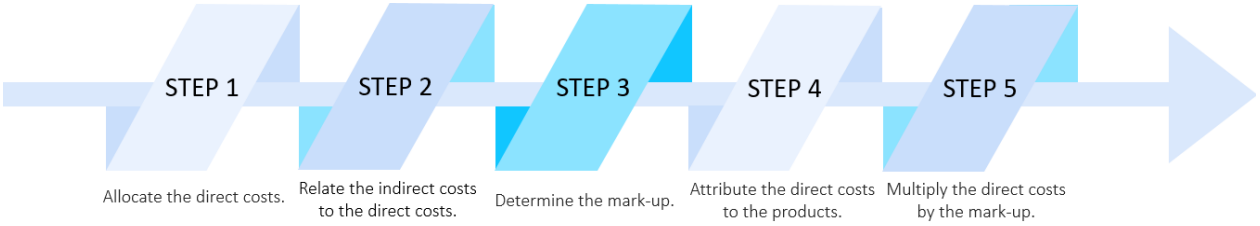

Figure 4.2: the steps involved in the sophisticated mark-up method.

We once again use an example to elaborate on the method. Table 4.2 illustrates this example.

Sophisticated mark-up method	Amount	Mark-up	Direct costs	Indirect costs	Total costs
Amount of products	10.000				
Raw material	4.000	30%	0,40	0,12	
Direct wages	2.000	50%	0,20	0,10	
Total direct costs	6.000	20%		0,12	0,60
Total indirect costs	1.500				0,34
Total costs					0,94

Table 4.2: the example of the sophisticated mark-up method.

In contrast to the primitive mark-up method, the ratio is not calculated by a formula. Instead, the percentages are given already. A different percentage is used for each individual cost item. Multiplying the percentages by the cost item it is attributed to results in the indirect costs. The difference in result in our examples between the primitive (€0,75) and sophisticated mark-up method (€0,94) shows that the two methods differ significantly.

NEVI (n.d.) states that just as the primitive mark-up method, the ratio between the direct and indirect costs can be misleading and therefore lead to inaccurate calculations. Next to that, this mark-up method is especially not suitable when a company has many different products and processes, and therefore many indirect costs.

Activity-based costing (ABC)

In contrast to the mark-up method and the absorption method, activity-based costing (ABC) is a refined costing system. Bhimani et al. (2008) explains that such a system reduces the use of broad averages for assigning the cost of resources to cost objects and provides better measurement of the costs of indirect resources used by different cost objects. ABC costing focusses on individual activities as the fundamental cost objects. ABC systems calculate the costs of individual activities and assign costs to cost objects such as products and services on the basis of the activities undertaken to produce each product or service. Walther and Skousen (2009) state that the method consists of the steps provided in Figure 4.3.

Figure 4.3: the steps involved in activity-based costing.

The following example stated in Table 4.3 shows that the method is harder to implement, but the results are more accurate.

Item	Product A	Product B	Cost driver	Total costs
Amount of products	5.000	10.000		
Cost of sales	6.000	7.000		13.000
Staff			FTE	1.750
Building			M2	2.830

Table 4.3: the data of the ABC example.

The amount of products and cost of sales provide information on the product itself. We want to allocate the indirect costs to the products. These costs exist of staff and building costs, which are linked to FTE and M2 respectively, and their respective costs. Table 4.4 allocates the costs on the basis of the cost drivers.

Activity	FTE	Staff costs	M2	Building costs	Total costs
Make sales calls	2	500	8	400	900
Ship the order	3	750	33	1650	2.400
Make credit control calls	2	500	15,6	780	1.280
Total	7	1.750	57	2.830	4.580

Table 4.4: the allocation of the costs on the basis of the cost drivers.

The company identifies three activities that have to be conducted in selling the products: making sales calls, shipping the products and making credit control calls. The staff costs are allocated by the FTE and the building costs are allocated by M2. This results in the costs per activity. The next step is to allocate the activities to the products, which is provided in Table 4.5.

Activity	Activity driver	Product A	Product B	Total	Product A	Product B	Total
Make sales calls	# sales calls	18	12	30	540	360	900
Shipping the order	# orders	10	50	60	400	2.000	2400
Make credit control calls	# credit control calls	0	12	12	0	1.280	1280
Total		28	74	102	940	3.640	4.580

Table 4.5: the allocation of the activities to the products.

The activities are linked to the products in Table 4.5. Because of this link and the costs being allocated to the activities, we are able to allocate the costs to the two products. This results in the indirect costs being attributed to the different products. The last step is shown in Table 4.6.

Item	Product A	Product B	Total
Amount of products	5.000,00	10.000,00	
Cost of sales	6.000	7.000	13.000
Overhead costs	940	3.640	4.580
Total costs	6.940	10.640	17.580
Total costs per product	1,388	1,064	

Table 4.6: adding all of the costs.

This table adds the direct costs to the indirect costs to obtain the total costs. When dividing this by the amount of products, we obtain the total costs per product.

According to Turney (2010), the logic of ABC systems is that more finely structured activity-cost objects with activity-specific cost allocation bases, which are cost drivers for the cost objects, are considered to lead to more accurate costing of activities. Furthermore, ABC systems can create process oriented metrics that are not available with traditional costing methods, can be used as a means of linking sustainability initiatives with cost and finance information, provides costs of employees performing activities, and improves resource planning and allocation.

There are some disadvantages however according to Kaplan and Anderson (2003). The method may produce results that differ from those required under generally accepted accounting principles (GAAP). This means that an organization has to develop two costing systems if it wants to implement the ABC; one for external reporting and one for internal management. Next to that, many companies have found it difficult to implement the method because of the relatively high costs incurred to interview people for the initial model, and the time allocations are subjective and costly to validate. Furthermore, it is difficult to maintain and update the model because processes and the amount of resources change over time, new activities are possibly added, and the complexity and diversity of individual orders, channels and customers increase.

Time-driven activity-based costing

Time-driven activity-based costing is a variant of the ABC method and consists of the steps as described in Figure 4.4.

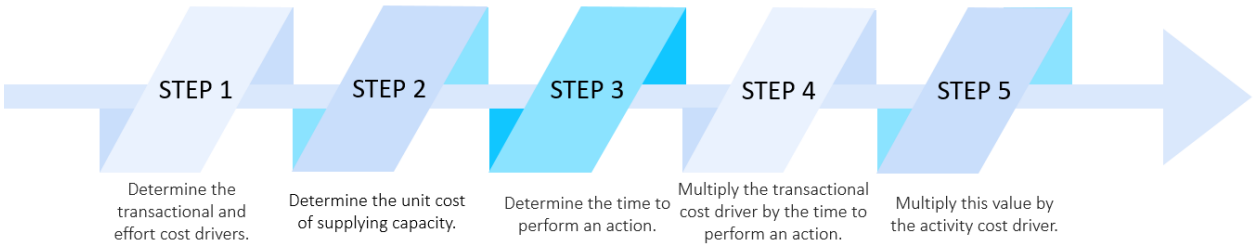

Figure 4.4: the steps involved in time-driven activity-based costing.

This is the most complicated method and therefore, we will explain it in more detail than the other methods. This method differentiates between transactional and effort cost drivers. Transactional cost drivers count the number of times an activity is performed. The heterogeneity of the transactions is an issue that should be solved. The first way to cope with this heterogeneity is to expand the number of activities in for example a simple order, an average order and a complex order. The resource costs have to be assigned to the three types of order-handling activities, and a transaction cost driver should be defined for each activity. The second possibility is to use duration cost drivers, which estimate the time required to perform the task. Duration cost drivers are generally more accurate than transaction cost drivers, but they are also more expensive to measure. The method only requires estimates of two parameters: the unit cost of supplying capacity and the time required to perform a transaction or an activity. The unit cost of supplying capacity is determined by dividing the cost of capacity supplied by the practical capacity of resources supplied. The cost of capacity supplied is determined by identifying the various groups of resources that perform activities. The practical capacity is estimated by determining how much time an employee or machine is working effectively.

The next aspect is the unit time estimate. The method uses an estimate of the time required each time the activity is performed. The time estimates can be obtained either by direct observation or by interviews. Rough accuracy is sufficient as precision is not critical. By multiplying the unit time with the number of times that the action is performed, a total number of minutes is acquired. Multiplying this number by the activity cost driver rate results in the total costs.

One more problem should however be addressed. In general, not all orders require the same amount of time to process. Rather than define a separate activity for every possible combination of actions, or use a duration driver for every combination of actions, the time-driven approach estimates the resource demand by a simple equation. This equation usually exists of one element that applies to all actions and copes with possible additional actions by using if-statements. Our example uses the same data as provided in Table 4.3. Table 4.7 shows how the costs per minute are calculated.

Activity	Total costs	Time spent	Relative costs	Costs/minute
Make sales calls	900	70%	630	1,43
Shipping the order	2400	20%	480	5,00
Make credit control calls	1280	10%	128	10,00
Total		1000	1238	

Table 4.7: determining the costs per minute.

By multiplying the total costs by the time spent, we obtain the costs that should be attributed to that activity. When dividing the total costs by the relative costs, we achieve the costs per minute. Table 4.8 shows how we attribute the activities to the products.

Activity	Costs/minute	Product A	Product B	Total	Product A	Product B	Total
Make sales calls	1,43	460	170	630	657	243	900
Shipping the order	5,00	150	330	480	750	1.650	2.400
Make credit control calls	10,00	58	70	128	580	700	1.280
Total		668	570	1238	1.987	2.593	4.580

Table 4.8: attributing the activities to the products.

Data is available on how many minutes of a certain activity are spent on either product A or product B. By multiplying these minutes by the costs per minute, we obtain the costs per activity. Table 4.9 shows the last step of this method.

Item	Product A	Product B	Total
Amount of products	5.000,00	10.000,00	
Cost of sales	6.000	7.000	13.000
Overhead costs	1.987	2.593	4.580
Total costs	7.987	9.593	17.580
Total costs per product	1,5974	0,9593	

Table 4.9: adding all of the costs.

The costs are added and divided by the amount of products to obtain the total costs per product. Time-driven activity-based costing is seen as superior to all other costing methods. The main reasons are the quick estimation and installation time, the system being easily updatable, it can be fed from transactional ERP and CRM systems, and it is easily scalable to handle millions of transactions while still delivering fast processing times and real-time reporting.

The absorption method

Togo (2010) states that organizations in general have two types of departments: operational departments, which are directly involved in producing and distributing outputs, and service departments, whose primary activity is providing service to other operational departments. Service departments generate costs that must be covered by the operational departments because they do not produce revenues or profits directly. Service department costs are allocated to other departments based on some measure that represents the usage of the service activity. Ideally, a direct measure of service department output can be used. This is in most instances not possible however.

Therefore, a less straightforward measure must be used. The absorption method does not make use of a percentage to calculate the cost price. Figure 4.5 provides the steps involved in the method.

Figure 4.5: the steps involved in the absorption method.

We do not explain the method, because too much information is needed to calculate a sound model and we discuss the method in Section 4.2 as well. This method is much more accurate than the mark-up method because the costs are attributed more accurately. There is however no direct relationship between the costs and the products that caused these costs. Therefore, it is possible that the cost price is less accurate. When applying the third step of the absorption method, there are a number of allocation methods to consider.

The direct method

The direct method is the widely used approach by companies. This method "only considers operating departments. This means that costs are not allocated among other service departments" (Yukcu & Ozkaya, 2010). The direct method is the easiest method to use because it requires the least amount of data and the fewest computations (Meeting & Harvey, 1998). The use of the direct method is best explained by an example. Consider the departments as described in Figure 4.6.

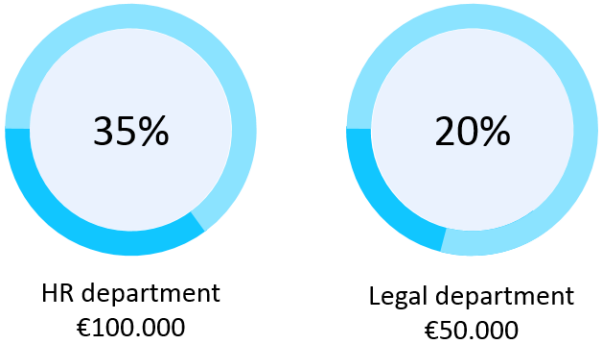

Figure 4.6: the percentage of costs that should be attributed to the other department.

The costs of the HR department are €100.000 and 35% of these costs should be allocated to the legal department, while the costs of the legal department are €50.000 and 20% of these costs should be attributed to the HR department. The other costs are attributed to other departments, but this is not important when discussing this example. The method is applied to our example in Figure 4.7.

Figure 4.7: allocation by the direct method.

When applying the direct method, the allocation order is random. There are no problems when allocating the costs of the legal department to the HR department. Issues do arise however when the HR department attempts to allocate its costs to the legal department. It is not possible to allocate to departments, which have already allocated their costs, because this would imply that these costs would have to be allocated once again.

The step-down method/sequential allocation method

This method is more accurate than the direct method, but less accurate than the reciprocal method. It "considers the inter allocation of costs among service departments, but does not allocate all service departments costs to every one of them. It follows a hierarchy among service departments while considering cost allocation" according to Yukcu & Ozkaya (2010). This hierarchy is based on the percentage of costs that a support department incurs to help other support departments. The support department with the highest percentage will be allocated first. This ensures that the department does not have enough costs left to allocate to the other support department(s). Figure 4.8 shows the application of the method in our example.

Figure 4.8: allocation by the step-down/sequential allocation method.

Because the HR department allocates more costs to supporting departments than the legal department allocates costs to supporting departments, the costs of the HR department are allocated first. This ensures that more costs are correctly allocated in comparison to the direct method. This method still does not allow costs to be allocated between multiple support departments however.

The reciprocal method

This method is generally accepted to be the superior allocation method because it is the only one that recognizes all service costs a service department provides and receives from other service departments (Meeting & Harvey, 1998). The application of this method is however rare because it is more complicated than the other methods and it requires sophisticated computer aid. The reciprocal method "considers all served departments including service departments and operating departments by a service department except the one whose costs are allocated" (Yukcu & Ozkaya, 2010).

This means that it is possible to allocate costs between multiple support departments. When this method is applied to the example, the result in Figure 4.9 is obtained.

Figure 4.9: allocation by the reciprocal method.

The method consists of several steps. The first step is to allocate the costs just as in the other two methods, except you should exclude the department costs that you are trying to allocate. The next step is to determine the formulas that you will use to calculate the total amount of costs. This is where it becomes more sophisticated in comparison to the other two methods. These formulas are likely to have more than two variables and it takes some algebraic skills to solve the equations. Once these formulas are properly applied, it is time to combine the first and second step. This results in the final allocation of the costs.

Once could wonder why the direct method is used more than the other two methods. There are two reasons for this. First, the direct method is much easier to conduct in comparison to the other methods. A company could substantiate that they do not think that the extra effort is worth the higher level of accuracy. The second reason is the difficulty in applying the methods in an ERP system. ERP systems that are designed to employ the reciprocal method or step-down method are rare. Yukcu & Ozkaya (2010) state that the direct method is the common default method for most of the software systems, which makes it the only choice for most of the companies.

4.2 The current costing method

The way in which the company currently calculates the cost price model is shown in Figure 4.10.

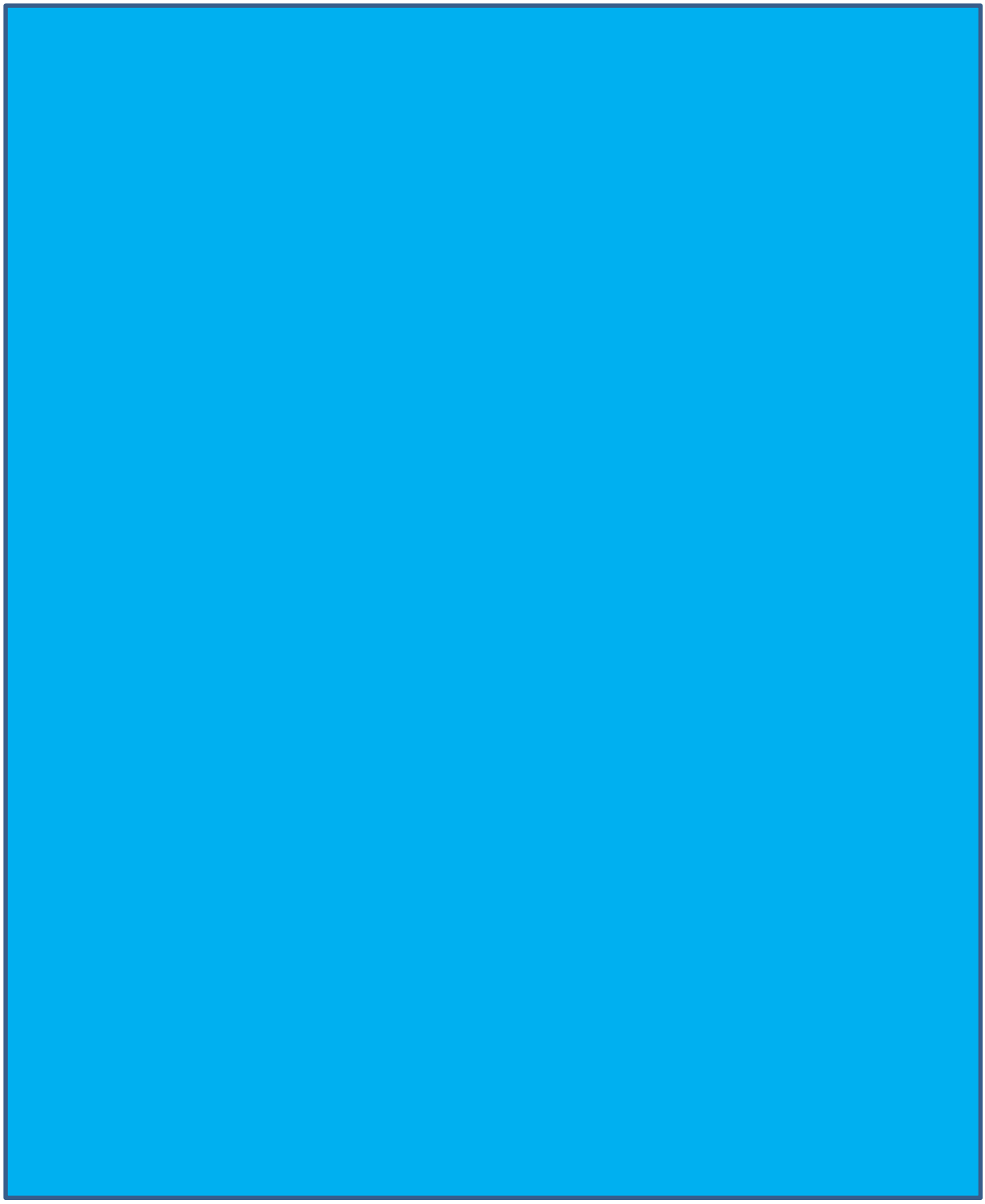

Figure 4.10: a schematic representation of the costing method.

4.3 The recommendations on the costing method

We would recommend Company X to use the absorption method when constructing the new cost price model. This choice is elaborated upon by using Figure 4.11.

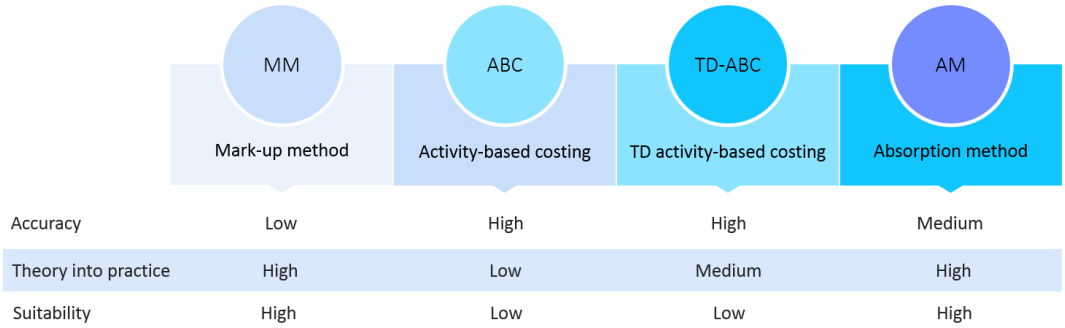

Figure 4.11: the characteristics of the costing methods.

Although the mark-up method is very easy to put into practice and it is suitable for this type of company, the method does not provide the accuracy that Company X desires. The method actually provides the lowest level of accuracy of all of the methods. One of the main criteria of Company X is to provide more accuracy, so this method is not suitable. Activity-based costing does provide a high level of accuracy, but it is both hard to apply and not suitable. Time-driven activity-based costing is an improvement in comparison to the activity-based costing, but it lacks suitability as well. This is due to Company X performing so many different activities in order to produce and deliver their wide variety of products, that it is simply not possible to apply this method. One of the main issues of Company X is performance. If the company would implement either activity-based costing or time-driven activity based costing, the servers would not be able to cope with the enormous amount of data. For example, Excel would fail to process the data and crash when these methods would be used. The absorption method offers an average level of accuracy, but this can be altered by applying more specific cost centres. Furthermore, the method is easy to put into practice and is suitable for this type of company. Therefore, the absorption method is used. Because of this decision, we have to determine which allocation method to use. We will once again elaborate on this decision by using Figure 4.12.

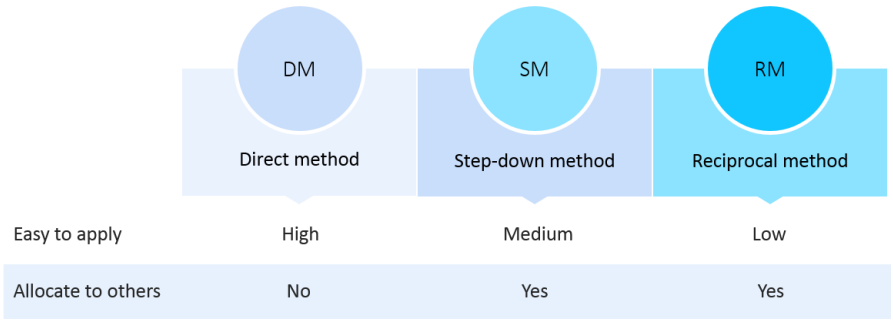

Figure 4.12: the characteristics of the allocation methods.

There is actually just one criterion; it should be easy to implement. There are no service departments that have to be attributed to other service departments in the current hierarchy, so it is not necessary to apply a difficult method. That is why we choose to implement the direct method.

5. The implementation in ERP system XY

In this section, the way in which both the distribution and the production cost price model are implemented are covered. The implementation in ERP system XY and the way in which the new cost price model can be implemented are discussed as well.

5.1 The distribution cost price model

We will first discuss the distribution cost price model.

5.1.1 The current implementation in ERP system XY

The calculation of the distribution cost price model is given in Figure 5.1.

Figure 5.1: the calculation of the distribution cost price model.

The different modules that play a role in the cost price model and their relationship are depicted in Figure 5.2.

Figure 5.2: the different modules that play a role in the distribution cost price model and their relationship.

5.1.2 The implementation of the new cost price model in ERP system XY

Now that has been identified how the distribution cost price is calculated in ERP system XY, we can determine whether changes have to be made in the system to be able to implement the new model. The method in general will remain the same, which is positive as another method could change the system quite drastically.

5.2 The production cost price model

We will now discuss the production cost price model. Many different modules are involved in the calculation of the model as well as a very different calculation.

5.2.1 The current implementation in ERP system XY

The calculation of the production cost price in ERP system XY is provided in Figure 5.3.

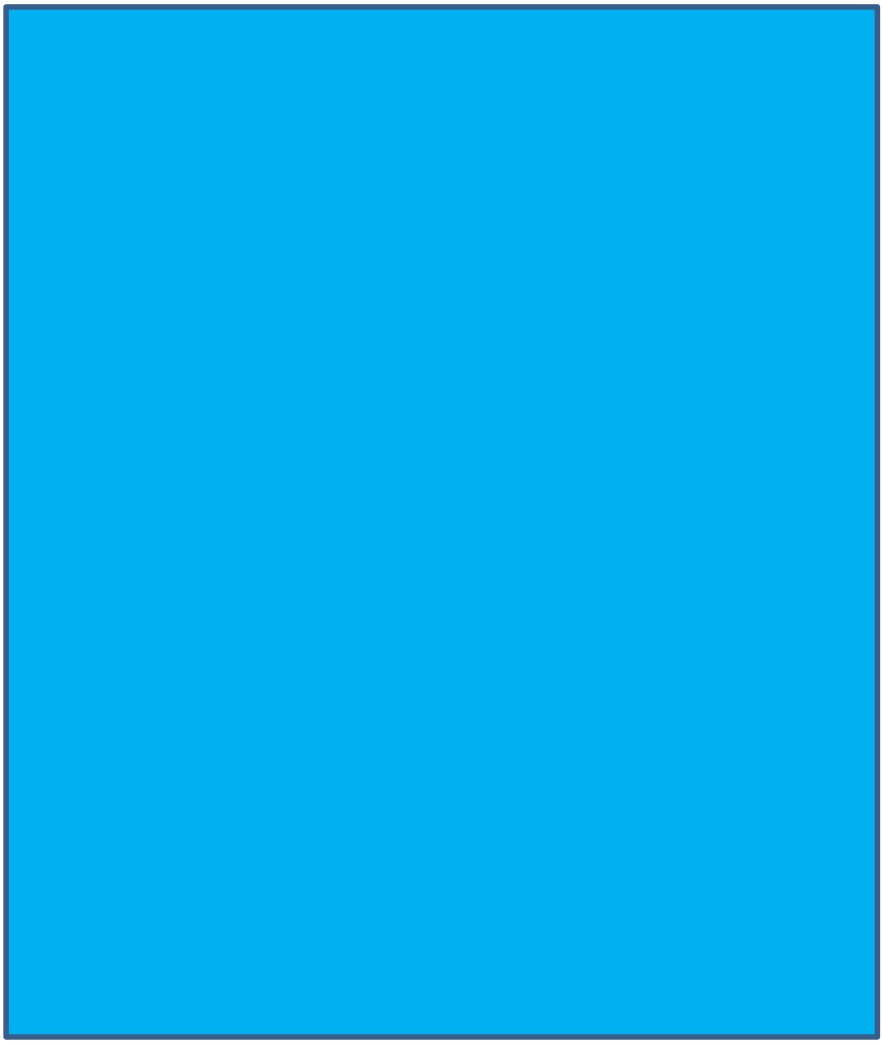

Figure 5.3: the calculation of the production cost price model.

The different modules that play a role in the cost price model and their relationship are depicted in Figure 5.4.

Figure 5.4: the different modules that play a role in the production cost price model and their relationship.

5.2.2 The implementation of the new cost price model in ERP system XY

The calculation by the absorption method will be much more accurate, and this will alter the coverage of the indirect costs as well. This does however not affect the calculation in ERP system XY. The only changes are the values of the coverages. The way in which the cost price is calculated is therefore not changed.

6. The deliverables

6.1 The income statement

Company X does not have enough insight into how the costs are defined. This can be improved by critically assessing the definitions of the costs. The theory states that there is no template to construct the cost price model, although there are some common elements. The analysis leads to a clearly defined number of costs and a conformation of the applicability of the model.

The old model did not use the theory as described in some books. In contrast, the model was made without theory whatsoever. Our analysis showed that the model already contained elements as described in the theory. Our research resulted in a model, which is in line with the theory.

6.2 The results per department

The results per department have significantly been changed throughout the course of the research. We would first like to explain what the results per department model actually does. It compares the forecasted costs with the actual costs. The costs are forecasted by using the coverage. For the production departments for example, the coverage equals all of the costs calculated by the recipe. This includes the direct costs, which are directly attributed and the indirect costs, which have to be allocated by using coverages. The changes in the costs have already been discussed in the income statement, so we will not go over this again. Instead, we want to elaborate on the most important new changes and we will give arguments as to why certain decisions were made.

The departments

As mentioned earlier, we would like to improve the cost price model, although the same method is used. The update on the cost centres greatly contributes to this improvement. The company has changed so drastically that the cost centres did not represent the company anymore. First, we added new distribution departments to the model. Instead of five distribution departments, the new model has ten different departments. This growth is mainly because of the expansion of Location B, Location C and Location D. Next to that, the small warehouse has been added to the central warehouse.

Furthermore, new production departments have been added. Instead of just six production departments, the company now has ten departments. This is due to some departments adding so much costs to a department with which it was merged, not splitting these departments would result in unrealistic financial data. Next to that, convenience departments have been added to both Location D and Location E.

In addition, new supporting departments were added to the model. Although the number of departments has more or less remained the same, the names of the departments have changed. The main reason for this change is the significant alterations in both the distribution and the production departments. Next to that, sales departments have been added to the model. These departments have such far-reaching consequences for the model that we discuss them individually.

The sales departments

In the previous model, the revenue was used to determine the results per department. This has changed however. Currently, all of the revenue of a location is transferred to an individual sales department. Instead of the revenue, the coverage is used to calculate the results per department. The company does not want to have internal profit or losses within the company. Therefore, a coverage is used to deal with the indirect costs of the department. Ideally, subtracting the costs from the coverage amounts to zero. In this case, the coverage equals the costs and no internal profit nor loss is made.

This does have some consequences for the model because this would mean that no profit could be made in the most ideal situation. Therefore, the company introduced sales departments. All of the sales and the costs involved in making these sales are dealt with by using these departments. This is done for each separate department and provides the possibility for the company to make results per location.

The allocation bases

The direct costs are very easy to attribute to the cost centres. This is however not the case for the indirect costs and therefore, allocation bases have to be used. Allocation bases are usually based on the cost driver of the specific cost. Next to that, a causal relationship is preferred and the base is preferably larger than one because this makes sure that a minor change does not greatly affect the calculation of the values. We will now discuss the different supporting departments and their respective allocation bases by analyzing the different departments and their costs.

Logistics warehouse and Location E

All of these supporting departments will directly be attributed to their respective departments. One might wonder why we are able to this, since we just mentioned that we had to use an allocation base to attribute the indirect costs to the departments. The costs involved in these supporting departments are however semi-direct. Although they are indirect costs such as housing costs and general costs, the departments are so specific that they can fully be attributed to the respective department.

General Location A, general Location B, general Location C, general Location D and overhead

The allocation of the costs associated with these departments are probably the most significant change due to the implementation of the ERP system. Before the system, all of the costs were attributed to a supporting department after which one allocation base distributed the costs over the operating departments. Because of ERP system XY, the costs of the supporting departments are attributed to specific cost centres. We can now create specific allocation bases for these cost centres. By combining these allocation bases and the information provided by the supporting departments (for example, general Location A should only be attributed to departments in Location A), we are able to create a much more accurate model. An overview of the cost centres and their respective cost drivers and allocation bases is given in Table 6.1.

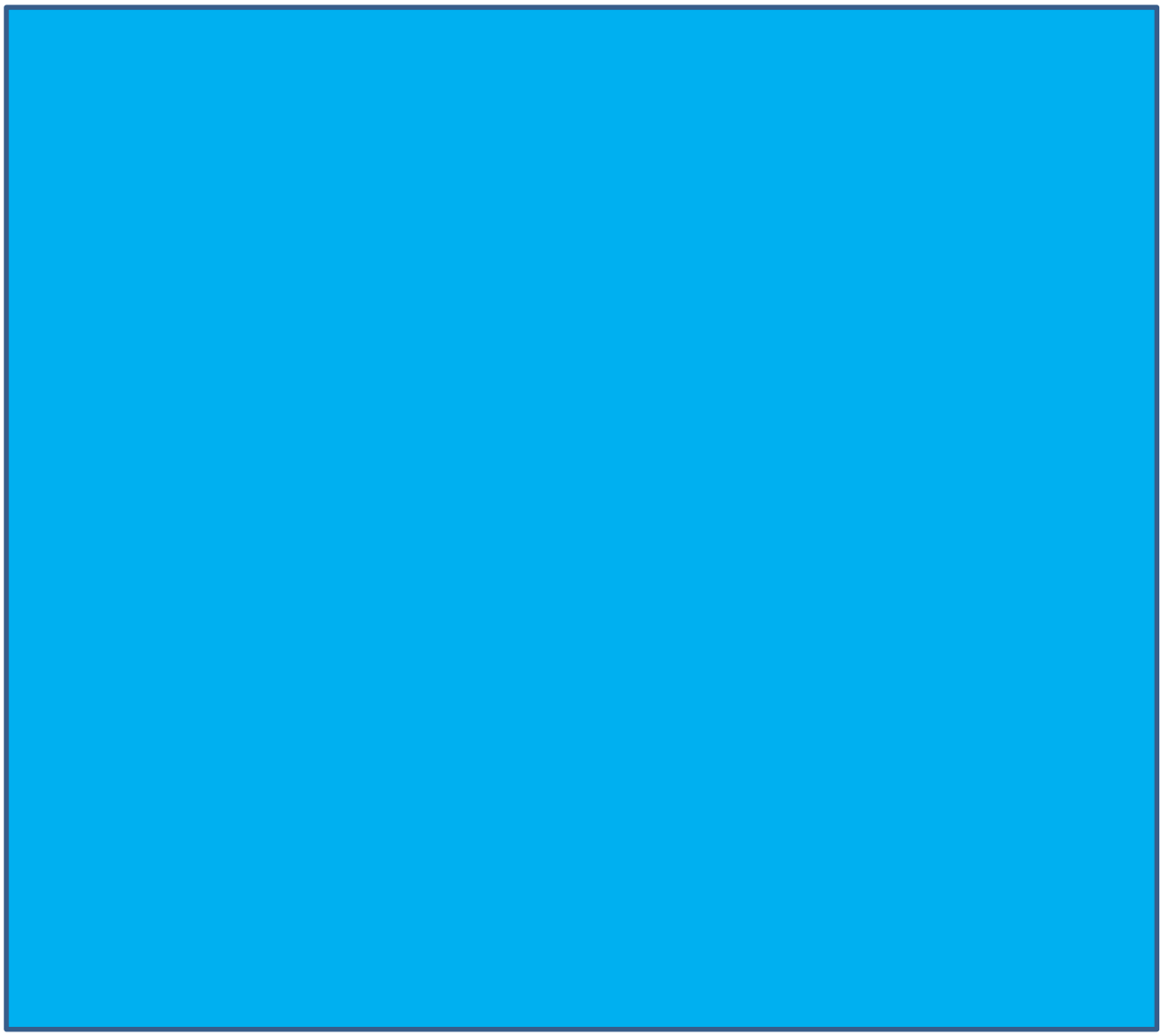

Table 6.1: the cost centres and their cost driver and allocation base.

The allocation bases can be attributed to three categories:

- **Revenue**: revenue is used as an allocation base because it usually takes resources to obtain revenue. Therefore, the more revenue, the more resources (results in costs) should be assigned to a department. We differentiate between external revenue at sales price and internal revenue at cost price. External revenue at sales price accounts for revenue obtained from selling products to customers, while internal revenue at cost price refers to the internal revenue without coverages through which we obtain the sales price. The internal revenue at cost price was not hard to obtain as it was just a matter of analyzing a document. On the contrary, it was quite hard to obtain the data for the external revenue at sales price. We were not able to directly relate the revenue to the individual departments because the ERP system allocates all of the revenue to the sales departments. After a lengthy conversation with the BI-specialist, we obtained a document in which all of the products with its revenues were linked to specified versions of our departments. We were able to logically attribute these specified versions to our departments because of the clear link between the two and this resulted in the external revenue at sales price.
- **Number of employees**: some cost centres are strongly related to the number of people that work in a certain department. This indicator is used for human resources for example because the work that these people have to put into a certain department is related to the number of people that work in that department. We reached out to human resources and they were able to directly provide the employees per department.
- **Squared metres**: the number of squared metres that a department occupies can be an accurate indicator of cost centres that involve costs that increase when the space increases. Take housing costs for example. These costs are strongly related to squared meters because the more space a certain department occupies, the more rent has to be paid among others. There was no document in which the data was provided, so we had to do some research of our own. We contacted the technical service to find out if they were able to provide the data that we sought. They sent us a floor map in which Location A was divided into different departments and linked to the number of squared meters. This document covered the necessary data of Location A. Next to that, we obtained the number of squared meters for Location B, Location C and Location D.

We would have liked to use several different allocation bases if the necessary data were available. For example, we would have preferred to allocate transportation of goods on the basis of volume and not external revenue. We think that this would have resulted in much better allocation bases because the volume has a strong relationship with the costs it incurs. Unfortunately, we are not able to do this because of a lack of data. Therefore, more general allocation bases like revenue have to be used. We will elaborate upon this issue in the advisory report.

The calculation

The first step in the construction of the model is to attribute the revenue and cost price to the sales departments, the direct costs to the operating departments, and the indirect costs to the supporting departments. This is straightforward as the data is provided by the financial report. About ten percent of the revenue could not directly be attributed to the sales departments by ERP system XY. We therefore linked these goods to the departments by using a QlikView report. Similar issues popped up every now and then, but we were always able to solve them by using other reports. We used the steps depicted in Figure 6.1 to attribute the indirect costs to the operating departments.

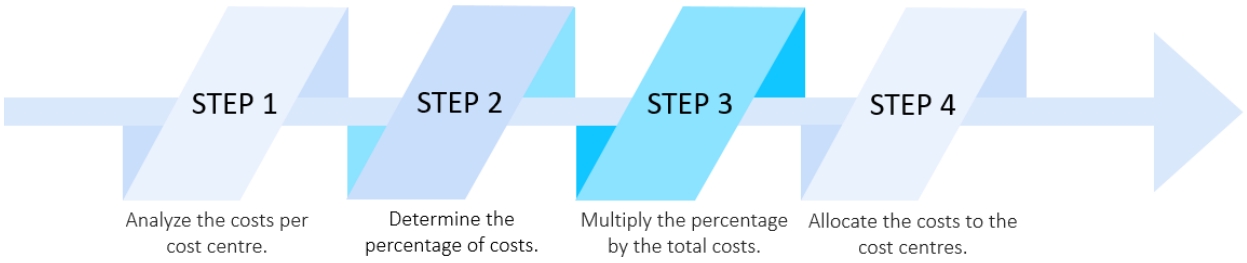

Figure 6.1: the steps involved in the calculation of the results per department.

The indirect costs of the supporting departments have to be attributed to the operating departments. Even though the allocation bases and data were already identified, this proved to be quite a difficult job. Before the costs could be allocated, we had to determine which part of the costs had to be attributed to which department. The first step in achieving this was to determine which cost centres were associated with which mutation. Let us analyse an example of the allocation of the costs involved in human resources to show how the steps are put into practice. The human resource costs are allocated on the basis of FTE and contained the costs as depicted in Table 6.2.

Costs to be allocated	Mutation human resources (600)
General Location A	108.043,00
General Location B	35.054,00
General Location C	29.587,00
General Location D	17.956,00
General logistics centre	-
Overhead	79.126,45

Table 6.2: the costs that have to be allocated.

All of these cost centres had to be allocated in a different way. General Location B had to be attributed to the departments Freezer Location B and Cooler Location B for example, while overhead had to be attributed to all of the departments. The percentages were calculated by adding all of the FTE's per department and dividing the individual department by the obtained value. This calculation can be seen in the Excel file 'Financial models; sheet Pre-calculation'. The calculation of the percentages of our example is given in Table 6.3.

Mutation human resources	FTE	Percentage overh.	Costs overh.	FTE	Costs
A	31,15	10,00%	7.909,22	12,82%	13.850,81
B	7,43	2,39%	1.887,38	33,33%	11.684,67
C	6,27	2,01%	1.591,15	33,33%	9.862,33
D	1,92	0,62%	486,66	9,91%	1.778,59
E	11,80	3,79%	2.996,11	4,86%	5.246,86
F	14,87	4,77%	3.774,76	66,67%	23.369,33
G	12,53	4,02%	3.182,31	66,67%	19.724,67
H	3,83	1,23%	973,31	19,81%	3.557,17
I	49,60	15,92%	12.593,81	20,41%	22.054,58
J	2,00	0,64%	507,81	0,82%	889,30
K	15,50	4,97%	3.935,57	6,38%	6.892,06
L	2,80	0,90%	710,94	1,15%	1.245,02
M	5,98	1,92%	1.517,10	2,46%	2.656,78
N	22,25	7,14%	5.649,44	9,16%	9.893,44
O	10,82	3,47%	2.747,28	4,45%	4.811,10
P	36,60	11,74%	9.293,01	15,06%	16.274,15
Q	13,60	4,36%	3.453,14	70,28%	12.620,24
R	8,20	2,63%	2.082,04	-	-
S	43,24	13,88%	10.978,96	17,80%	19.226,62
T	11,25	3,61%	2.856,46	4,63%	5.002,30
Total	311,64	100%	79.126,45	400,00%	190.640,00

Table 6.3: the calculation of the costs per department.

The last step is to multiply the obtained percentage by the costs attributed to the specific supporting department. Mistakes are easily made and therefore, we used a control tool to check whether the costs were allocated in the right way. A logical test in Excel compared the costs before allocation by the costs after allocation. A value of 1 would appear when the values equalled each other, while a 0 indicated a wrong calculation. This ensured that no mistakes were made. When we compared the total results according to the financial report with the results that we achieved by the above calculations we noticed that there was no difference whatsoever. This shows that the indirect costs have accurately been allocated.

6.3 The results per location

Because the current results per department utilize sales departments, the step towards the results per location is rather small. By subtracting the internal gross profit and the cost price of goods sold from the revenue per sales department, we obtain the result. This is not the final value however. We still need to deal with the other departments. The results per department are added to the corresponding sales department. When all of the results are added, we obtain the results per location.

6.4 The functional/technical design of the new production cost price model

Company X currently applies the absorption method. There are several methods available to construct a cost price model: the mark-up method, activity-based costing, TD activity-based costing and the absorption method. The absorption method is chosen because it provides a medium level of accuracy, while it is very easy to put into practice and suitable for this type of company.

The results per department are essential to the production cost price model because the coverages are calculated by using the data provided by this model. The coverages are used to cover the indirect costs of the department. Two types of cost prices are calculated at Company X: the production cost price and the integral cost price. The production cost price equals all of the costs, which are incurred when the product leaves the company, while the integral cost price equals all of the costs involved from manufacturing to delivering the product. Because of this difference we are not able to compute one coverage for all of the indirect costs. Instead, we have to compute a coverage for the indirect production costs and a coverage for the indirect distribution costs. We use the following formulas for the calculation of the coverages:

$$Production\ coverage = indirect\ production\ cost\ /\ weight\ of\ internal\ and\ external\ deliveries$$

$$Integral\ coverage = indirect\ distribution\ costs\ /\ weight\ of\ external\ deliveries$$

The weight of internal and external deliveries is used because all of the goods are produced in the production departments. The external weight of deliveries is used for the integral coverage because the internal deliveries are not distributed to the customers.

First, we explain how we obtained the indirect production and logistics costs. The total amount of indirect costs was calculated by using the allocation bases in the results per department. We had a conversation with the BI-specialist, controller and information manager to determine whether the cost centres consist primarily of either production or distribution costs. We did not use a ratio between the two options because the company prefers ease of use over accuracy.

The data of the external deliveries is obtained by creating a QlikView report on the information of ERP system Y. The data on the internal deliveries is available in ERP system X at the moment because the production module of ERP system Y is not used yet.

6.5 The functional/technical design of the distribution cost price model

Company X currently applies the absorption method. Several methods are available to construct a cost price model: the mark-up method, activity-based costing, TD activity-based costing and the absorption method. The absorption method is chosen because it provides a medium level of accuracy, while it is very easy to put into practice and suitable for this type of company.

We will not perform a new calculation of the coverages, as nothing has changed. Although we were not allowed to research the coverage extensively, we do have some recommendations on future research and our own view of how the calculation should be altered. Because this is strictly a recommendation, this is discussed in Chapter 7.

6.6 The functional/technical design of the premium service models

The lack of insight into how the premium services that Company X provides translate into costs and benefits is seen as a problem by the company. The common factor of these services is that they provide a varying level of detail from extremely basic to very extensive, while they do not incur additional costs for the customer. The improved insight and the application of additional costs for premium services can be obtained by modelling the premium services of the company.

We created a new model based on the results per department in which service departments have been added. This was necessary to be able to construct the premium service models. The services consist of distribution, quality, project management, administration, and ICT services. These costs have to be removed from the cost centres they are currently assigned to. Next, the costs should be added to the service department at hand.

This means that we first had to identify which costs are associated with the different services. This was done by going through all of the cost objects and then assigning it to one of the services if possible. For example, the cost object logistics/transportation of goods was assigned to the service distribution. Once this was established, these cost objects were further analysed to see which costs they consisted of. The main purpose of this analysis was to identify which costs had to be removed from which cost centres. Next to that, if we were able to notice a cost driver that was significantly higher than all of the other costs, we had an indication of a possible indicator that we could use for the premium service model. Now that the costs associated with the services have been identified, the associated cost centres should be subtracted and added to the services.

7. The advisory report

We mentioned several times that the biggest constraint during our research is the time aspect. We were able to construct the model, but we are not present once the model is implemented in the company. Therefore, we discuss what we recommend the company to research in the future.

Premium services

We identified premium services as services that should be removed from the cost price model because they incur varying amounts of costs while the customer pays the same amount of money. Because of this characteristic, we recommend Company X to conduct research on how to remove these services from the cost price model. We were able to assign costs to the different services and determine which indicators could be used to link the services to the customers. However, we do not have data available regarding these indicators. Therefore, we recommend the company to gather the data. This is not a matter of difficulty, but it will take some time to gather enough data for the indicator to become valid. The number of MI reports can for example be measured by simply counting the number of reports in an Excel file and directly attributing those reports to the customer at hand.

Once the models are constructed, the company has to choose what to do with these models. Company X can choose to not act on it whatsoever. We do not recommend this option because the premium services would still not be accounted for. Instead, we would recommend the company to use one of the ways in which revenue can be obtained by utilizing the premium services. Figure 7.1 shows three possible options.

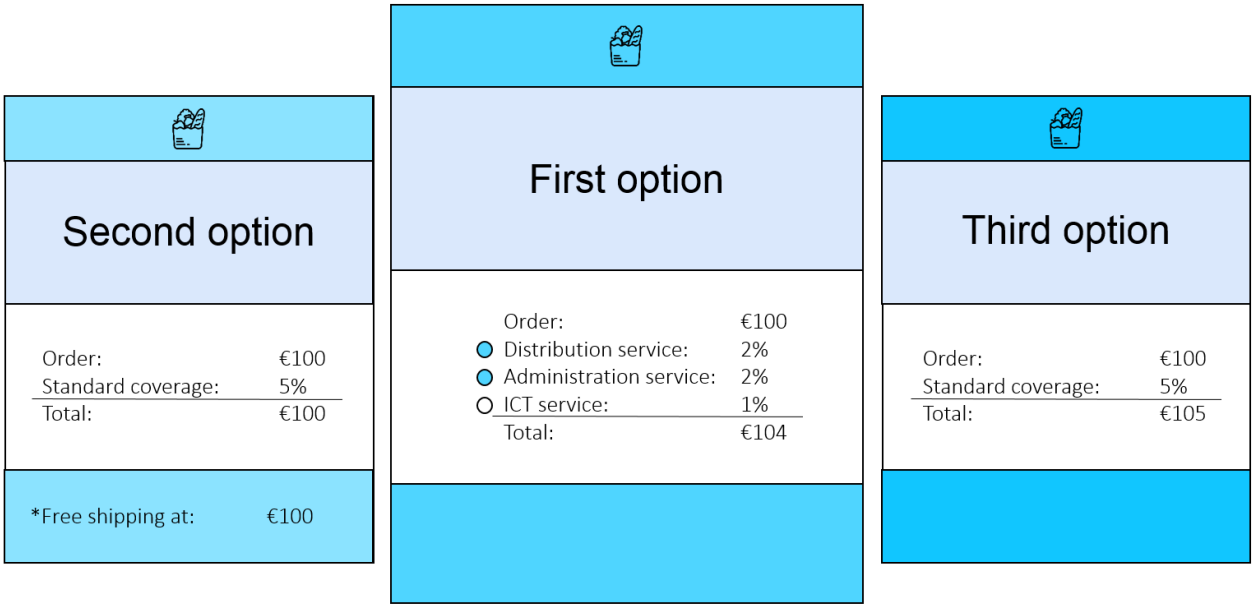

Figure 7.1: the three options of offering premium services.

The first option is to incorporate the premium service costs in the cost price model itself. This involves calculating a new coverage, which has to account for the premium service costs. This is quite similar to the coverages that are currently used to account for the indirect costs. Instead of just tackling the customers who actually make use of the services, this would involve all of the customers of Company X as the percentage is used in every single product. It would therefore lead to a small increase in price of all products.

The second option actually elaborates on the second option. We could calculate at which amount of sales the premium services are covered on average. Until this amount is reached, a premium is incurred. Once the amount is reached, the premium is removed. Some companies already use this concept. For example, Bol.com delivers their products for free once the price of the order exceeds €20. This gives incentive to the customer to order some more products if their order is close to the €20 mark.

The third option is to make the customers pay a premium if they wish to make use of a service. This is similar to the way in which for example Bol.com copes with its premium services. We do not know how the customer will react if they have to pay more for the same products and services all of a sudden. The company could cope with this problem by using the power of the salespersons. This would involve the customer to become dependent on Company X to the extent that it would either be impossible to switch suppliers or would incur a very large amount of costs. This phenomenon is called vendor lock-in/dependency. The company can do this by assigning a salesperson to multiple customers. This salesperson would become responsible for all purchases of that company. Because of this dependency, the company is not able to switch to another supplier easily.

We recommend Company X to apply the third option because the costs are assigned to the appropriate customers. The other options fail to fairly distribute the costs over those who actually are responsible. This could potentially lead to a drop in sales as the increase in price is not fair to those who do not use the services. Next to that, we can use the salespersons to negate the effects of the sudden increase in price.

The distribution cost price model

One of the most important results of our research is the new calculation of the coverages of the distribution cost price model. Although we are convinced that the coverages are more accurate, we cannot say for certain. We would need data of the next period to implement our calculation. Once implemented, we would be able to compare the actual costs to the calculated costs and assess the validity of our calculation. We recommend the company to conduct this analysis in the future. If this analysis shows that our coverage does not accurately represent the indirect costs, then the system needs to be fine-tuned. If the analysis on the other hand shows that the calculation is quite accurate, then the companies needs to assess the attribution of the variable direct costs. At the moment, this is calculated by multiplying the time spent on an activity by the salary. This is still based on data of 2012. We think that it is very likely to be outdated at this point in time. This is caused by the increase in salary over the years and the characteristics of the machines. These machines are either outdated, which causes more costs, or renewed and therefore likely to incur less costs due to improvements of technology.

The distribution cost price model

Although we were not able to conduct research on the distribution cost price model, we do want to recommend the company to apply some changes to the way in which the model is calculated at the moment.

The distribution cost price model does not use a recipe to calculate the cost price. Instead, the model is fully calculated in ERP system XY. This offers possibilities concerning the method of calculating the coverages. There are no costs that are specifically assigned to the production of the product and the distribution of the product because the distribution departments do not produce any products. Therefore, we are not able to implement the same calculation as is used to calculate the production cost price model.

We do not agree with this current calculation because it is very unlikely that the same percentage should be used for every single department. Next to that, we do not think that there is a clear relationship between the net purchase price and the indirect costs. Therefore, we seek to create a model in which the coverages are calculated for each department individually and which is based on an indicator with a clear link to the indirect costs.

The process of distribution consists of registering the order, picking the order and setting the order up for distribution. By a clear mile, most time is spent on picking the order. Therefore, we think that this is a good indicator to represent the indirect costs of the distribution cost price model. We illustrate the model by using an example in Table 7.1.

Object	Item	Costs
Location A	Indirect costs	€9.000
	Number of picks	100.000
	Indirect costs per pick	€0,09/pick
Order Janssen	Number of picks	15
	Indirect costs of order	€1,35

Table 7.1: the calculation of the indirect costs per department.

The indirect costs per pick are calculated by dividing the indirect costs by the number of picks. The indirect costs per order are calculated by multiplying the indirect costs per pick by the number of picks. We already obtained the data on the indirect costs per department by our results per department model. At the moment, the company does not have the number of picks per department available. We are therefore not able to calculate the coverages at this point in time.

The logistics service

We managed to create a model for the premium service logistics in which the costs are compared to the revenue of an order. We already established that we have to obtain more data to be able to implement the model. If the company is able to get the model to function fully, then there are some very interesting ways in which the model can be used.

Among others, the company would be able to determine which route to take to incur the least amount of costs when delivering orders to customers that are located between two locations. This is what we call a 'grey area' because we are not sure whether to deliver the order from one location or the other. We can use the model to see which route is more beneficial by simply computing the formula. This could potentially save tons of money as there are some doubts on whether the optimal routes are utilized at the moment. The optimization of the routes is not adequate because the process is restricted by the time constraints that the customers impose. If a new customer is added to the company, then the allocation to a route is based on its location and time of delivery. This is a severe problem that Company X is currently trying to cope with. The model could prove to be of significant value in solving this problem.

Preferably, the amount of orders transported is equally distributed over the course of the day. Company X however copes with a large peak in the morning, while the afternoon is relatively calm. This results in a shortage of trucks in the morning and an excess of trucks in the afternoon. This is caused by most customers preferring an early time slot because the order is processed on the same day. We are able to reduce the number of trucks when more trucks ride in the afternoon. This would significantly reduce the costs because the costs involved in leasing and maintaining the trucks would be removed. The change is not only beneficial in terms of costs, but also in terms of carbon emission. This would imply the company to find a way to convince the customer to prefer delivery in the afternoon instead of the morning. If we calculate how much costs would be removed when a customer switches timeslots, then we can offer a discount to the customer as an incentive to switch. This could possibly lead to a win-win situation; the customer has to pay less while the company obtains more profit as long as the discount does not outdo the removed costs.

8. The conclusion and discussion

This section intends to provide an overview of the research by determining whether we actually found a solution to our research problem. We will dissect the problem in different aspects and discuss whether we achieved our intended goal for each aspect. Our research focussed on answering the following main problem:

The current cost price model does not satisfy Company X's needs

We discuss all of these needs to determine whether we fulfilled them or not and how we achieved this result.

The definition of the cost price

The company wanted to have a document in which all the aspects of the cost price are defined in terms of cost objects. We conducted a critical analysis on the definitions of the cost price. We used the current income statement as the foundation on which we were able to create our own model. All of the costs were assessed on whether they met the theory and the practice of the company. The current income statement is improved because it is stated in one document and all of the costs now resemble the theory. This is exactly the result that the company wanted to achieve, so we think that we managed to successfully fulfil this need.

The method of the cost price

Company X wanted us to determine whether their costing method was the most suitable method for the company by analysing the different methods. We conducted a literature research on all of the costing methods to gain insight into their properties, usage, and advantages and disadvantages. Next to this research, we created examples to clearly illustrate the implementation of each method. This resulted in an overview of all methods. Next, the methods were assessed on the criteria as stated by the company. The choice for absorption costing was mainly based on the suitability for the company. We think that the result was in line with the expectations beforehand as we were able to make a choice with arguments to back this choice up.

The insight in the premium services

The company wished to gain more insight into how the premium services affected the company. The first step in gaining this insight was to determine which services had to be seen as premium. These services are characterised by a large difference in utilization between different customers while each customer pays the same price and being accountable for a large part of the total amount of costs. We identified five premium services. All of the costs involved in the services were identified and correctly attributed to the corresponding service. We preferred to conduct research in all of the services, but the time constraint forced us to focus on one premium service. We chose to focus on the logistics because of its very large amount of costs in comparison to the other services.

We created a model in which the costs can be attributed to specific customers and compared to the revenue. Yet, we are not able to implement it yet due to a lack of data at this point in time. Although we succeeded in gaining insight in all of the services, we would have liked to conduct some more research in the services besides the logistics service. This means that we did fulfil the criteria as mentioned before the research, but not to the extent in which we would have liked to.

The integration between the cost price model and the other financial control models

We wanted to research to what extent the cost price model affects the other financial models and how to solve any issues that might arise. Very early in the research however, we discovered that the cost price model would not have significant consequences for the other financial models. The value of the cost price might change, but we do not think that this has far reaching consequences for the other financial models. This does not necessarily mean that there will be no issues in the future, because the implementation of the model will be conducted in a later stage. We are not able to determine the issues that might arise, let alone solve these issues. Therefore, we were not able to conduct this part of the research effectively.

The implementation of the cost price model in ERP system XY

Company X wants the model to become directive in the ERP system in the future. This means that it is used as a control measure, foundation for the results per department, implemented into the net added value per organisation model and even budgeting. Although this was not prioritised by the company, we did need ensure that these functionalities can be added in the future. The model could already be used as a control measure, but it is much more accurate because of our research. The cost price model is used in the calculation of the results per department in our research as well. Due to time constraints, we were not able to model a net added value per organisation model. The organisation is not ready to budget on the basis of the cost price model yet and therefore, we did not focus on this during our research. We think that we fulfilled this need to quite some extent.

All in all, we are very satisfied with the results that we were able to achieve. The model has significantly improved over the course of the research and we feel like it really adds value to the company. The research constantly changed over the course of time. Although the project plan was very extensive and contained everything we thought we would need, the reality sometimes forced us to slightly alter the project plan. As time passed, less changes were needed and changes that had to be implemented were less significant. We experienced our time at the company as very pleasant. Because we were at the office the whole time surrounded by our colleagues we were involved in the day-to-day operations of the company. This resulted in a great learning experience on how such a company operates and will surely benefit us during future researches.

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Appendix I. The systematic literature review

This systematic literature review was used in the project plan to obtain data on the ways in which indirect costs could be allocated by absorption costing. First, the knowledge question should be formulated. This is strongly related to the topic at hand, while also being clear and specific. We will answer the following knowledge question:

How do the available methods for allocating indirect costs work?

This knowledge questions clearly states what we are looking for (how the available methods work). It is however not known which methods are available to allocate indirect costs. Bhimani (2008) wrote a book on costing methods in which we found a section on allocating indirect costs. This book identified three methods for allocating indirect costs: the direct method, the step-down method and the reciprocal method. These three methods will serve as the search strings in our review.

Now that the search strings have been defined, we will have to apply these strings in sources. The first three recommendations on literature databases on the website of the library of the university were Scopus, Web of Science and Google Scholar. Inserting the search string into Google Scholar did not result in the intended outcome. Therefore, the strings will only be applied to Scopus and Web of Science.

Too many results to effectively be analyzed appeared when we search for the strings in the sources. Next to that, most of the articles did not involve cost allocation at all. Therefore, we added the search string "cost allocation" to narrow the results down. Table II.1 show the results of our search query.

Key words/source	**Scopus**	**Web of Science**
"*Cost allocation*"	4054	1506
AND "*Direct method*"	12	2
AND "*Step-down method*"	6	1
AND "*Reciprocal method*"	9	1

Table I.1: results of applying the search strings in the sources.

The following articles were identified:

1. Transmission network cost allocation via nodal methodology considering different dispatching scenarios and tariff zones
2. A novel method for power decomposition in the electric system
3. Cost allocation of transmission usage based on current magnitude
4. Unbundling flows and losses in restructured power systems
5. A new methodology for cost allocation of transmission systems in interconnected energy markets
6. Practical security region based security cost allocation of power systems
7. A direct method for transmission network cost allocation
8. 2008 IEEE Region 10 Conference, TENCON 2008
9. Strategic cost account helps create a competitive edge
10. Adopting more sophisticated cost-allocation methods can help healthcare providers develop advantageous pricing for managed care contracting
11. Use of cost accounting concepts in managing IT projects
12. Improved cost allocation in case-mix accounting
13. Support department cost allocations with a matrix-based reciprocal approach
14. The determinants of hospital cost: a cost-volume-profit analysis of health services in the occupied territories: Palestine
15. Step up the step-down method
16. Health Care Financing Administration—Medicare program; cost reporting requirements for home health agencies. Final rule
17. Lattice allocations: a better way to do cost allocations
18. Service department cost allocations using the net services model and the MDTERM function in Excel
19. Cost accounting and simulation: toward a post-structuralist understanding
20. Transfer pricing and decentralized dynamic lot-sizing in multistage, multiproduct production processes
21. Using reciprocal allocation of service department costs for decision making
22. Removing the computational burden from reciprocal cost allocations
23. Comparison of methods for allocation of service departments' costs to operating departments: a Monte Carlo simulation
24. A Direct Method for Transmission Network Cost Allocation

Still, not all of these articles seemed to be relevant for the knowledge question at hand. Therefore, inclusion and exclusion criteria were used to narrow the results down. Articles should be included when a description of one or more of the methods is given. Furthermore, it should be included when a method is applied in such a way that it is clear how it is applied in general.

An article should be excluded when the method is not mentioned in the context of cost allocation, although the search strings should have already ensured this. Next to that, the article is excluded when the application of the method has nothing to do with the field or research, which I am involved in. The last exclusion criterion is rather obvious but should still be mentioned. If the article cannot be opened, then it should be excluded. An overview of the inclusion and exclusion criteria is given in Table II.2.

Inclusion criteria	Exclusion criteria
A description of the method is given.	The direct method is not mentioned in the context of cost allocation.
	The article cannot be opened
The method is applied in such a way that it is clear how it is applied in general.	The application of the method has nothing to do with the field or research, which I am involved in.

Table I.2: the overview of the inclusion and exclusion criteria.

Assessing the articles on the inclusion and exclusion criteria resulted in the following three articles:

Meeting, D., & Harvey, R. (1998, December). *Strategic cost account helps create a competitive edge*. Retrieved from ebscohost.com: http://web.b.ebscohost.com.ezproxy2.utwente.nl/ehost/detail/detail?vid=0&sid=e1c4b8d6-0ac4-4a4d-91bd-b6dc2de79832%40sessionmgr102&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1405420&db=bsh

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Yukcu, S., & Ozkaya, H. (2010, March). *Comparison of methods for allocation of service departments' costs to operating departments: A Monte Carlo Simulation*. Retrieved from utwente.nl: http://citeseerx.ist.psu.edu.ezproxy2.utwente.nl/viewdoc/download?doi=10.1.1.913.895&rep=rep1&type=pdf\

Table II.3 provides a concept matrix, which shows the topics that are discussed in the articles.

Article/aspect of topic	Direct method	Step-down method	Reciprocal method
Meeting, D., & Harvey, R.	X	X	X
Togo, D.	X	X	X
Yuckcu, S., Ozkaya, H.	X	X	X

Table I.3: the concept matrix.

As can be seen in the matrix, all of the topics are mentioned in all of the articles. This strengthens the quality of the information obtained because multiple articles discuss the different methods. The articles are further analyzed by critically reading the sections that apply to my topic.