Developing a more advanced and insightful cost price model

Industrial Engineering and Management – University of Twente

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Preface and reading guide

This thesis is written to complete the bachelor Industrial Engineering and Management at the University of Twente.

There are a couple of people that we would like to thank for their efforts and contribution in our research. First, we would like to thank the company. The company welcomed us open-heartedly and facilitated us with the right materials and resources. We remember our time at the company as very pleasant. This is because it gave us the ability to sit in the office amongst other colleagues. Every contact person was very friendly, and questions were appreciated. We especially would like to thank the supervisor of the company. Here most questions about managerial and financial related topics were answered with ease. Furthermore, our second thanks go to the IT manager of the company, where we could always go to with data related questions. At the company, we had a great learning experience on how a company in general operates but also on how it operates in this specific sector. The experiences gained will surely benefit us in future research. Finally, we would like to thank Reinoud Joosten, the supervisor of the University of Twente, for his insights and guidance throughout the research.

We provide a reading guide for the reader to give an overview of the contents of our research. The executive summary provides an overview of the main findings of our research.

Executive summary

The concerning company is currently using an abstract precalculative cost price model. During COVID-19, commodity prices increased. This resulted in more pressure on profitability and the need to get more insight into the costs generated. Therefore, the company has set higher criteria for its current cost price model. The current model used an average cost price for the entire product mix. However, all products have different cost prices. This puts the company at risks in selling several products at a loss without knowing it. There is also limited insight where certain costs originate from. Furthermore, the model does also not show how many costs business processes generate. What is more, the current model has a low user-friendliness and is hard to understand.

We intended to solve this problem by researching the following topics:

- The processes at the company.
- The costs of the company.
- Cost price methods.

Based on this knowledge we build a new cost price model which meets the criteria. This results in the following deliverables:

- **Business Process Model Notation**
  This model displays all processes and activities involved at the production line on a global basis. This displays how these processes are interlinked and their chronological order when executed for a single product. This BPMN functions as the foundation for our cost price model and can be found in Appendix A.

- **Justification of the selected method.**
  We justify why we choose the activity-based costing method over the other ones. This is assessed on several requirements from the University of Twente and the concerning company. These requirements are assessed on the methods found in literature. These requirements involve: *time-bound, high accuracy,* and *administrative bound.*

- **Explanations and elaboration on cost price model.**
  For our selected cost price method, we must make several decisions. It is essential to explain each decision made for the model. This is because for the same thing, several decisions are possible. We choose the most fitting one and back up why. We also discuss other decisions which we considered but did not implement.

- **Cost price model in the form of an Excel file.**
  We deliver an Excel file which includes the cost price model. Here all aspects of the selected cost price method can be found. This includes the operational expenses (OPEX), the costs of goods sold (COGS), and the cost drivers used. The Excel file contains an output sheet which shows the cost prices of the product mix. Here is shown how costs are composed and what their major components are. This file enables the user to alter input values and to analyse the financial results with respect to the cost prices. The heart of our cost price model is the Allocation Table which can be found in Appendix F.

To make the model accessible for a large public, we made it in Excel. This file provides a clear overview of the integral cost prices and their contents for several types of products. The model can be used in such a way that inputs can be filled in which results in direct outputs.

- **Advisory report**
  After we made the cost price model, we have noticed some shortcomings or potential improvements for the future which could benefit the model. These are:

    o   Exclude the electricity costs from the occupancy costs.
    o   Add dried products as cost objects to the model.
    o   Exclude gas costs from the occupancy costs.
    o   Find correlation between diameter sizes and packaging types.
    o   Add transport supply as activity.
    o   Add Folding boxes as activity.

- **Disclaimers**
  Our cost price model has a couple of disclaimers with regard to the method implemented and managerial decision making.

    o   When an activity is eliminated from the model, not all its allocated costs are eliminated.
    o   Higher risk of reporting manipulated data when also used as performance measures.
    o   Does not primarily function as guideline for sales department, but sales department should use variable costs as guideline.
    o   It is not an activity-based costing model, but a traditional volume-based costing model.

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List of Abbreviations

Abbreviation	Description
BPMN	Business Process Model Notation: Displays the interlinkage and order of processes of for example a company.
COGS	Cost Of Goods Sold: All expenses required to buy in the raw materials.
GP	Grootpak activity
GPP	Grootpak Product
KP	Kleinpak activity
KPP	Kleinpak Product
OPEX	Operational Expenses: All expenses required to keep the company running.
SQM	Square metres

Introduction

The concerning company processes several field crops. It buys them from growers. These are transported to the company by a third party or by the company itself. The company is responsible for sorting and packaging its products. The products are sorted based on their diameters. Furthermore, the field crops are packaged in several types of packaging, customed to the needs of its customers. This is packaging like big bags, nets, and cardboard boxes. Furthermore, the company has the ability to dry its products. This improves quality and decreases chances of early decay. The company is responsible for processing more than 100.000 tons of field crops annually.

During the COVID-19 crisis, commodity prices took a leap. This resulted in a higher pressure on the profitability of the company. In such times it is essential to have a cost price model which enables the manager to tweak parameters to cut costs and maintain profitable. However, the company is currently using an abstract precalculated cost price model. This model only provides a mere indication of what the cost prices actually are. Due to its abstractness, the true meaning of input values is hard to understand. This is a barrier to adjust input values with the goal of seeing their effects. Furthermore, the model is unable to provide insight into the cost prices of all products. The model only provides the average cost price of all products. This is not accurate and therefore it makes it hard to set up a sales strategy for the product mix. Due to a lack of adjustability and presence of parameters, the company is only able to react on structural changes in the present.

The company would like to have a more detailed cost price model which distinguishes cost drivers. This model should enable the company to adjust its parameters to analyse their financial effects. In this way the company oversees potential changes and can react faster to structural changes.

Managerial Problem-Solving Method

The problem of the company can be identified as an action problem, i.e., when things are not as you want them to be (Heerkens & van Winden, 2021, pp. 21-22). In this case the company does not want its cost price model to be as it is now. Due to the fact that it is an action problem, we apply the Managerial Problem-Solving Method (MPSM) (Heerkens & van Winden, 2021, p. 25). According to this method, several steps have to be followed. These are:

1. Defining the problem.
2. Formulating the problem-solving approach.
3. Analysing the problem.
4. Formulating (alternative) solutions.
5. Choosing a solution.
6. Implementing the solution.
7. Evaluating the solution.

1 Defining the problem

The first step of the MPSM is to define the problem. We do this by collecting all problems of the company and connect them in a cluster based on cause and effect. With this cluster, we identify our core and action problem. As can be seen in our problem cluster in Figure 1, most arise due to the fact that the company uses an abstract precalculative cost price model. The arising problems are:

- Inability to know cost prices of multiple products.
- Limited understanding about construction of the cost price model.
- Sales department has no insight whether it maintains profit margins.
- Inability to forecast cost price with understanding.
- No insight into costs generated at specific processes.
- Difficulty in making managerial decisions with respect to machines and processes.
- The interface of the cost price model is not user-friendly.
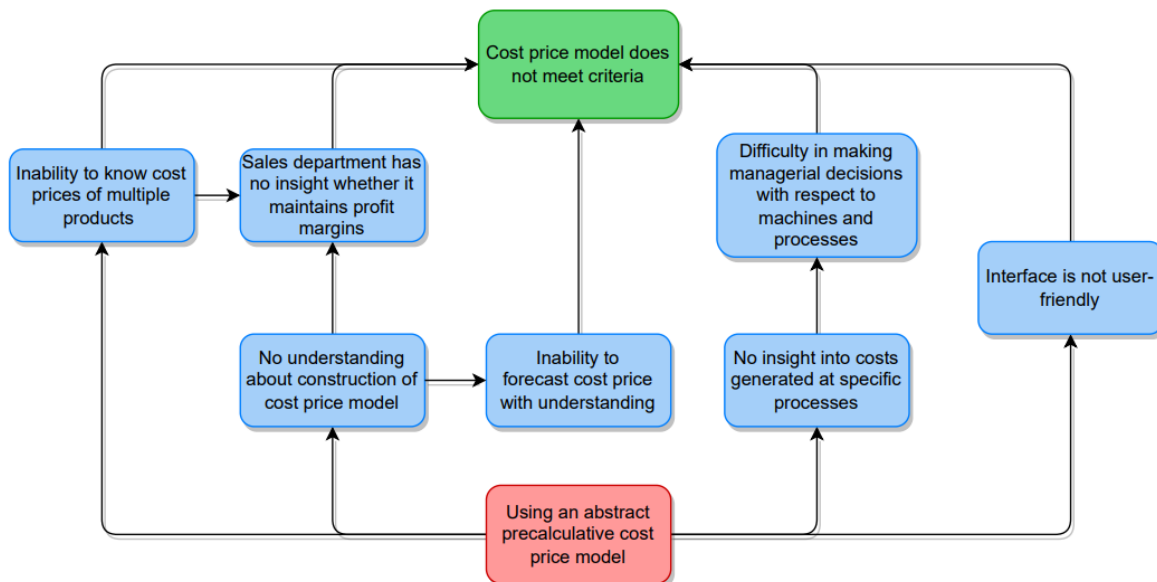
Figure 1 Problem Cluster.

1.1   Core problem

According to our problem cluster, using an abstract precalculative cost price model has no direct cause, see the red box in Figure 1. Nevertheless, this problem is influenceable, i.e., we have the ability to change the current situation by implementing a solution. We can do this by for example implementing a more understandable cost price model. Due to the fact that it does not have a direct cause, is influenceable, and causes many other problems which result in the action problem, we consider it as a viable core problem (Heerkens & van Winden, 2021, p. 44).

1.2   Action problem

The action problem is that the current cost price model does not meet the company's criteria, see the green box in Figure 1. There is an action problem when things are not as you want them to be. This is expressed with the discrepancy between norm and reality (Heerkens & van Winden, 2021, pp. 21-22). The norm is what the company wants to achieve, the reality is the current situation. When the action problem is solved, the reality is at the same level as the norm, assuming the company is not willing to lower its norm. The norm is that the company's criteria are met. To meet these, we solve the core problem, since the action problem arises due to this, see Figure 1.

1.3   Indicators

To get an indication whether we truly solved the action problem, we use the variable: "fulfilment of criteria of the company". This measures to what degree we solved our action problem. We concretise this variable with several indicators. These indicators are the criteria where the cost price model has to suffice to. Based on the extent of improvement of these criteria, we get an indication whether our solution was effective.

- **Justification method**

The company wants us to be critical about the calculation procedure of our cost price model. It wants to know why specifically we choose a method above another method. The method needs to fit with the structure of the company and the limitations set by the University of Twente. These requirements are mentioned after the literature search. Once we have selected our method based on these requirements, we justify our choices made for our cost price model. Therefore, the company wants an explanatory manual of our cost price model, in which all aspects are specified, explained, and justified.

- **Usability**

The cost price model needs to be easy to use. This is especially for the managers and accountants who use the model to forecast the cost price based on forecasted volumes, budgets, and prices. Therefore, a comprehensible user-interface is required. The model also needs to be usable in the future when the company may be subject to structural changes.

- **Insight**

The company wants to have more insight in what the cost prices are of its product mix. Also, the different costs included in a cost price can be analysed. What is more is that the company is able to see at what processes these costs are actually generated the most. The model has the ability to show the financial effects when certain parameters are adjusted. In this way the company is able to make managerial decisions with respect the product mix, processes, and costs. Last but not least, the model provides insight into the cost drivers used. These are also adjustable as input values in the model, to be able to analyse their financial effects.

2 Problem-solving approach

The second step of the MPSM is to formulate the problem-solving approach. We draft a problem-solving approach to describe the activities involved and the knowledge that is required to solve the core problem.

2.1 Investigating processes

We first have to get a better insight in the processes of the company. This is because it is a criterion to have insight in how many costs each process generates. With a better understanding of the processes involved at the company, we can select a cost price model with more ease. We make an overview of these processes with the use of a Business Process Model Notation (BPMN) (Weske, 2007, pp. 205–225). To make this, knowledge is required about what processes are involved and how they are connected. Therefore, our first knowledge question is: *"What processes are involved and how are they connected?".*

2.2 Selecting cost price method

A cost price method is required for our model. This means that we have the next knowledge question: *"Which are the different cost price methods, and which is best for the company?"*. To find out what fits the company best, we have to know what cost price methods are the most convenient and meet the criteria of the company.

2.3 Data requirements and availability

To conduct our calculations with the selected cost price method, data are required to conduct these calculations. Therefore, our knowledge question is: *"Which data are required to conduct the calculations of the selected cost price method?"*. This knowledge question is answered when we have selected our cost price method, since this method shows which data are required to execute its

calculations. To know whether the required data are available at the company. We have the knowledge question: *"Which data does the company have available?"*.

2.4   Building cost price model

Once we have the required data, we start with conducting calculations and building our cost price model. We make our model in an Excel file which functions as a calculation tool. This tool needs to have a user-friendly interface and adjustable parameters or input values. These result in the output of the cost prices for several products. It can also be seen what the actual contents of these cost prices are.

2.5   Assess model

We need to know whether our cost price model fulfils the company's criteria. Therefore, we came up with the knowledge question: *"Does our model meet the company's criteria?"*.

2.6   Scope

We mention the boundaries of our research and what aspects are left out.

We want to finish our project within the time period of 10 weeks. This is the period the University of Twente offers us. Therefore, adherence to this time limit is a killer requirement (Heerkens & van Winden, 2021, p. 77). This time-limit restricts us in doing follow-up research in specific aspects of the company. Nevertheless, we mention some follow-up research with respect to our research later.

With respect to the cost price method, the level of modularity of most cost price models is arbitrary. This means it is in our own hands, how specified we make the model. A cost price model can be quite plain, but also extremely sophisticated. This means that we have to keep the time limit in mind while building our cost price model. Furthermore, the company does not want to have an overcomplicated model that no one is able to use.

Our model enables the management team to forecast its cost prices based on inputs. These inputs include for example, estimated costs and volumes. These have to be forecasted and might in the end be not as precise as expected. This influences the reliability of the outputs of our model. However, it is not our scope of the project to improve the forecasting procedure of the inputs but to enhance the company's cost price model.

The previous financial manager provided a suggested selling price for the sales department. This resulted in discussion from the sales department, since they felt they were not taken seriously. This is because of the discrepancies between the beliefs of the sales department of the actual market value and the suggested selling price provided by the finance department. Therefore, our model does not provide a selling price. Nevertheless, it provides the cost price which can be used by the sales department. However, the outputs ought not to be decisive for the sales department. On the other hand, the sales department might use it to have an indication whether it is maintaining its profit margins in the long-term.

3   Research design

The third step of the MPSM is to analyse the problem. This includes re-examining the problem identification and problem cluster and filling in missing details. These are already included in our problem cluster, see Figure 1. The third step also involves setting up the research design. This includes how we solve the knowledge questions mentioned in the problem-solving approach. We elaborate on the solving method for each knowledge question.

3.1   Which processes are involved and how are they connected?

To know which processes are involved and how they are connected, we conduct a descriptive study, because the deliverable includes a BPMN which includes *which* processes are involved, and *where* they are located in the production line (Schindler, 2018, p. 75). For our data collection design, we use a record analysis (Schindler, 2018, p. 154). This involves using historical data.

The research population is the whole collection of processes that are part of the production line. All other processes performed outside the company or that are not part of the business are excluded. These are for example the outsourcing of services or rental of houses. Our data collection method involves requesting a sophisticated blueprint which includes all processes and their subprocesses. Hence, some remarkably small processes are mentioned which do not have to be included in our cost price model specifically. Therefore, we cluster these together with similar properties. A cluster represents a specific process within the company. In the end, we have a meso-overview of the processes in our BPMN, compared to the micro-overview of the blueprint.

3.2   Which are the different cost price methods, and which is best for the company?

We investigate which cost price method to use by executing a literature review into the various kinds of cost price methods. Based on the requirements of the company and the University of Twente, we assess the methods. We rank these requirements based on priorities. Based on whether these are fulfilled, we determine if the cost price method can be considered viable for our model. Once, we have selected our cost price method, we obtain more knowledge about the required data for the execution of the method.

3.3   Which data does the company have available?

We have to know whether the data required for this method are available at the company. Therefore, we research the availability of these data. Based on the required data, we conduct an interview with the supervisors of the company and ask whether they are able to deliver these data. We see this interview as a nonbehavioral observational study. This is because you ask the supervisors themselves what is available in the data system. Here you actually look at what the current situation is. It can be seen as a physical condition analysis (Schindler, 2018, p. 154) since it questions the availability of particular data in the data systems. However, if missing required data comes in vast amounts, a reconsideration about the cost price method might be necessary.

3.4   Does our cost price model meet the company's criteria?

We want to know whether we solved our action problem. To measure this, we identified several indicators to measure the variable: *"fulfilment of criteria of the company"*. These criteria are *justification method, usability,* and *insight*. We give our opinion about whether these criteria are met. Based on this, we can make a conclusion whether we solved the action problem.

3.5   Validity

According to Schindler (2018, p. 237) validity consists of external validity and internal validity. Here the external validity is the data's ability to be generalised across persons, settings, and times. Since the vast majority of data obtainable in our research meet these conditions, we may state that the external validity of our research is high.

Internal validity is about the ability of a research instrument to measure what it is purported to. Since there are several ways to calculate the cost price, it is discussable whether the internal validity is high. Nevertheless, our model is backed with valid arguments and concrete values. Other methods might have a different but similar value as output. Therefore, the internal validity can still be seen as adequate.

3.6 Reliability & Limitations

The reliability has to do with the accuracy and precision of a measurement procedure (Schindler, 2018, p. 237). When we look at the reliability of our model, we have to look at it in two ways. The first way is when the model is used to calculate the historical cost price. Here the inputs are based on data of previous years. In this case, the reliability is high since the true values are used to calculate the cost price. However, when the model is used to forecast the cost price for the coming year, the inputs have to be estimated. This estimation procedure does not fall in our scope. One could imagine that these estimations are less reliable when calculating the cost price. Therefore, the measurement of the cost price itself is less reliable.

It has to be mentioned that cost price calculations are based on several subjective decisions. Furthermore, companies have a dynamic character, processes change. This means that the model has to be adapted in the future according to these changes. This means that when this model is replicated later in the future, outputs may differ from ours.

3.7 Deliverables

In the end we deliver the following items to the company. These deliverables comply with the criteria and attribute to the solution of the action problem.

- **BPMN**
  We provide a BPMN which includes all the processes of the production line. This enables the reader to make a better visualisation of the actual business process. What is more, is that it serves as a support for our choices made for our cost price model.

- **Explanations and elaboration on our cost price model**
  We justify our choices for the cost price model. This includes the definitions of variables used, the way costs are calculated and why they are calculated in a particular way. Therefore, this explanation can also be seen as a more in-depth manual about how the model works and why it executes calculations in a particular way.

- **Justification method**
  We provide a literature review about the several types of cost price models. Here we also motivate why we selected our cost price model over the other ones. These factors include the criteria of the company and our killer requirement.

- **Cost price calculation tool**
  We provide an Excel file which functions as a calculation tool for the cost prices of the company. We pay attention to make the interface user-friendly. In this tool we embed our cost price model and add input fields which can be filled in, and automatically result in output values. Output values of the model are how many of each operational expense is allocated to the activities, how much each activity contributes to the cost price, and the contents of the cost price with respect to cost types. This tool can also be used to forecast future cost prices.

- **Advisory report**
  During the creation of our cost price model, we came across several shortcomings or alternative ideas. Due to our killer requirement, which is to build the model within the restricted timespan, we are unable to implement these alternative ideas in our model. Therefore, we recommend and mention these in our advisory report. Furthermore, we mention several risks, disclaimers and pitfalls associated with the cost price method and cost prices in general.

- **Disclaimers**

We provide certain disclaimers about our cost price model. In the end it must be clear for when the model can be used and not.

4 Theoretical framework

The fourth step of the MPSM is to formulate alternative solutions. We formulate potential solutions in our literature review. Prior to our review, we had little understanding in the basic concept of cost prices. To get a better understanding, we consulted an accountant that is familiar with the material. This accountant provided sources to improve our basic understanding of the concepts of calculating the cost price and the cost price methods involved. These sources helped us to find the right search terms for our search strings for the literature review. We use the provided sources, to answer our knowledge question. The knowledge question is: *"What are the different cost price methods?"*.

We define what we mean by the cost price in advance. With the cost price, we actually mean the integral cost price, this means that the cost price of a product includes all costs the company makes. This includes both the direct and indirect costs. The direct costs are directly retraceable to the products, like the purchase price of raw materials. However indirect costs are not directly retraceable to the products, like occupancy expenses and administration costs. The investigated cost price methods show diverse ways for allocating the indirect costs. The reason we put so much effort in methods for allocating the indirect costs is because this is the most difficult part of integral cost price calculation. In the literature we find the following cost price methods for allocating the indirect costs to products.

1. Mark-up method.
2. Allocation of service department costs.
   a. Direct method.
   b. Step-down method.
   c. Reciprocal method.
      I. Lattice Allocation (LA).
3. Activity-Based Costing (ABC).
4. Time-Driven Activity-Based Costing (TD-ABC).

4.1 Mark-up method

The first method we investigate is the mark-up method, here the direct costs are increased with a mark-up to be able to calculate the integral cost price. This mark-up is a percentage on the direct costs which serves as coverage for the indirect costs. The sum of these direct costs and indirect costs per product results in the integral cost price. To determine the mark-up percentage, the mark-up base has to be determined (Faber, 2017). This includes the direct costs on which you want to have a mark-up. The formula for the mark-up is as follows:

$$Mark-up = \frac{Indirect\ costs}{Mark-up\ base} \times 100$$

Consider for example the following scenario from Bakker and van Houten (2018):

Types of costs	Direct Material costs	Direct Wages	Indirect costs
Total	€100,000	€200,000	€70,000

Table 1 Primitive Mark-up method example, given information.

Consider that the company makes several products. The manager decides to cover the cost price of product A by increasing the direct material costs with a mark-up. In this case the mark-up base is €100,000 since the manager has decided to cover the indirect costs with the direct material costs. The mark-up is: (€70,000/€100,000) × 100 = 70%. It is given that the material cost of product A are €80, and the wages are €200. Now we can determine the integral cost price of product A.

Cost type	Product A costs
Material costs	€80
Wages	€200
Mark-up	70% × €80 = €56
Integral cost price (total)	**€336**

Table 2 Primitive Mark-up method example, calculation.

In this case the indirect costs are divided by only one mark-up base. It is possible to have several mark-up bases. The method where only one mark-up base is used is also known as the primitive mark-up method. When several mark-up bases are used, it is known as the sophisticated mark-up method. An example of this is given in Table 3. In the next example, a further analysis states that €30.000 is related to the direct material costs and €40.000 to the direct wages. This means that our mark-ups are:

- Material Mark-up =   (€30,000/€100,000) × 100 = 30%
- Wages Mark-up =   (€40,000/€200,000) × 100 = 20%

Now we can determine the cost price of product A with the sophisticated mark-up method:

Cost type	Product A costs
Material costs	€80
Wages	€200
Mark – up material (30%)	30% × €80 = €24
Mark – up wages (20%)	20% × €200 = €40
Integral cost price (total)	**€344**

Table 3 Sophisticated Mark-up method example, calculation.

Of course, we can apply this method to several types of products. To keep overview, the example shows only one type of product.

To come to the integral cost price with the use of the mark-up method a couple of steps have to be taken. At first, we make an analysis of the indirect costs. Then, we have to look at possibilities to group the indirect costs together with the direct costs and look at causal relationships. After that, we have to determine the mark-ups. Finally, we calculate the integral cost price of each product.

The biggest benefit of the mark-up method is the fact that few resources are required. This makes the method cheap, and easy to adapt. When there is a reorganisation within the company, it has almost no influence on the cost price. Especially for less complex organisations, the mark-up method is useful.

The problem with the mark-up method is that the calculation of the cost-price cannot be considered accurate. This is because, most of the time indirect costs are not coherent with direct costs. Furthermore, using this method for several products gives them all the same mark-ups. This is not true

in reality. Another disadvantage of the mark-up method is the fact that it divides the direct costs directly over the products and not over different departments or activities. So, this method does not provide insights into the costs of departments.

4.2 Allocation of service department costs
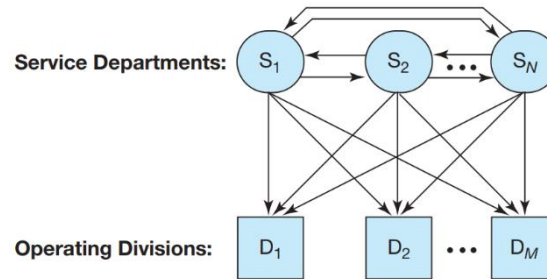
Figure 2 Reality/Reciprocal method approach.

Here, we distinguish two types of departments. These are the support and operational departments. With this method we allocate indirect costs by allocating the support department costs. The end goal is to know how much of the indirect costs are allocated from the support departments to the operational departments. This can be computed in three ways (Zimmerman, 2016, p. 333-343):

1. Direct method.
2. Step-down method.
3. Reciprocal method.

We first explain what support and operational departments are. Support departments are fictional departments, these departments are not present at the company, for example, occupancy and maintenance (Faber, 2017, p. 81). These departments are used to divide the indirect costs. During this process there is a hierarchy. The support departments allocate their costs to operational departments like sales and production. This is done with the allocation base.

For example, with occupancy the allocation base is the number of square metres for each cost object. So, if an operational department has 700 square metres in use of the allocation base of 1000 square metres (total), then 70% of the occupancy costs are allocated to this operational department. Based on these percentages between support and operational departments, we calculate how much the support departments allocate to the operational departments. Figure 2 gives a representation about the allocations between support (service) and operational departments in reality.

4.2.1 Direct method
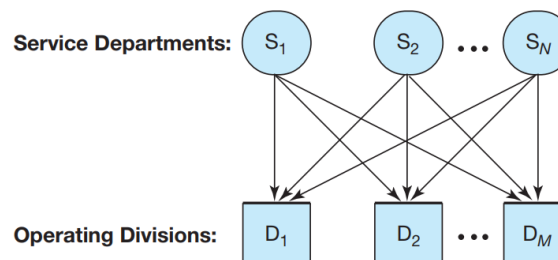
Figure 3 Direct method approach.

The direct method is the most applied cost allocation procedure Togo (2011). This is because the direct method is the simplest to use. In this method, only the support department costs are allocated to the

different operational departments. In the direct method, the costs generated by services between the support departments is excluded. Figure 3 gives a representation about the allocations between the support departments and the operational departments using the direct method. Due to the fact that these allocations between the support departments are excluded, the method cannot be considered as an accurate method. However, because there are few complex calculations required, we can say this is the easiest method to apply with respect to allocating support department costs.

4.2.2 Step-down method
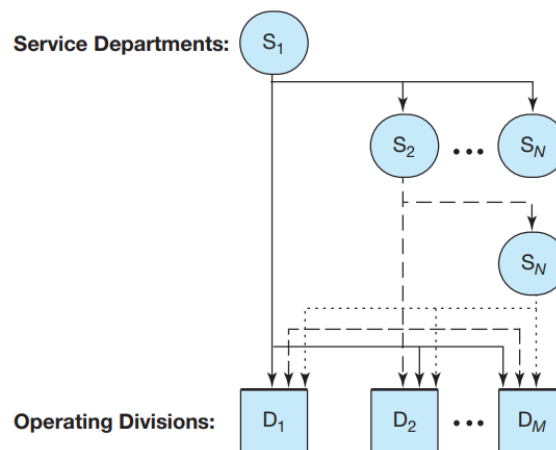
Figure 4 Step-down method approach.

The step-down method is compared with the direct method a step further in the integration of the allocation between the support departments. However, this method allows for a partial recognition of support services provided to other support departments. This partial recognition occurs when a closed support department cannot receive allocations from remaining support departments (Togo, 2011). For example, in Figure 4, where support department S_1 is taken as starting point. Here S_1 cannot receive allocations from other support departments. When all costs are allocated, S_2 is taken as starting point and the process starts over. The costs are all allocated to the operational departments or the remaining "step-down" support departments until there are no support departments left and all costs are allocated to operational departments. These allocations are likely to be different when other support departments are taken as starting points. This method may be closer to reality. However, it does not involve all cost allocations between the support departments. What is more, these costs are not allocated the same way as the support departments operate in reality. This method might be more accurate, however does not fully represent reality.

4.2.3 Reciprocal method

The reciprocal method includes all the support services among the support departments entirely, see Figure 2. The base for this method is the table of the reciprocated cost allocations and the table of the department costs (Zimmerman, 2016, p. 342). This involvement of all the services makes the results of the reciprocal method very realistic. However, the problem with the reciprocal method is that it only gives the relationship between the support departments and the operational departments. It does not give a direct relationship between the products and the costs allocated to these products. Furthermore, to make this method work, the support and operational departments have to be defined first. This is quite a time-intensive task. After the departments have been defined, the interdepartmental relationships have to be determined which is very time-consuming. Mirzamohammadi et al. (2019) provides a complex but sophisticated way in determining the relationships between these departments. However, this goes beyond our scope and experience.

With the use of the allocations and costs table, a set of independent linear equations have to be solved simultaneously. This calculation procedure can be quite challenging, and errors are made easily. Therefore, several ways have been developed to calculate these equations with more ease. Togo (2011) introduces a way of solving these equations with the use of matrices. Still for this method, there are many steps involved.

Lattice Allocation (LA)
A comparable method for calculating these types of equations with more ease and efficiency is introduced by Bent & Caplan (2017). This method, which is applied for the reciprocal method, is called *Lattice Allocation (LA).*

In this method, the percentages that are allocated to the different departments, are put into a matrix. In this matrix, the costs of the operational departments are allocated to themselves. This matrix is taken to a high power, which cancels out the cost allocations between the support departments. This is because the operational departments have an absorbing state (Privault, 2018, p. 93). The result of this matrix provides insight into how much each support department allocates its costs to each operational department in terms of percentages. There are a couple of advantages mentioned about LA (Bent and Caplan, 2017):

1. It is easy to learn and implement.
2. It is less prone to error.
3. It highlights for downstream managers precise information about the original source of the costs allocated to them.
4. It is applicable for different numbers of departments.

LA contributes a lot to the reciprocal method with regard to the calculation procedure. However, the reciprocal method is not widely implemented by managers, since its implementation is just too complex and time-consuming (Mistry, 2019).

4.3 Activity-Based Costing (ABC)
With activity-based costing, the cost price for each activity per product is calculated. The ABC method is quite comparable with the reciprocal method with regard to its allocation bases. But here the allocation bases are used to directly allocate the indirect costs to various products. The ABC method follows a two-stage procedure to allocate overhead costs (indirect costs) to cost objects (Kim et al., 2011). In the first stage, overhead costs are allocated to activity centres, in accordance with the way resources are consumed by the activities. In the second stage, the activity centre costs, are allocated to each cost object, in accordance with the way cost objects consume activities. The steps involved to calculate the integral cost price with the use of the ABC method are:

1. Define the most important activities.
2. Divide the indirect costs over these activities.
3. Determine how the cost pool is divided amongst the products.
4. Determine the costs for each activity cost driver.
5. Determine the integral cost price of each cost object.

According to Bhimani et al (2008), a lot of organisations recognise their cost prices as accurate when using activity-based costing. Nevertheless, finding a usable cost driver, is the most difficult part of the ABC method (Bakker & van Houten, 2018, p. 147). Due to this, a basis for assessing and selecting these allocation bases to make this process easier, is provided (Kholkin, 2020). The ABC method is explained in the following example from Bakker and van Houten (2018), here the company makes two types of chairs. Chair A and Chair B. The following information in Table 4 is given:

Information	Chair A	Chair B
Number of square metres wood per chair	2	4
Purchase price 1 square metres of wood	€2.50	€2.50
Number of labour hours per chair	0.5	2.5
Costs per labour hour	€75	€75
Production in chairs	15,000	5,000
Selling price	€80	€260
Indirect costs	€250,000	

Table 4 ABC method example, given information.

Now the activities are named, with their cost pools in Table 5. Furthermore, the cost drivers and their costs per unit are mentioned in Table 6.

Activity	Cost Pool
Occupancy	€100,000
Processing salaries	€40,000
Supporting managers	€30,000
Processing invoices	€60,000
Processing offers	€20,000
Total indirect costs	**€250,000**

Table 5 ABC method example, given divisions of total indirect costs.

Cost driver	Chair A	Chair B	Total	Cost per unit
Surface used	750	250	1,000	€100
Number of paycheques	60	100	160	€250
Number of managers	1	2	3	€10,000
Number of invoices	7,500	5,000	12,500	€4.80
Number of offers	150	100	250	€80

Table 6 ABC method example, calculation of cost per unit per cost driver.

Based on this information, we calculate the cost price.

Cost type	Cost for Product A	Cost of Product B
Material (direct costs)	2*€2.50 = €5.00	4*€2.50 = €10.00
Wages (direct costs)	0.5*€75 = €37.50	2.5*€75 = €187.50
Occupancy	(750 x €100)/15,000 = €5.00	(250*€100)/5,000 = €5.00
Processing salaries	(60 x €250)/15,000 = €1.00	(100*€250)/5,000 = €5.00
Supporting managers	(1 x €10,000)/15,000 = €0.67	(2*€10,000)/5,000 = €4.00
Processing invoices	(7,500 x €4.80)/15,000 = €2.40	(5,000*€4.80)/5,000 = €4.80
Processing offers	(150 x €80)/15,000 = €0.80	(100*€80)/5,000 = €1.60
Integral cost price (total)	**€52.37**	**€217.19**

Table 7 ABC method example, calculation of integral cost price.

4.4 Time-Driven Activity-Based Costing (TD-ABC)

The TD-ABC is a more in-depth extension with regard to the allocation bases, here they also use the amount of time spent for a certain activity. Since it includes the time per activity, it does represent reality better. However, it is administration intensive to keep track of how long certain activities take. A disadvantage is that specific software is required to execute TD-ABC and keep it up to date (Bakker & van Houten, 2018, pp. 150-151). On the other hand, there are four advantages of TD-ABC in comparison with ABC:

1. More accuracy.
2. Highlights what department has overcapacity.
3. Cheaper to implement.
4. Easier to keep up to date.

TD-ABC is explained with the following example: suppose you have three activities, activity A, B and C. You also know the following: Total indirect costs: €800.000 and total hours of work: 20.000 hours per year. This means the cost per hour is €800.000/20.000= €40. You also know that the time it takes to perform an activity is 1.5 hours, 8 hours, and 5 hours respectively for A, B and C. Furthermore, the number of activities is 6.000, 500, and 600, respectively. With the use of this information, the allocated costs can be calculated according to Table 8 (Pitcher, 2020).

Activity type	Time taken in hours	Cost per activity	Number of activities	Total allocated costs
A	1.5	1.5 x €40 = €60	6,000	€360,000
B	8	8 x €40 = €320	500	€160,000
C	5	5 x €40 = €200	600	€120,000
Total costs of activities				€640,000
Costs of unutilised capacity	€800,000 - €640,000 = €160,000			
Unutilised hours	€160,000/€40 = 4,000 hours			

Table 8 TD-ABC example calculation procedure.

As seen in Table 8, there are costs left. These are the unutilised costs. These costs cannot be tied to an activity. Assuming all numbers are correct, this can give an indication whether all the activities are included the calculation procedure. we can miss an activity, activities are not performed constantly during the working hours, or costs are generated somewhere that cannot be included in an activity.

5 Choosing a solution

The fifth step of the MPSM is to select one of the possible solutions. In this case, the solution is a cost price model which includes correct cost price method. We define specific requirements that determine our decision about what cost price method we are going to use. These are in line with the demands of the company and the University of Twente. The requirements mentioned here, are not the criteria to fulfil the needs to the company. These are solely meant for selecting the cost price method itself, and therefore is part of the method justification criterion.

5.1 Time-bound

The first requirement is that the execution of the method needs to be *Time-bound*. This means that the method has to be time-bound to set up, execute, and evaluate in a time period of ten weeks. The period of ten weeks is a guideline that is mapped out by the University of Twente for the bachelor assignment. The time-boundness really depends on the availability of data at the company. Therefore, extended research in the availability of data is necessary. Since we have limited time to conduct our project plan, we set this requirement as killer requirement, which means that no other can weigh up against this requirement.

5.2 High accuracy

The company wants a *High accuracy* in the calculation of the integral cost price. With a *High accuracy* we mean that the cost price method represents reality in its best way possible. When literature mentions that a method does not represent reality at its best, this method is considered to not have a *High accuracy*. When theory mentions that the method represents reality quite good, we can say that the method has a *High accuracy*. We use this requirement with the highest priority.

This means that this requirement weighs higher than all other which are not identified as killer requirements. This is because the main goal of the company, is to have a cost price model which is accurate. Nevertheless, it has to be mentioned that 100% accuracy can never be achieved since it is entirely arbitrary what allocation base someone chooses to allocate its indirect costs.

5.3 Administrative bound

The cost price method has to be *Administrative bound*. This means that the method does not require a significant extra amount of administration and monitoring and is able to be implemented in the long-term. This means that the method should not generate high administrative costs. Furthermore, it is not a long-lasting task to rewrite the method when the company is subject to structural changes in the future.

For our literature review we can make the following decision table of our criteria:

Method	High accuracy	Time-bound	Administrative bound
Mark-up	No	Yes	Yes
Direct	No	Yes	Yes
Step-down	Partially	No	Yes
Reciprocal	Yes	No	No
ABC	Yes	Yes	Yes
TD-ABC	Yes	Yes	No

Table 9 Requirement selection table.

The Mark-up and Direct method are time-bound since they are quite simple to use, however this is at the cost of their accuracy. The Step-down and Reciprocal method both are not time-bound. This is because all departments and their interrelationships have to be determined. ABC and TD-ABC are both time-bound due to the flexibility of the methods. The creator has control over the extent of a model. Therefore, it can be seen as time-bound for our project. Furthermore, the TD-ABC might not be that administrative bound. This is because the time for a specific activity needs to be investigated every year. This gives a lot of administrative pressure. Since the ABC method represents reality very well, is executable within our time limit and is administrative bound, we make the decision to use the ABC method for our cost price model.

5.4 Available data

To know whether we are able to apply ABC at the company, we need to do research into the data the company has available. For ABC, we need data of which we can shape resource and activity cost drivers. Furthermore, we need to know the costs of the company. This can be split up into operational expenses (OPEX) and costs of goods sold (COGS). Furthermore, we need to know processes of which we can define certain activities at the company. Based on these requirements and the theory, we ask whether the following things are available:

- Processing times of packaging machines with error rates.
- Wattages of machines
- Sales orders of products
- Volumes of packaging machines.
- Income statement including details of operational expenses and costs of goods sold.
- Map of processes at the company.
- Number of square metres per department.
- Number of hours worked per department.

Despite the fact that the wattages and error rates are the only things that are not available, we are still positive to continue building our cost price model with the use of ABC. This is because we can identify most costs and make resource and activity cost drivers to allocate these costs to activities and cost objects, respectively.

6   Our cost price model

The sixth step of the MPSM is to implement our selected solution. Here we build our cost price model according to ABC. In advance we provide a step-by-step description.

6.1   Business Process Model Notation

To identify the activities for ABC, we first need to investigate which processes are involved at the company. The best way to get familiar with the processes is by setting up a Business Process Model Notation (BPMN). This BPMN provides a good overview of the interlinkage of processes. The first step of making this model, is to request a blueprint which includes all production processes of the company. With this as a starting point, we ask questions about the specification of certain processes. These questions mostly consist of the order of processes, their role in the production line, and their relationships with other processes. Based on the answers, we make a sophisticated BPMN. However, the processes of the blueprint are quite numerous. The BPMN would be hard to comprehend when all its processes are included. Therefore, we cluster the processes with similar goals and properties. These clustered processes have a high potential to be identified as activities for our ABC method. The end result is a BPMN where the main processes of the production line are defined and interlinked. This BPMN can be seen in Appendix A.

6.2   The ABC procedure

In our example of ABC, the activity centre costs, or cost pools, of the activities are known in advance (Bakker & van Houten, 2018, p. 148). However, in practice this is not the case. This means that we need to determine the activity centre costs, with the use of resource expenses and resource cost drivers (Kaplan & Cooper, 1997, p. 84).

To set up our ABC method, we need to take several steps. These are depicted in Figure 5. Based on our analysis of the processes involved at the company, we identify activities. This is the most difficult part of setting up the ABC method. This is because the activities are chosen arbitrarily. However, these

activities have to be tailored in such a way that they can be interlinked with the resource expenses and cost objects (products). What is more, is that activity cost drivers of these activities have to be made in such a way that they relate to a specific cost object.

It is convenient to identify the cost objects at the start of creating the model. In this way we can tailor the activities more to the cost objects. This also enables us to identify the direct costs. These can be directly allocated to the cost objects. Not only identifying the cost objects is essential for determining the activities, but also analysing the resource expenses. These costs have to be allocated to the activities. Therefore, it is crucial to know how these resource expenses are composed and what potential resource cost drivers are to allocate these costs to activities.

When all stages are identified and analysed, we determine the resource cost drivers to allocate each resource expense to different activities. The next step is to determine activity cost drivers to allocate the activity centre costs to the cost objects. In the end, all direct costs are added to the calculated cost prices of the cost objects. The structure of these steps can be found in Figure 6 (Siguenza-Guzman et al., 2013).

Figure 5 Steps order ABC model.
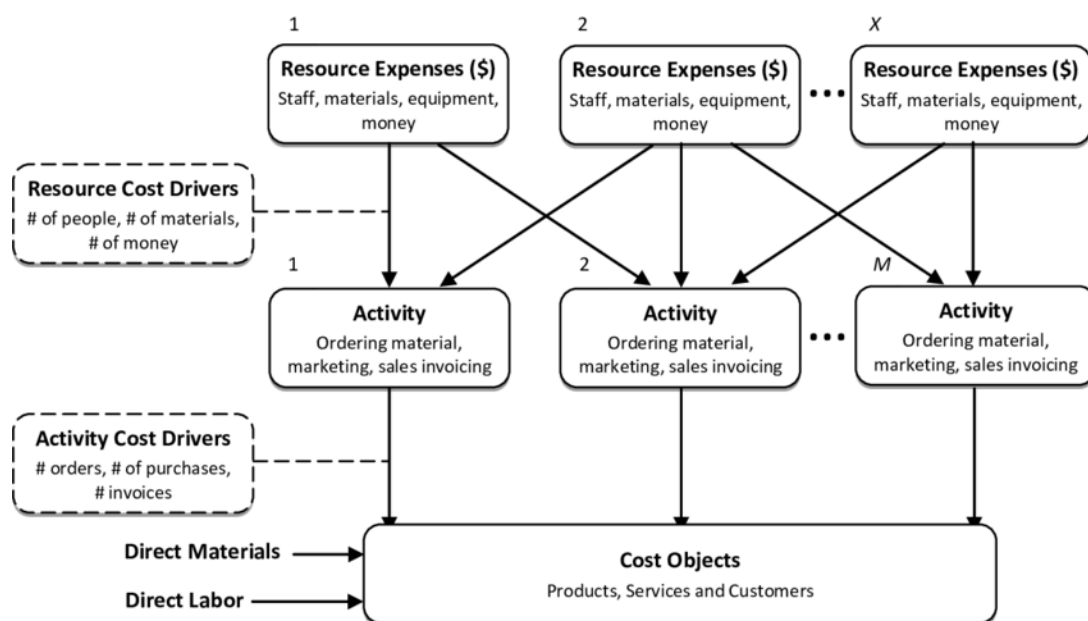
Figure 6 ABC steps structure.

6.3   Cost objects

The company has a tremendously diversified product mix. This has several reasons. The first reason is that the field crops are sold in different diameter intervals. The company is able to deliver each diameter interval to meet the demands of its customer. Furthermore, the company delivers these field crops in various types of packaging. What is more is that there are several species of field crops that can be delivered. To make things even more complex is the fact that the company delivers different quality standards for its customers. All these factors make the product mix really broad and includes more than a thousand types of products. Due to the broad product mix, it is not possible to define all types of products as a cost object for our ABC method. This is because it is impossible to determine the volumes and activity cost centres for each product.

To allocate the activity costs easily to the final products, we divide the final products into two categories. These are the Kleinpak and Grootpak products. The sales volumes of these are known. This enables us to allocate most of the activity centre costs to these two categories. Based on the costs of these categories, we can add the variable packaging costs of each type of product. In this way we calculate the cost price of each product with respect to different types of packaging and their category. However, we do not know the cost prices for different diameters and species.

All cost prices are expressed in prices per 100 kg of field crops. This is because, the sales department already uses this to calculate its cost prices, packaging costs and premiums. For convenience purposes the Kleinpak and Grootpak activities are referred to as GP and KP, respectively. The cost objects, the Kleinpak and Grootpak products, are referred to as KPP and GPP, respectively.

6.4   Activity identification

To apply ABC, we have to identify the activities. Activities are repetitive tasks performed by each specialised group or activity centre within the firm (Zimmerman, 2016, p. 488). Costs are assigned to activities and then these activity centre costs are either directly traced or allocated to products. All activities are interlinked and are not isolated within the company (Sinha et al., 2020).

We divide activities up into two categories, primary and secondary activities. The primary activities are part of the production line and have a direct physical influence on the creation of properties for the final product. These activities are interlinked with each other. This interlinkage can be found back in our BPMN.

Secondary activities support the primary and do not have a direct influence on properties of products. Despite the fact that these are indirect, they are essential for maintaining a consistent stream in the production line. These activities are not included in our BPMN.

Primary activities

We discuss our primary activities. The relationships between these activities can be found back in our BPMN in Appendix A.

Sorting – S

Sorting consists of several processes. Prior to the actual sorting process, crops go through a roller desoiler. This machine is responsible for removing excess material like earth and foliage from the field crops. When this activity is not performed in advance of the actual sorting process, the sorting line is more likely to jam. The excess material is transported to a biogas production plant. The second process of the sorting activity is topping the crops. This means that the unwanted parts of the crops are removed. Thereafter, the crops are sorted based on their diameter. The ones that do not comply with the standards of the customer, are taken out by hand. Different standards are used for different customers. The excluded ones that still have a sufficient quality are sold to customers with lower standards. The crops that do not fit the standards of customers are transported to the biogas production plant. The company is in possession of three such sorting lines, which represent the sorting activity. The final result is having several pallet crates filled with varied sizes of field crops.

Drying – D

This activity is used in two cases. The first case is when the field crops are bought directly from the farmland. This happens mainly during a specific season. These crops have to be dried at the company. Drying the crops improves their shelf life and makes processing them easier. Due to drying, bacteria and fungi have less chances to develop. Crops directly from the farmland arrive at arrival hall 3. Processes performed in this entrance hall are also assigned to this activity. These processes include loading and unloading of field crops. These processes are assigned to this activity since they are

performed with the sole purpose of transporting the field crops to their drying cell. The second case where crops are dried is when a batch comes in which has inferior quality and additional drying treatment necessary.

Grootpak – GP

Grootpak, or big packaging, consists of several processes. We are unable to specify each packaging process as an activity because of several reasons. The first reason is that at times with low volumes arbitrary processes or machines are idle. This means that in these periods, the machine costs might be allocated unfairly to similar machines. Furthermore, the volume of each Grootpak process is not known. To overcome complexity and extensive time consumption, the Grootpak packaging processes are clustered together as one activity. The machines included in this activity are named at the company: GP1, GP2, GP3, GP4, BB1, and BB2. Here the GP processes package field crops in big nets and the BB processes in big bags.

Kleinpak – KP

With Kleinpak, or small packaging, the processes of the machines are clustered together as one activity. This is for the same reasons as with the Grootpak processes. In this activity, several machines are involved: KP1, KP1A, KP1B, KP2, KP2-3B, KP3A, KP3B, and KP TUBE. Here the field crops are weighted and packed in small nets, which are thereafter put in cardboard boxes. Finally, the boxes are stacked on pallets for export.

Arrival – AA

Arrival consists of two machines. These are the big bag emptier and the Box filling machine in arrival hall 2. The big bag emptier operates only during a small period of the year. Furthermore, it is not known specifically how many hours employees work at each process during the year. Fortunately, it is known how long employees work for these processes in total. Due to this reason, we cluster the processes of these machines together and name it Arrival. The main purpose of Arrival is to transfer the arrived transport units in which the goods arrive, into pallet crates. In this way goods can be transported through the company.

- ### Big bag emptier – BL
  The big bag emptier is a special type of activity. Here, mainly pre-sorted field crops arrive in big bags. The big bag emptier is responsible for converting the field crops in big bags into pallet crates. It empties the big bags and directly fills the pallet crates. This is necessary since the internal logistic system is driven on pallet crates which are transported with forklift trucks. This activity can be considered as a special type of activity since the arrived field crops are pre-sorted. This means that these field crops skip the sorting process of the production line.

- ### Pallet crate filling machine – O2
  This is a multi-purpose machine which cannot be directly tied to a specific activity, therefore we made it as one activity. In this activity, pallet crates can be filled or emptied. Here crates are filled with field crops from a belt unloader. Most of the time, these are not sorted yet because the quality is not sufficient enough. They first need to dry before they get sorted. What is more, is that this machine also empties crates. This is mainly done with unsorted crates. these are emptied in a belt unloader for internal transport to the sorting line.

Taring process – TP

The taring process is an important process of the company. Here a sample is taken from each supplier. This sample is assessed on the weight of bad field crops and excess material like foliage. When for example this weight is 5% of the total weight, the company pays its supplier 5% less. However, when this percentage is above 15%, it has the right to cancel the order. In this scenario, the company negotiates with the supplier about an alternative solution.

Secondary activities
We discuss the secondary activities. These are pivotal for the maintaining the streamline of the production line.

Sales department - DP
The sales department is responsible for selling the field crops to customers. The employees of the sales department mainly operate in the office.

Office – O
The office activity consists of a set of processes which are performed at the office and have an indirect contribution to the cost prices of the final products. These are processes like administration, HR, purchasing, IT, production planning, and housekeeping. Despite the fact that the sales department is actually part of the office we did not include it because in this way we directly allocate the sales costs to the sales department.

Internal Logistics – IL
The internal logistics is not a part of the production line. However, it is responsible for the transport of crops between the processes of the production line. Without this activity, other processes come to a halt due to a lack of supply and space. This activity includes forklift trucks transporting pallet crates between activities.

Originally, Arrival is actually part of the Internal Logistics. However, we make the decision to extract Arrival from the Internal Logistics due to several reasons. The first reason is that Arrival has a different purpose in comparison with Internal Logistics. The purpose of Arrival is to receive goods in different types of transport units and transfer these into pallet crates. Whereas the purpose of the "remaining" internal logistics is to transport the goods between processes. Furthermore, Arrival contains stationary machinery to transfer the goods into the pallet crates. Internal Logistics does not contain any stationary machinery. Without Arrival, the Internal Logistics would not be able to operate. Because Arrival differs in properties and purpose, it has a different cost structure compared with Internal Logistics. Therefore, we split Arrival from the internal logistics.

Technical Service – TD
The technical service is essential to support the production process. This activity is responsible for the maintenance and repair of machines. Without the technical service, the production process runs less smooth due to an increase in failing machinery and equipment.

General/Other – A
Other processes that cannot be assigned to an activity or are used in general are assigned to the general activity.

6.5 Resource expenses analysis (OPEX)

We conduct an analysis about which resource expenses are involved in the company and how these costs are structured. The resource expenses are the same as the operational expenditures (OPEX). This is because these costs are generated at activities. We obtain the OPEX from a consolidated income statement of the company. The income statement is consolidated since the company has several subsidiaries to protect its assets. It is the aggregative reporting of the entire business collectively. Some costs are generated at the packaging activities (Kenton, 2020). Since our cost objects divided in two categories with respect to the packaging activities, these costs can be considered as direct costs. Nevertheless, we still allocate these costs to the packaging activities. The reason we do not allocate these costs directly to the cost objects, is the fact that we want to know the costs these packaging activities generate in total. We analyse the resource expenses in the order from high to low costs. The OPEX that we analyse are:

1. Personnel costs.
2. Depreciation expense.
3. Occupancy expense.
4. Inventory costs.
5. General costs.
6. Management fee.
7. Sales costs.

Personnel costs – C1

The personnel costs constitute a major part of the total costs. Employees are essential for picking out excess material, transporting field crops with the use of forklift trucks, and refilling packaging machines. These costs consist of salaries, social charges, and other personnel costs.

Depreciation expenses – C2

Currently, a form of accelerated depreciation is put into practice (Tuovila, 2020). The depreciation costs are calculated with the use of straight-line basis (Liberto, 2022). With accelerated depreciation, shorter lifespans are used in comparison with actual lifespans of assets. Due to these shorter lifespans, depreciations are accelerated. These provide a higher tax deduction in the present, since the cost for purchasing assets are higher than usual. This means that this method of depreciating is fiscally attractive.

Assets purchased a long time ago have a salvage value; however, most assets do not have a salvage value. The current policy of the company does not include any revaluations of its assets when an asset has been depreciated or when they are fully depreciated.

Occupancy costs – C3

The occupancy costs consist of the rent and power costs. The power costs consist of electricity and gas costs. The power costs constitute a big part of the occupancy costs.

Inventory & Car costs – C4

These costs consist of the inventory costs and the car costs. Most inventory costs consist of maintenance costs of equipment and machinery. Some maintenance costs include manufacturing supplies used to keep machines running, it is not specifically known which manufacturing supplies are used for which machine. Furthermore, the car costs consist of fuel costs, insurance costs, maintenance costs, and road taxes.

General expenses – C5
The biggest part of the General expenses includes IT costs, accounting costs, consultancy costs, and contributions/subscriptions. These costs are quite diversified.

Management fee – C6
The management fee is the compensation for the management.

Cost of sales – C7
The costs of sales are generated by selling products. These are for example costs like the PR costs, representation costs, and marketing costs.

A total overview of all operational expenses and their ledger accounts can be found in Appendix B. For convenience, the ledger accounts for the depreciation expenses are not mentioned

6.6   Resource cost drivers
We have to determine the resource cost drivers for each resource expense. The choice of these cost drivers is entirely arbitrary and subjective. Since this is purely a political issue, we back up our choices for resource cost drivers with several arguments. The suggestions that follow from these arguments ought not to be seen as pontificate, since alternative cost drivers may be viable too.

Personnel costs – C1
Currently the personnel costs are not allocated directly but just based on the number of hours worked per activity.

We make this directly by identifying the number of hours worked for each function per activity. These hours are obtained from the personnel planning system of the company. We multiply these hours by the average personnel costs per position. These are estimated by the financial manager of the company. These personnel costs do not include the following ledger accounts: Travel and staying costs, travel allowance, working clothes, canteen costs, charged wages third parties, personnel costs, Study costs, and wage subsidies. These excluded costs are allocated based on the total hours worked per activity.

The personnel costs are obtained from the salary administration system of the company. Because two systems are involved with different descriptions of functions, we have to identify what function of the planning software is the same as in the salary system. Based on the obtained information and synchronisation, we calculate the personnel costs per activity.

We are not able to allocate the costs of the Operations Manager directly to the activities. Since the manager spends most of its time in managing the Sorting, Kleinpak and Grootpak activity, we allocate the Operations Manager costs based on the number of hours worked per activity. The reason why we choose this cost driver is more elaborated in the Management fee section.

All calculations of the personnel costs and the synchronisation of the positions of employees are found in Appendix C.

Recovery costs – C2
Due to accelerated depreciation, lifespans are shorter than they actually are. To come to a realistic cost price, we need to have the actual lifespan of the assets instead of this "fiscal lifespan".

To overcome confusion, we call the costs based on the actual lifespans, the *recovery costs*. This is because you want to earn the assets back during the actual lifespan. These costs are not equal to

depreciation expenses in the income sheet as another lifespan is used to calculate the costs. Since the actual lifespans are not known, we give an inventory list to one of the managers to determine the actual lifespan per asset. We also asked the manager what asset belongs to what type of activity. This enables us to allocate the *recovery costs* directly to activities. With the information provided, we calculate the *recovery costs* of the assets and allocate the these to activities.

Due to several subsidiaries, the *recovery costs* consist of several divisions which are *machinery and devices*, *building related assets*, and *car inventory*. One part of which the machinery and devices consists, is the office inventory. The office inventory only contributes 0.57% of the total purchase value of assets. This makes no significant difference in the cost price. It is time consuming to implement this into our calculation and to ask the activity and actual lifespan per item. Therefore, we make the decision to not implement the office inventory into our cost price model.

For the *building related assets*, most are not directly relatable to any activity. Therefore, we allocate these assets with the use of the number of square metres per activity. We explain how we determine these values per activity in the next section.

In the end we have an overview of all recovery costs and total purchase values per activity per division. This is shown in Appendix D.

Occupancy costs – C3
The occupancy costs consist of two types. These are the rent and the power costs. The power costs consist of electricity and gas costs. We provide a resource cost driver for the occupancy costs with the use of several arguments seen from the perspectives of the costs.

- **Rent**
  Occupancy costs mostly include the rent costs for the spaces used. The activities that are used in these spaces are performed next to each other and not above each other. Therefore, the number of square metres is chosen as cost driver for the occupancy costs.

  If it is the scenario where activities are performed above each other, the number of square metres per activity and the total number of square metres of the facility are not an adequate cost driver. This is because there is an overlap of square metres. Therefore, in this scenario it is more reasonable to use the number of cubic metres of the activities and the total number of cubic metres of the facility. In our case, activities are performed next to each other, and therefore we use the number of square metres to allocate the rent.

- **Electricity costs**
  The electricity costs can be determined by multiplying the wattages of the machines with their operating times.

  An analysis is made whether it is possible to allocate the electricity costs to several activities with the use of wattages and operating times. However, the Sorting, Kleinpak, and Grootpak activities consist of several machines of which the wattages are unknown. For example, KP itself consists of more than thirty different assets. For all these assets, we need to investigate if they consume electricity. If they consume electricity, the wattages and operating times have to be found. This task is time-consuming and complex since for some machines it is hard to measure what their operating times are.

  Since we are unable to know the wattages and operating times of every machine, we need to find another cost driver. As mentioned before, we allocate the rent costs based on the surface of each activity. Applying this for the electricity costs would not entirely result in an accurate

allocation, since the electricity costs are not proportional to the number of square metres. This is because machines with bigger surfaces may have lower wattages than machines with smaller surfaces. The same goes for operating times. Nevertheless, this cost driver is the closest option to allocate the electricity costs in the most accurate way. This is because the number of square metres and electricity costs might not be always proportional, but there is a correlation.

- *Gas costs*
  Most gas costs are generated at the drying activity. This process is particularly done during a specific period of the year. Therefore, the costs specifically generated for the drying activity may be found by comparing the gas bill of this specific period and other periods during the year. However, this period does not start every year at the same time. This depends on what the harvesting time is. The harvesting time depends on several factors. Due to this complexity, we make the decision to use the surface per activity as resource cost driver for the gas costs. This is quite reasonable since the drying cells have a big surface.

  The number of square metres per department per hall was estimated earlier based on the total number of square metres per hall of the company. Here, it was determined per hall how much percent the department takes up surface. Based on these percentages and the total number of square metres of the halls, the total number of square metres were calculated. This method sounds reasonable to us. Therefore, we use it as the basis for our calculation of the square meters per activity. The basis is not an exact fit with our activities. A couple of adjustments had to made to our model. We mention these changes below and the exact calculations of square metres per hall per activity can be found in Appendix E.

- *Technical Service*
  The workplace of the technical service was not included. We estimate the space for this workplace in two ways. We first estimate how many times the rectangular working place fits in the length and width of Hall 1, which was 11 and 4 times, respectively. This means that this rectangular space fits 11x4=44 times in Hall 1. This means that it takes 1/44 = 2.27% of surface of Hall 1. The second way is that we make a rough estimation of the surface of the workplace, this was 80 square metres. Since the total surface of Hall 1 is 3,535 square metres, it takes 80/3,535 = 2.26%. Since this percentage is really close to our previous estimation, we assume the workplace of TD is roughly 80 square metres. Since an extra activity is added to Hall 1, we subtract a total of 80 square metres with an equal division from the other activities in Hall 1 to still achieve a total of 3,535 square metres.

- *Arrival*
  Furthermore, we add the Arrival by using a part of the expedition department. This is because previously a space in Hall 2 was dedicated to expedition. We subtracted this space from the total space of Internal Logistics and added it the Arrival.

- *Sorting*
  Besides, the previous model mentioned the sorting activity taking place at Hall 2. This is not the case for our sorting activity, so we excluded this, and divided these square metres equally among the remaining activities in Hall 2.

- *Expedition hall 3*
  The drying activity involves every activity performed in hall 3, since the main purpose of these activities is to dry the products. Therefore, we eliminate the Expedition department in hall 3 and add these square metres to Drying.

- *Office*
  The purchasing was excluded from the office activities. We include this in the office activity and add its costs to it.

Inventory & Car costs – C4

Since the inventory costs consist of several cost items which can be allocated to several activities, several resource cost drivers are used. We go through these various kinds of costs specifically.

- *Maintenance palletiser*
  The maintenance costs for the palletiser are allocated to activities based on which activities contain a palletiser. We can find back this information in our list with assets and their activities. Based on this we could make the conclusion to allocate 2/5 of the costs to the sorting activity and 3/5 of the costs to the Grootpak activity. Here we made the assumption that the efforts required for the palletisers, are the same for each palletiser.

- *Car costs*
  The car costs are divided among the activities that use cars. To find this, the information about the cars, their license plates and driver names is used. These drivers can be traced back to specific activities with the use of information about the personnel and its departments. With this information, we can say how many cars each activity has. Based on the ratio of cars per activity and the total number of cars, the car costs are allocated to activities. We conclude that 2/12 of the costs go to General, 4/12 to Purchasing department, 4/12 to Sales department, and 2/12 to TD.

- *Insurance of inventory*
  The insurance inventory costs are a big part of the inventory costs. These costs are allocated to activities based on the total purchase value of the assets these activities hold. This is because assets with a high value have higher insurances in general.

- *Sewing assembly*
  The maintenance costs for the sewing assembly are all allocated to GP. According to the provided activities to assets, this is the only activity that contains the sewing assembly. An employee justified this assumption.

- *Maintenance inventory*
  One of the biggest costs of the Inventory & Car costs are the maintenance costs of the inventory. These costs are hard to allocate since we do not really know what these costs specifically include. Therefore, we interview the manager of the technical service department to get a better insight in where they generate the most costs. The manager stated that €60,000 was used for the sorting maintenance and €60,000 for the Grootpak maintenance. Since these values were above the actual costs stated for Sorting and Grootpak maintenance in the ledger accounts, we allocated the excess costs to Sorting and Grootpak. These are €28,212 and €20,171, respectively. The remaining costs of the maintenance of inventory are allocated to the general/other activity. This is €316,722.

- *Internal Logistics*
  The following costs are directly allocated to the internal logistics: Maintenance of forklift trucks, Fuel trucks, Maintenance trucks, Truck road taxes, Insurance trucks.

- *Sorting*
  The costs generated for the maintenance of the sorting line are directly allocated to Sorting.

- *Kleinpak*
  The costs generated for the maintenance of the Kleinpak machine are directly allocated to Kleinpak.

General costs – C5
The general costs are allocated based on the number of hours worked. This is because the constitutes of the general cost cannot be directly allocated to activities. Since the costs are diverse, we cannot think of one general cost driver. We made the assumption that the biggest portions of the general costs are also generated by the activities that have the most working hours in them.

Management fee – C6
The management fee is allocated to activities based on the number of hours worked for each activity. These can be found in Appendix C.

The management fee is a compensation for the management of the company. Therefore, it is not only hard to allocate these costs to the final products but even to activities. We assume that the manager is the busiest in managing where the most hours are worked. However, this way of reasoning could be criticised.

Suppose you have two situations. In the first situation 1 employee works 40 hours every week. In the second situation 4 employees work 10 hours every week. In both situations a total of 40 hours is worked per week. What situation would take more efforts to manage? It would be reasonable to say the second situation, since 4 people have to be instructed and managed instead of 1. On the contrary, when we assume an equal probability for each employee to be absent for a week, the first situation is more likely to create an abrupt backlog of 40 hours. This abrupt change in working hours has to be caught up in the near future. Here, additional managing and planning might be necessary. Despite the fact that the probability is higher of more employees being absent in the second situation, the potential backlog does not have big fluctuations and is more predictable. In both situations, the same number of hours are worked per week on average.

The question is what the relation is between the number of employees, the time they work and their influence on managing efforts. Since we are unable to answer this question, we decide to stick with our cost driver which is based on the number of hours worked per activity.

Sales costs – C7
The sales costs are directly allocated to the sales department since in reality most of these costs are generated at the sales department.

Now we have found resource cost drivers for each operational expense. These are summarised in the table below.

Acronym	Cost type	Resource cost driver
C1	Personnel costs	Directly
C2	Recovery costs	Directly/SQM
C3	Occupancy	SQM
C4	Inventory and car	Custom
C5	General costs	Hours worked
C6	Management fee	Hours worked
C7	Sales costs	Hours worked

Table 10 Resource cost drivers

6.7 Activity cost drivers

We have to allocate the activity centre costs to different cost objects. Or in other words, to Kleinpak and Grootpak products. This means that we have to determine an activity cost driver for each activity. In the literature the activity cost drivers are the number of activities an object utilises which is retraceable to a cost object. Due to the fact that most of the time field crops cannot be traced directly back to KPPs and GPPs, we must consider an alternative way of allocating the activity centre costs. A reasonable cost driver for activities which are part of the production line, is using the volumes of KP and GP. This is possible because the total volume that is destined only for KP and GP products, goes through all the activities prior to the packaging activity. These activities are defined in such a way, that they do not operate parallel. This means that the volume is never split up in our model till they are transported to the packaging activities.

If we think in terms of purposes this makes more sense. For example, with the Sorting activity, of all the field crops it is not yet known what the end destinations are of these batches. However, based on the volumes through KP and GP we say that (*Volume KP)/(Volume KP + GP)* is the percentage of purpose of the Sorting activity for KP products. For GP products it is the remaining percentage. In this way we allocate activity centre costs in a reasonable and supported way. We call this cost driver, the *Volume ratio*.

The (fictional) historical value for the volumes in kilograms of KP and GP are 57,753,672 and 156,356,328, respectively. This implies that 26.97% is allocated to KP and 73.03% to GP.

Drying - D
Since the field crops are not sorted yet when they get dried, we use the *Volume ratio* of KP and GP field crops to allocate these drying costs to KPP and GPP. We assume that the distribution of KP and GP field crops in the drying process is close to the distribution of the actual volume of KP and GP field crops.

Arrival – AA
The purpose of the Arrival is to transfer all the goods into pallet crates. This makes it possible for the goods to be transported throughout the company. This happens for mixed field crops. So, the Arrival makes these ready for both KP and GP. The exact division of goods destinated for KP and GP is not known. Therefore, we work with the *Volume ratio*. Based on this we allocate the activity centre costs to KPP and GPP

Taring process – TP
The taring process is performed for field crops that are destined for both KP and GP. Therefore, we use the *Volume ratio* to allocate these activity centre costs.

Sorting – S
The goods processed in the sorting process are destined to KP and GP. Furthermore, we assume that there is no significant correlation between the diameter interval sorted and their destination to the KP or GP activities. This means that we also use the *Volume ratio* as a cost driver for the sorting costs.

Grootpak – GP
The purpose of the GP machines is only for the GP products. Therefore, the activity centre costs of GP are allocated to GPP.

Kleinpak – KP
The same is for KP. KP machines solely operate for the production of KP products. Therefore, the activity centre costs are allocated to KPP.

Internal Logistics – IL
Internal Logistics transport the field crops between processes. Internal Logistics are committed to both KP and GP products.

Technical Service – TD
The core business of the Technical Service is repairing forklift trucks of Internal Logistics. Besides, TD also repairs other processes of the production. We decided to use the *Volume ratio* as cost driver. This is because the Internal Logistics itself has the *Volume ratio* as cost driver and the fact that TD contributes to all main activities.

Sales department – SD
The number of orders would be a great cost driver for the Sales Department costs. This would be allocated based on the ratio of the number of KPP and GPP orders. However, for KPP orders, less time is needed in comparison with GPP orders. This is because of a big customer for KPPs which has a contract with the company. This means that the number of orders is not a viable cost driver. Therefore, we use the *Volume ratio* as a cost driver since this is closer to reality and divides the costs in a fairer way.

Office – O
To allocate the office costs, we use the *Volume ratio* as cost driver. This is because we clustered several processes together and named it the office activity. If we genuinely wanted to allocate these costs with the use of more direct cost drivers, we would have needed to think of an activity cost driver for each of these processes. This is quite time-consuming and almost unnecessary due low costs generated per department in comparison with the activities at the production line.

General/other – A
We allocate these costs based on the *Volume ratio.* This is because this activity is not specifiable and therefore choosing a cost driver that sufficiently expresses the activities performed is impossible. Therefore, we decided to allocate these remaining costs with the use of the *Volume ratio.*

Now we have determined an activity cost driver for each activity. These are summarised in the table below.

Acronym	Activity	Activity cost driver
D	Drying	Volume
AA	Arrival	Volume
TP	Taring Process	Volume
S	Sorting	Volume
GP	Grootpak	To GPP
KP	Kleinpak	To KPP
IL	Internal Logistics	Volume
TD	Technical Service	Volume
SD	Sales Department	Volume
O	Office	Volume
A	Remaining	Volume

Table 11 Activity cost drivers.

6.8 Allocation table

Now we have identified all activities, operational expenses, resource cost drivers, activity cost drivers, and cost objects. This results in the allocation table in Appendix F.

To provide a visualisation of the contents of the allocation table, we use a matrix which shows how our aforementioned aspects of our cost price model are intertwined, see Table 9. In this matrix acronyms are used for convenience purposes. The meaning of these acronyms can be found in Table 10 or in earlier sections. This matrix represents a two stage ABC model. These allocations have been represented with a matrix in contrast with the way it is represented in Figure 6. This is because otherwise it would be unclear to read. The OPEXs are allocated to activities with the use of resource cost drivers. Thereafter these activity centre costs are allocated to cost objects with the use of activity cost drivers. The Xs indicate an allocated cost from OPEXs to activities. The Ys indicate the total allocated costs from the Activity to cost object. The Zs indicate OPEXs allocated to cost objects.

OPEX/Activities	S	GP	KP	A	D	O	IL	SD	AA	TD	TP	KPP	GPP
Personnel costs	X	X	X	X	-	X	X	X	X	X	X	Z	Z
Recovery costs	X	X	X	X	X	X	X	-	X	X	-	Z	Z
Occupancy	X	X	X	X	X	X	X	X	X	X	X	Z	Z
Inventory & Car costs	X	X	X	X	X	X	X	X	X	X	-	Z	Z
General costs	X	X	X	X	-	X	X	X	X	X	X	Z	Z
Management fees	X	X	X	X	-	X	X	X	X	X	X	Z	Z
Sales costs	-	-	-	-	-	-	-	X	-	-	-	Z	Z
KPP	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y		
GPP	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y		

Table 12 Allocation Table.

Acronym	Activity/Category		Acronym	Cost type
	Primary		C1	Personnel costs
D	Drying		C2	Recovery costs
AA	Arrival		C3	Occupancy costs
TP	Taring process		C4	Inventory & Car costs
S	Sorting		C5	General costs
GP	Grootpak		C6	Management fees
KP	Kleinpak		C7	Sales costs
	Secondary		**Cost objects**	
IL	Internal Logistics		KPP	Kleinpak Product
TD	Technical Service		GPP	Grootpak Product
A	General/other			
SD	Sales department			
O	Office			

Table 13 Legend Activities, Costs, and Cost Objects.

6.9   Direct costs and packaging (COGS)

Costs of goods sold

Our direct costs are the Cost of Goods Sold (COGS) of the company. These costs are not generated at activities. These costs mainly include purchase costs of field crops. We obtain these from the income statement. The COGS consist of several types of costs. These are mentioned in Appendix G.

We add these direct costs to our previously calculated cost prices of KPP and GPP derived from the OPEX. Due to the fact that we specify our cost objects into two types of products, we divide the COGS between them. We do this by using the *volume ratio.* This is because we assume that the COGS are the same for every 100 kg of crops with disregard of the type of packaging. This means that we excluded the packaging costs from the COGS for our allocation of these costs. The costs excluded are the Emballage, Purchase IC Packaging, Packaging, and Purchase IC emballage 2.

Packaging costs

We exclude all packaging costs from the COGS. This is because cost prices are calculated per 100 kg of field crops. KPPs use more material of packaging per 100 kg in comparison with GPPs. This means that we cannot allocate the packaging costs based on the *Volume ratio*.

Therefore, we consulted the Sales department, which is also responsible for the purchasing of packaging. The sales department provided its calculation files. With the use of these files, we calculate the packaging costs for different types of KPPs and GPPs. We add this calculation procedure of the packaging costs to our model. The tables and inputs for these packaging costs can be found in Appendix H.

Our model adds the cost price of KPP and GPP, derived from the OPEX and COGS, to the packaging costs. This results in the integral costs prices for specific products. The contents of these integral cost price for Grootpak and Kleinpak products can be found in Appendix I and Appendix J, respectively. These outputs are the results when we tested our model. For this test we used the inputs mentioned above. In the appendices all yellow boxes and cost drivers represent inputs.

6.10 Forecasting

With our cost price model, we calculate the historical cost price. We can also apply this model to forecast the cost prices for the next year. To make this forecast, we need specific information. We go through each piece of information necessary.

Volume

A forecast has to be made about the future volumes of KPPs and GPPs. No forecast has to be made about the different diameters that are bought in. This is because we assume that these diameters have no significant correlation with the different final products. Large and small diameters can be both in KPPs and GPPs.

Activities

The company is a dynamic entity where things change rapidly. Therefore, it is pivotal to investigate whether the activity structure in the company has changed. Activities can be removed, added, or altered. After each year, an assessment has to be made how is dealt with these structural changes and how these changes influence the calculation procedure of our model.

Personnel costs

Based on this forecast, we need to make an estimation about the number of working hours per person and how many costs an individual would generate for the coming year. Knowing the working hours is also beneficial for allocating the general costs and management fees.

Recovery costs

Since these are fixed costs, we do not have to make an estimation. To calculate these costs, we register the purchase values of new assets bought in the current year. Also, the actual lifespans of the new assets are determined. When machines are disposed and not replaced at the company, the related recovery costs are eliminated.

Occupancy costs

For occupancy costs, it is essential to know whether there are additional activities in the next year. This is because a new activity takes up space. This means that the occupancy costs have to be reallocated based on the new distribution of square metres per activity. What is more is that it is possible for the company to rent extra space in an external building or to build an extension. Furthermore, the occupancy costs itself also have to be forecasted.

Management fees

The management fees are allocated based on the number of working hours per activity. These have to be forecasted too.

Inventory & Car costs

The Inventory and car costs are allocated to activities based on what assets fall under specific activities. Since mutations in the sets of assets and activities could occur, these costs have to be allocated based on the same method while using the new set of assets or activities.

Sales costs

A forecast has to be made about the future sales costs.

General costs

A forecast has to be made of the general costs.

Packaging costs

To forecast the packaging costs, we have to ask the sales department how many costs they forecast the coming year for the KPP and GPP packaging.

Resource Cost drivers

Some unmentioned resource cost drivers have to be reassessed to forecast the cost price.

- **Number of palletisers per activity**
  The maintenance costs of palletisers are allocated based on the number of palletisers per activity. It has to be checked whether this division is still the same in the future.

- **Number of cars per activity**
  The total car costs are allocated based on the number of cars per department. It has to be checked whether this division is still the same in the future.

- **Number total purchase value activity**
  The insurance costs of assets are allocated based on the total purchase values of the assets of an activity. The total purchase value of each activity has to be reassessed to make a forecast of the cost price.

- ***Distribution maintenance costs assets***
  The maintenance costs of the assets are allocated based on an interview with the head of the Technical Service. It has to be reassessed whether the results of the interview are still the case in the next year due structural and economic changes.

6.11 Advisory Report

During our research. we stumbled across several problems and shortcomings. Due to our killer requirement, we could not solve all problems and tackle all shortcomings to come to the best cost price model possible. Therefore, we recommend future improvements for the model. Furthermore, we mention disadvantages and risks with respect to our method used.

6.11.1 Wattages and Operating times

Currently the wattages and operating times of specific machines are unknown. So, we cannot measure the kilowatt-hours of a machine and to calculate the electricity costs. When these parameters are known, we are able to extract the electricity costs from our occupancy costs and allocate these costs with the use of kilowatt-hours used per activity. This would be a far better resource cost driver in comparison with the number of square metres used per activity. This is because the number of square metres is not proportional to the electricity consumed by a machine. Another advantage of keeping track of the electricity costs, is that the company gets insight in what activities generate the most electricity costs. Based on this, optimalisation procedures can follow. However, a disadvantage is a potential increase in administrative pressure on monitoring the operating times or ampere levels.

6.11.2 Drying

Right now, we know that most gas costs are generated at Drying. Crops are mostly dried during a specific period of the year. Therefore, crops processed in this period have a higher cost price in comparison with other periods. In our model the gas costs are included in the occupancy costs. The gas costs are spread evenly over the total volume of crops. This is not accurate, because these costs only apply for the crops dried. In the product mix of the company, there is made no distinction whether it is dried or not. To make our model more accurate, the gas costs with respect to drying have to be extracted from the occupancy costs. In this way we allocate these gas costs to Drying.

Next, the user must be able to select the option whether the product consists of dried crops. When the user selects the product consists of dried crops, all costs of Drying are included in the cost price of that product. When the user selects that it does not consist of dried crops, these costs are not included. To make this able to work, we have to make a forecast about how many crops are getting dried during the year.

6.11.3 Correlation size and packaging type

We suggest investigating the correlation between the diameter intervals of field crops and their types of packaging. We wonder how small and large diameters are distributed between the KPPs and GPPs. Based on this information, we are able to use this correlation as a new cost driver for the sorting activity instead of the *Volume ratio* cost driver.

This correlation can be investigated when the company is finished with one of its current projects. This project monitors all pallet crates with their contents. Therefore, also the end destinations of the sorted field crops are monitored and registered. Based on the data the correlation can be investigated. However, a disadvantage is that this correlation has to be forecasted for the next year, which can be a challenge.

6.11.4 Transport supply

A new activity is the transport of field crops from customers to the company. The company has several trucks and employees for this activity. Currently these are included in the Internal Logistics. To get a better insight into the costs of this activity and to compare it with the costs of external transport services, the activity must be implemented.

6.11.5 Folding Boxes

Currently in our model, the box folding activity is not included. This is quite a recently implemented activity. Currently all boxes being folded are folded for KPPs. This would mean that all costs generated at this box folding machine can be allocated to the KPPs. This activity can be found back in our BPMN in Appendix A.

6.12 Disclaimers

We mention some pitfalls about the use of our model and some potential disadvantages which can occur when the model is put into practice.

6.12.1 Eliminating activities

One should know that the elimination of an activity, does not imply that all activity centre costs are eliminated. The costs that are eliminated with certainty, are the allocated Personnel costs and Recovery costs, as long as dedicated personnel are fired, and dedicated machines are sold. The Occupancy costs are a bit different. These costs consist of electricity/gas costs and rent. By eliminating an activity, only the related electricity/gas costs are eliminated. The same rent would still be allocated over the remaining activities based on the square metres per activity. The Inventory & Car costs, General costs, and Management fees are all allocated based on the hours worked per activity. These costs are also allocated over the remaining activities. All sales costs are allocated to the sales department. Nevertheless, eliminating the Sales Department would be illogical since it is a facility-sustaining activity. Without the Sales department, the company would not be able to operate. Nevertheless, eliminating an activity means a decrease in maintenance costs. This decrease has to be taken into account when eliminating an activity.

6.12.2 Abuse of reporting numbers

Since a lot of inputs are involved in our model, it might increase vulnerabilities with respect to the reporting of numbers. Especially when these numbers are also used to measure the performance of the reporter. Balanced scorecards (BSCs) might overcome the problem of performances being measured with one type of factor (Tarver, 2022). This would decrease the vulnerability of potential manipulation in measurements which is beneficial for the reporter.

6.12.3 Guideline Sales

The cost price model is not entirely a guideline for the Sales Department. This is due to the fact that the sales department tries to sell its products for the best possible prices at the market. For example, when the cost price is 30 and the average market price is 28. It is still a good accomplishment to sell for 29. Nevertheless, the selling price (SP) would not cover all fixed costs assuming the volume is forecasted correctly. It at least covers some fixed costs (FC). In the case where the selling price is below the variable cost (VC), the sales department should actually take this cost price model as a guideline to not sell. This is because when VC > SP the contribution margin (CM = SP - VC) is negative. This means losses only increase by selling products.

6.12.4 ABC Discussion

In our literature review we selected the ABC method to allocate our indirect costs to the cost objects. However, our final model does not implement the ABC method. This is because we used the *Volume ratio* as activity cost drivers. This is theoretically not an activity cost driver. It is not directly retraceable to one type of product. Using volumes as cost driver is part of the traditional cost system, the volume-based costing method (Kaplan & Cooper, 1998, p. 83).

The reason we are unable to use activities in our model is because for many activities it is far from possible to directly refer to the final product. This is because during the processes prior to the packaging process, there can be found no linkages of what type of packaging these crops will go in.

We can enhance our cost price model by adding more cost drivers (Zimmerman, 2016, p. 501). This improves the accuracy of costs allocated to the cost objects. However, it has to be mentioned that at some point, the cost of adding more cost drivers exceeds the benefit, in terms of better decisions resulting from the additional accuracy. Therefore, it is unlikely that it ever achieves a 100% accuracy.

7   Conclusion & Discussion

The seventh and last step of the MPSM is to evaluate the solution. We do this by checking whether the model suffices the company's criteria. Based on this, we make a conclusion about our cost price model and whether we have solved the action problem.

- **Justification method**
  This included justifying why we chose a specific cost price method. We used three requirements for selecting the right cost price method. These are: *Time-bound, High accuracy,* and *Administrative bound.* For each researched method it was assessed whether it sufficed to each requirement. This led to the conclusion to use Activity-Based Costing for our model. However, this literature search did not offer the limitations for the activity cost drivers. Therefore, we accidently used another method which was not mentioned in our literature search, which is the traditional volume-based costing method (VBC). Despite the fact that we used the wrong name, we still have the opinion that VBC meets all three requirements.

  Another part of *justification method* is that the decisions made, and calculations executed have to be understandable and justified. This explanation of the decision made are included in the "Our model" section. We are of the opinion that most of the aspects are explained globally and sometimes really specific in this section. However, we also think that an external person might have difficulty reading this due to the loads of acronyms, concepts, and information. This makes it quite difficult for someone to directly understand the working of the model by reading it globally.

  The company's model did not really include any elaborations on the decisions made in the model. Therefore, we are positive that our model provides a better justification of the method, despite the fact that the method itself was wrongly identified at the beginning of our research and the fact that the explanatory part can be an intense read.

- **Usability**
  We delivered our model in an Excel file. Most people on the administration have a basic understanding how Excel works and all of them have excess to it. Therefore, the accessibility of this file is high. A wide range of people are able to use the model. Furthermore, the Excel file is designed in such a way that for the current business situations, only inputs have to be filled in, in the yellow, black-bordered cells. This makes it really easy for an individual to understand the purpose of these cells. Furthermore, our model is quite clear without any

unnecessary elements. Based on this we could say that the model has a reasonable user-interface.

We think that our model still has a greater usability in comparison with the company's model. This is because, we think that our model has a better user interface, since the company's model contains more unnecessary texts, calculations, and notes throughout the sheet which is quite distracting from the main subjects. With respect to user-friendliness, we think that we made an improvement in comparison with the company's model.

- **Insight**
  The insight criterion consists of several aspects. The company wants to have insight into the cost prices of its entire product mix. This is provided by the model. The model also enables to give insight in what types of costs and processes contribute to the cost prices. Furthermore, it gives the option to adjust parameters and inputs to see the financial effects of these adjustments. What is more, is that the model also gives insight into the cost drivers used.

  These aspects were included in the older cost price model, however only calculated one average cost price for all products. This means that our model gives far more insights into the cost prices of the company. We can conclude that we significantly increased the insights in comparison with the company's model.

All in all, we can conclude that our model satisfies to the set criteria by the company. Nevertheless, it has to be mentioned that there are still a few flaws in the aspects of criteria which makes it hard to tell whether we entirely fulfilled the criteria. Despite these flaws, we can say that we made an improvement in the cost price model of the company.

8 References

1. Bakker, J., & van Houten, T. (2018). *Bedrijfseconomie in de praktijk* (1st ed.). Concept Uitgeefgroep.
2. Bent, K., & Caplan, D. (2017). Lattice allocations: A better way to do cost allocations. *Advances in Accounting*, *38*, 99–105. https://doi.org/10.1016/j.adiac.2017.07.008
3. Bhimani, A., Horngren, C. T., Datar, S. M., & Foster, G. (2008). *Management And Cost Accounting* (4th Edition). Financial times/Prentice hall.
4. Brugha, R. (2000). Stakeholder analysis: a review. *Health Policy and Planning*, *15*(3), 239–246. https://doi.org/10.1093/heapol/15.3.239
5. Faber, M. (2017). *MBA kostencalculatie Theorieboek* (3rd ed.). Convoy Uitgevers Bv.
6. Heerkens, H., & Van Winden, A. (2021). *Solving Managerial Problems Systematically* (1ste editie). Wolters-Noordhoff.
7. Liberto, D. (2022). *Straight Line Basis Definition*. Investopedia. https://www.investopedia.com/terms/s/straightlinebasis.asp#:%7E:text=Key%20Takeaways-,Straight%20line%20basis%20is%20a%20method%20of%20calculating%20depreciation%20and,is%20expected%20to%20be%20used.
8. Kaplan, R. S., & Cooper, R. (1998). *Cost & Effect: Using Integrated Cost Systems to Drive Profitability and Performance*. Harvard Business Review Press.
9. Kenton, W. (2020). *Consolidated Financial Statements*. Investopedia. https://www.investopedia.com/terms/c/consolidatedfinancialstatement.asp
10. Kholkin, A. (2020). Criteria for choosing the cost allocation base for industrial enterprises. *E3S Web of Conferences*, *164*, 09035. https://doi.org/10.1051/e3sconf/202016409035
11. Kim, Y., Han, S., Shin, S., & Choi, K. (2011). A case study of activity-based costing in allocating rebar fabrication costs to projects. *Construction Management and Economics*, *29*(5), 449–461. https://doi.org/10.1080/01446193.2011.570354
12. Mirzamohammadi, S., Karimi, S., & Pishvaee, M. S. (2019). A novel cost allocation method applying fuzzy DEMATEL technique. *Kybernetes*, *49*(10), 2569–2587. https://doi.org/10.1108/k-07-2019-0513
13. Mistry, J. J. (2019). Cost Allocation and Information Technology. *IEEE Engineering Management Review*, *47*(1), 77–85. https://doi.org/10.1109/emr.2019.2901773
14. Pitcher, G. (2020, February 9). *Time-driven activity-based costing explained*. YouTube. Retrieved 22 April 2022, from https://www.youtube.com/watch?v=o2TQyrmGsd4
15. Privault, N. (2018). *Understanding Markov Chains* (2nd ed.). Springer Publishing.
16. Schindler, P. (2018). *ISE Business Research Methods* (13th edition). McGraw-Hill Education.
17. Siguenza-Guzman, L., van den Abbeele, A., Vandewalle, J., Verhaaren, H., & Cattrysse, D. (2013). Recent Evolutions in Costing Systems: A Literature Review of Time-Driven Activity-Based Costing. *REBEL Review of Business and Economic Literature*, *58*(1).
18. Sinha, V. K., Chandra, B., & Pattanayak, J. K. (2020). Applicability of activity-based management system in coal mines – A case study of an underground coal mine. *Journal of Mine, Metals and Fuels*, *Volume 68*(Issue 4).
19. Tarver, E. (2022). *How a Balanced Scorecard (BSC) Is Used*. Investopedia. https://www.investopedia.com/terms/b/balancedscorecard.asp
20. Togo, D. F. (2011). Maile-Ann Company: A Matrix Approach To Reciprocated Support Department Cost Allocations. *Journal of Business Case Studies (JBCS)*, *6*(2). https://doi.org/10.19030/jbcs.v6i2.866
21. Tuovila, A. (2020). *Accelerated Depreciation*. Investopedia. https://www.investopedia.com/terms/a/accelerateddepreciation.asp#:%7E:text=Accelerated%20depreciation%20is%20any%20depreciation,years'%20digits%20(SYD).
22. Weske, M. (2007). *Business Process Management*. Springer Publishing.
23. Zimmerman, J. (2016). *Accounting for Decision Making and Control* (9th ed.). McGraw Hill.

9 Appendix A – Business Process Model Notation
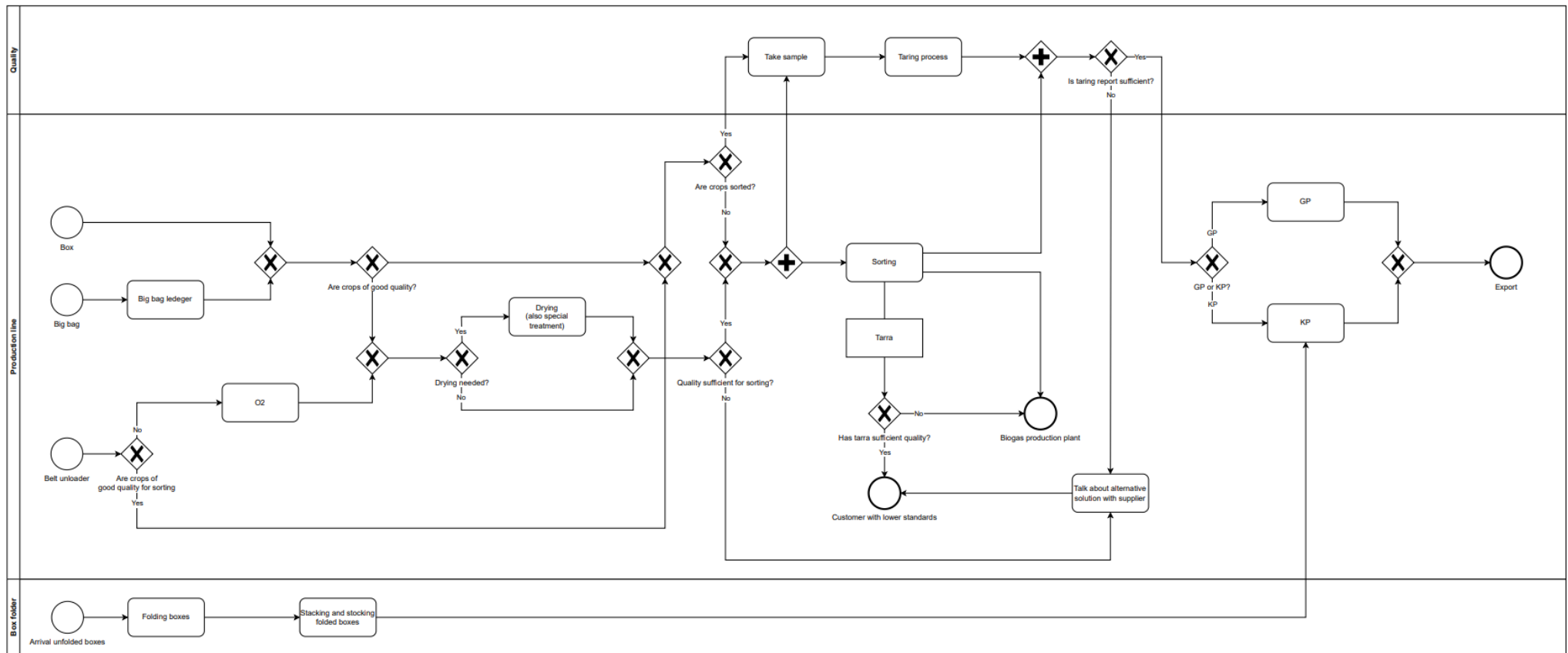
Figure 7 Business Process Model Notation.

10 Appendix B – Operational Expenses & Ledger accounts

OPEX

Excluded personnel costs		€ 221.415
400101	Bruto loon en salarissen	€ 2.914.379
400106	Opbouw res. vakantiegeld	€ 5.084
400116	Res. vakantiedagen	€ -18.788
400120	Ziekengeld	€ -39.693
400201	Soc. lasten (wg deel)	€ 331.568
400202	Soc. lasten (e.b.)	€ 4.377
400205	Afdracht WIA WGA	€ 3.935
400207	Vergoeding ZVW	€ 190.037
400301	Bedrijfspensioen	€ 159.209
402101	Reis en verblijfkosten	€ 1.101
402102	Reiskostenvergoeding	€ 33.376
402301	Bedrijfskleding	€ 86.481
402303	Onbelaste vergoeding	€ 12.500
402401	Kantinekosten	€ 31.427
402601	Uitzendkrachten	€ 570.802
402800	Doorbelast loon aan derden	€ -16.321
402801	Personeelskosten	€ 78.885
402802	Studiekosten	€ 79.401
402900	Resultaat vergoeding	€ -
409013	Loonsubsidies	€ -72.934
Depreciated costs		**€ 1.782.641**
Occupancy costs		**€ 1.149.076**
420000	Huisvestingskosten	€ -
421000	Huurkosten	€ -
421100	Huur Gebouwen	€ 40.794
421200	Huur Waterman Beheer	€ -
422000	Onderhoud gebouwen en terreinen	€ 97.336
422300	Schoonmaakkosten	€ 53.301
423001	Gas	€ 2.091
423002	Water	€ 40
423003	Elektriciteit	€ 659
426000	Belast. en zakelijke lasten	€ -
426100	Waterschap en zuiveringskosten	€ 3.436
427000	Verzekering gebouwen	€ 85.897
428000	Energiekosten woningen	€ -
428100	Electra	€ 464.545
428200	Gas	€ 363.669
428300	Water	€ 4.401
428500	Overige huisvestingskosten	€ 31.723
429000	Overige huisvestingskosten	€ 1.183

Inventory & Car costs		€ 999.463
431300	Huur inventaris	€ 17.796
434100	Aanschaf klein inventaris	€ 21.750
435000	Onderhoud bedrijfsinventaris	€ -
435100	Onderhoud inventaris	€ 365.105
435200	Onderhoud heftrucks/terminal trekker	€ 99.887
435300	Onderhoud Palletiseermachines	€ 32.872
435400	Onderhoud sorteerlijn	€ 23.639
435500	Onderhoud naaistraat	€ 25.106
435600	Onderhoud Kleinpakmachine	€ 29.729
437000	Verzekering inventaris	€ 196.062
438000	Brandstof inventaris/kachels	€ -
439000	Brandstof heftrucks	€ 54.712
443000	Autokosten	€ -
443100	Brandstof auto's	€ 39.132
443101	Brandstof vrachtwagens	€ -
444000	Onderhoud auto's	€ 56.835
444001	Onderhoud vrachtwagens	€ -
446000	Motorrijtuigenbelasting	€ 11.393
446001	Motorrijtuigenbelasting vrachtwagens	€ -
447000	Verzekering auto's	€ 16.351
447001	Verzekering vrachtwagens	€ -
449520	Prive gebruik auto	€ 9.095
General costs		**€ 684.042**
474000	Kantoorbehoeften	€ -
474100	Kantoorkosten	€ 23.330
474200	Telefoon/Data/Internet kst.	€ 24.942
474250	IT Hardware kleine aanschaf	€ 34.784
474300	Porti	€ 8.074
474400	Contributies en abonnementen	€ 66.673
475000	IT kosten	€ 230.351
476000	Accountantskosten	€ 22.091
477100	Accountantskosten	€ 80.475
477200	Kosten audits/certificering	€ 12.329
477300	Advieskosten	€ 75.250
478100	Betalingsverschillen	€ -7.612
478150	Koersverschillen	€ -14.443
478200	Overige verzekeringen	€ 24.057
478900	Diverse algemene kosten	€ 18.830
478990	Boetes en naheffingen	€ 47.774
481000	Contributies en abonnementen	€ 73
484200	Advieskosten	€ 20.261
484250	Administratie kosten	€ 15.800
486100	Betalingsverschillen	€ 0
489000	Overige algemene kosten	€ 1.001

Management fee		€ 419.960
402604	Management fee	€ 208.962
482000	Managementvergoeding	€ 210.998
Sales costs		**€ 285.809**
479000	Verkoopkosten	€ -
479100	Representatiekosten	€ 15.879
479200	Reis en verblijfkosten	€ 12.426
479300	Reclame- en advertentiekosten	€ 52.574
479320	Verkoopkosten overig	€ 31.077
479330	PR kosten	€ 27.040
479350	Reclamemateriaal	€ 4.680
479375	Sponsorkosten	€ 6.320
479400	Kredietverzekering	€ 38.869
479500	Afschr. kst. debiteuren	€ 96.944

Figure 8 Operational Expenses & Ledger accounts.

11 Appendix C – Position Synchronisation & Personnel costs

Activity	Acronym	Department planning system	Positions planning system	Positions salary administration	Hours	Average Salary	Costs
Grootpak	GP	Grootpak	Heftruckchauffeur	Heftruckchauffeur	6.220	€ 31,24	€ 194.282
	GP		Operator	Operator	20.054	€ 29,66	€ 594.743
	GP		Voorman	Voorman inpak	1.580	€ 29,14	€ 46.049
Kleinpak	KP	Kleinpak	Heftruckchauffeur	Heftruckchauffeur	1.874	€ 31,24	€ 58.540
	KP		Operator	Operator	21.460	€ 29,66	€ 636.442
	KP		Voorman	Voorman inpak	1.499	€ 29,14	€ 43.676
Sorting	S	Sorteren	Heftruckchauffeur	Heftruckchauffeur	7.115	€ 31,24	€ 222.251
	S		Operator	Operator	26.033	€ 29,66	€ 772.057
	S		Voorman	Voorman sorteren	4.731	€ 42,60	€ 201.538
	S	Schoonmaak productie	Afstaarters > SL12 - Afstaarter (1x3 en 1x2 messer)	Productie medewerker	182	€ 20,21	€ 3.677
	S		Afstaarters > SL12 - Afstaarters (2x3 messer)	Productie medewerker	379	€ 20,21	€ 7.670
	S		Afstaarters > SL3 - Afstaarters (2x3 messer)	Productie medewerker	347	€ 20,21	€ 7.021
Office	O	Administratie	ADMINISTRATIE	Administratief medewerker	1	€ 36,86	€ 44
	O		ADMINISTRATIE > Administration&Finance	Administratief medewerker	2.707	€ 36,86	€ 99.800
	O		ADMINISTRATIE > Financial Manager	MT-lid	1.572	€ 64,57	€ 101.539
	O		ADMINISTRATIE > HR&administration	Heftruckchauffeur/operator	644	€ 27,99	€ 18.010
	O	HR	ADMINISTRATIE > HR medewerker	HR medewerker	633	€ 44,38	€ 28.097
	O	Inkoop	Inkoper > Inkoper	Inkoper	2.482	€ 40,29	€ 100.019
	O	Hoofd inkoop		MT-lid	1.472	€ 64,57	€ 95.050
	O	IT	ADMINISTRATIE > IT medewerker	Applicatiebeheerder	1.030	€ 51,64	€ 53.196
	O	Productie planning	Voormannen > Productie planning	Productieplanner	1.681	€ 29,57	€ 49.709
	O	HHD	OVERIG > medewerker huishoudelijke dienst	Medew. huish. dienst	2.246	€ 25,55	€ 57.394
Sales Department	SD	Hoofd verkoop		MT-lid	1.496	€ 64,57	€ 96.618
	SD	Verkoop	SALES > Commercieel medewerker binnendienst	Sales Manager	366	€ 52,18	€ 19.073
	SD		SALES > Salesmanager	Sales Manager	3.679	€ 52,18	€ 191.942
Technical Service	TD	Technische dienst	TECHNISCHE DIENST > Leerling monteur	Leerling monteur	764	€ 26,40	€ 20.168
	TD		TECHNISCHE DIENST > Technische dienst	Monteur TD	4.364	€ 33,19	€ 144.833
	TD	Technische dienst derden	TECHNISCHE DIENST > Technische dienst derden	Monteur TD	143	€ 33,19	€ 4.753
Taring process	TP	Kwaliteit	OVERIG > Kwaliteitsmedewerker	Kwaliteitsmedewerker	1.464	€ 43,42	€ 63.577
General	A	NB	OVERIG	Productie medewerker	341	€ 20,21	€ 6.884
	A		OVERIG > Arbeid extern	Productie medewerker	95	€ 20,21	€ 1.911
	A		OVERIG > Kisten reparatie	Productie medewerker	886	€ 20,21	€ 17.906
	A	N/B	Heftruckchauffeurs	Heftruckchauffeur	6	€ 31,24	€ 200
	A		Martho Flex	Productie medewerker	38	€ 20,21	€ 760
	A		OVERIG > Chauffeur	Vrachtwagenchauffeur	992	€ 33,69	€ 33.422
	A		OVERIG > Rework	Productie medewerker	379	€ 20,21	€ 7.652
	A		SALES > Marketing & communicatie medewerker	Marketing medewerker	383	€ 29,68	€ 11.382
	A	Schoonmaak productie	OVERIG > Schoonmaak productie	Productie medewerker	2.258	€ 20,21	€ 45.639
Arrival	AA	Interne Logistiek	Heftruckchauffeurs > 1e heftruckchauffeur ontvangst	Heftruckchauffeur	1.670	€ 31,24	€ 52.149
	AA		Heftruckchauffeurs > Heftruckchauffeur ontvangst	Heftruckchauffeur	3.335	€ 31,24	€ 104.180
Internal Logistics	IL	Interne Logistiek	Heftruckchauffeurs > Verlader	Heftruckchauffeur	2.357	€ 31,24	€ 73.625
	IL		Voormannen > Planning en Logistiek	Teamleider Expeditie	2.863	€ 47,54	€ 136.105
	IL		Voormannen > Voorman Logistiek	Teamleider Ontvangst & Bewaring	1.008	€ 39,08	€ 39.384
NA	**NA**	NB	**MANAGER OPERATIONS > Manager Operations**	**MT-lid**	**1.657**	**€ 64,57**	**€ 107.032**
	S				703	€ 64,57	€ 45.384
	GP				505	€ 64,57	€ 32.591
	KP				450	€ 64,57	€ 29.056
Total					**136.488**		**€ 4.570.002**

Activity	Costs	Hours
S	€ 1.259.598	39.491
GP	€ 867.666	28.359
KP	€ 767.715	25.283
O	€ 602.859	14.470
A	€ 125.756	5.377
IL	€ 249.114	6.228
SD	€ 307.633	5.541
TD	€ 169.755	5.271
AA	€ 156.329	5.005
TP	€ 63.577	1.464
Total	**€ 4.570.002**	**136.488**

Distribution hours Manager Operations		
Activity	Hours	%
GP	27.854	30,45%
KP	24.833	27,15%
S	38.788	42,40%

Positions Salary administration	Average Salary
Administratief medewerker	€ 36,86
Applicatiebeheerder	€ 51,64
Ass. voorman inpak	€ 33,29
Ass. voorman sorteerder	€ 32,46
Assistent controller	€ 38,93
Bbl (leer-werktraject)	€ 20,20
Expeditie medewerker	€ 28,95
Heftruckchauffeur	€ 31,24
Heftruckchauffeur/operator	€ 27,99
HR medewerker	€ 44,38
Inkoper	€ 40,29
Kwaliteitsmedewerker	€ 43,42
Leerling monteur	€ 26,40
Marketing medewerker	€ 29,68
Medew. huish. dienst	€ 25,55
Monteur TD	€ 33,19
MT-lid	€ 64,57
Operator	€ 29,66
Productie medewerker	€ 20,21
Productieplanner	€ 29,57
Sales Manager	€ 52,18
Teamleider Expeditie	€ 47,54
Teamleider Ontvangst & Bewaring	€ 39,08
Voorman inpak	€ 29,14
Voorman sorteren	€ 42,60
Voorman TD	€ 46,57
Vrachtwagenchauffeur	€ 33,69

Total   136.488   € 4.570.002

Figure 9 Position Synchronisation & Personnel costs.

12 Appendix D – Recovery costs & Purchase values of activities

Vehicles

Activity	Recovery costs	Purchase value
A	€ 41.185	€ 214.800
TD	€ 18.791	€ 93.956
SD	€ 12.845	€ 102.002
O	€ 10.126	€ 70.779
Total	**€ 82.948**	**€ 481.537**

Machines and Devices

Activity	Recovery costs	Purchase value
D	€ 296.631	€ 2.989.933
S	€ 235.497	€ 4.730.087
KP	€ 230.050	€ 2.331.481
AA	€ 147.634	€ 1.375.350
O	€ 141.687	€ 1.202.080
A	€ 137.389	€ 1.272.896
GP	€ 91.052	€ 1.515.082
TD	€ 10.245	€ 102.454
IL	€ 7.140	€ 167.193
Total	**€ 1.297.326**	**€ 15.686.558**

Building related

Activity	Recovery costs	Purchase value
D	€ 498.500	€ 8.316.319
S	€ 135.808	€ 2.262.763
GP	€ 126.295	€ 2.104.253
KP	€ 73.909	€ 1.198.715
AA	€ 33.497	€ 558.114
IL	€ 33.045	€ 548.114
O	€ 13.516	€ 182.242
SD	€ 5.473	€ 91.182
TD	€ 5.187	€ 86.429
TP	€ 1.297	€ 21.607
Total	**€ 926.528**	**€ 15.369.739**

Total

Activity	Recovery costs	Purchase value
D	€ 795.131	€ 11.306.252
S	€ 371.305	€ 6.992.850
KP	€ 303.959	€ 3.530.197
GP	€ 217.347	€ 3.619.335
AA	€ 181.131	€ 1.933.464
A	€ 178.574	€ 1.487.696
O	€ 165.329	€ 1.455.101
IL	€ 40.185	€ 715.306
TD	€ 34.224	€ 282.839
SD	€ 18.318	€ 193.184
TP	€ 1.297	€ 21.607
Total	**€ 2.306.801**	**€ 31.537.833**

Figure 10 Recovery costs & Purchase values of activities

13 Appendix E – Square metres distribution

Old SQM distribution according to previous CFO			
Hall 1	Activity	%	SQM
3535,2	S	60,00%	2121,1
	GP	25,00%	883,8
	IL	15,00%	530,3
Total		**100,00%**	**3535,2**
Hall 2	Activity	%	SQM
4592	KP	22,50%	1033,2
	GP	22,50%	1033,2
	S	5,00%	229,6
	D	40,00%	1836,8
	Expeditie	10,00%	459,2
Total		**100,00%**	**4592,0**
Hall 3	Activity	%	SQM
5252	D	75,00%	3939,0
	Expeditie	25,00%	1313,0
Total		**100,00%**	**5252,0**
Office	Activity	%	SQM
208,8	SD	40,42%	84,4
	O	40,42%	84,4
	TP	9,58%	20
	Inkoop	9,58%	20
Total		**100,00%**	**208,8**
Total			**13588,0**

New SQM distribution according to our model			
Hall 1	Activity	%	SQM
3.535	S	59,25%	2094,5
	GP	24,25%	857,1
	IL	14,25%	503,6
	TD	2,26%	80,0
Total		**100,00%**	**3535,2**
Hall 2	Activity	%	SQM
4.592	KP	23,75%	1090,6
	GP	23,75%	1090,6
	D	41,25%	1894,2
	AA	11,25%	516,6
Total		**100,00%**	**4592,0**
Hall 3	Activity	%	SQM
5.252	D	100,00%	5252,0
Total		**100,00%**	**5252,0**
Office	Activity	%	SQM
209	SD	40,42%	84,4
	O	50,00%	104,4
	TP	9,58%	20,0
Total		**100,00%**	**208,8**
Total			**13588,0**

Summary SQM division	
Activity	SQM
D	7.146,20
S	2.094,45
GP	1.947,73
KP	1.090,60
AA	516,60
IL	503,61
O	104,40
SD	84,40
TD	80,00
TP	20,00
Total	**13.588,00**

Legend	
Input previous CFO	
Our change	

Figure 11 Square metres distribution.

14 Appendix F – Allocation Table

	Cost/Activity	Total	Volume S	GPP GP	KPP KP	Volume D	Volume A	Volume O	Volume IL	Volume SD	Volume AA	Volume TD	Volume TP	Total KPP	Total GPP	KPP/100kg	GPP/100kg
Direct	Personeelskosten	€ 4.791.417	€ 1.323.661	€ 913.671	€ 808.730	€ -	€ 134.479	€ 626.333	€ 259.217	€ 316.621	€ 164.448	€ 178.305	€ 65.952	€ 1.636.561	€ 3.154.856	€ 2,83	€ 2,02
Direct/SQM	Afschrijvingskosten	€ 2.306.801	€ 371.305	€ 217.347	€ 303.959	€ 795.131	€ 178.574	€ 165.329	€ 40.185	€ 18.318	€ 181.131	€ 34.224	€ 1.297	€ 785.576	€ 1.521.225	€ 1,36	€ 0,97
SQM	Huisvesting	€ 1.149.076	€ 177.118	€ 164.711	€ 92.227	€ 604.322	€ -	€ 8.829	€ 42.588	€ 7.137	€ 43.687	€ 6.765	€ 1.691	€ 332.871	€ 816.205	€ 0,58	€ 0,52
Custom	Inventaris en auto kosten	€ 999.329	€ 99.851	€ 63.911	€ 41.045	€ 8.838	€ 401.473	€ 45.474	€ 177.174	€ 44.269	€ 24.640	€ 92.655	€ -	€ 282.292	€ 717.037	€ 0,49	€ 0,46
FTE	Algemene kosten	€ 684.042	€ 193.074	€ 138.650	€ 123.612	€ -	€ 43.025	€ 70.745	€ 30.448	€ 27.089	€ 24.469	€ 25.771	€ 7.159	€ 237.382	€ 446.659	€ 0,41	€ 0,29
FTE	Management fees	€ 419.960	€ 118.536	€ 85.123	€ 75.890	€ -	€ 26.415	€ 43.433	€ 18.693	€ 16.631	€ 15.022	€ 15.822	€ 4.395	€ 145.738	€ 274.222	€ 0,25	€ 0,18
To SD	Verkoopkosten	€ 285.809	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ 285.809	€ -	€ -	€ -	€ 77.094	€ 208.716	€ 0,13	€ 0,13
	Total	€ 10.636.433	€ 2.283.545	€ 1.583.413	€ 1.445.464	€ 1.408.291	€ 783.965	€ 960.142	€ 568.305	€ 715.874	€ 453.398	€ 353.542	€ 80.494	€ 3.304.415	€ 6.616.144	€ 6,06	€ 4,57
	Total KPP	€ 3.497.514	€ 615.960	€ -	€ 1.445.464	€ 379.870	€ 211.465	€ 258.987	€ 153.294	€ 193.099	€ 122.299	€ 95.364	€ 21.712				
	Total GPP	€ 7.138.919	€ 1.667.586	€ 1.583.413	€ -	€ 1.028.421	€ 572.500	€ 701.155	€ 415.011	€ 522.775	€ 331.099	€ 258.178	€ 58.782				
	KPP/100kg	€ 6,06	€ 1,07	€ -	€ 2,50	€ 0,66	€ 0,37	€ 0,45	€ 0,27	€ 0,33	€ 0,21	€ 0,17	€ 0,04				
	GPP/100kg	€ 4,57	€ 1,07	€ 1,01	€ -	€ 0,66	€ 0,37	€ 0,45	€ 0,27	€ 0,33	€ 0,21	€ 0,17	€ 0,04				

Figure 12 Allocation Table.

15 Appendix G – COGS without packaging costs

COGS		
700000 - 701000	Inkoop	€ 31.644.208
705060	Werk derden inpakken/nalezen etc.	€ 689.278
705100	Transport aanvoer	€ 2.497.748
705150	Transport afvoer	€ 4.556.416
706010	Commissie derden	€ 365.719
706020	Sorteerkosten	€ 330.816
706030	Bewaarloon derden	€ 189.182
706035	Grondbemonstering/bodemanalyse	€ -
706040	Keurloonderden	€ 87.357
706050	Weegloonderden	€ -580
706070	Afvoeruienafval	€ 25.773
706080	Productschap	€ -
706090	Inkoopprijsverschillen	€ -

Figure 13 COGS without packaging costs.

16 Appendix H – Packaging Inputs & Calculation tables

Kleinpak

Item	Quantity	Cost
Product sizes		
15KG	per 100 nets	€ 18,20
25KG	per 100 nets	€ 24,70
Boxes		
Box A	per pc	€ 0,81
Box B	per pc	€ 1,52
Box C	per pc	€ 0,81
Box D	per pc	€ 0,83
Box E	per pc	€ 3,51
Nets		
Net A	per 1000m	€ 45,50
Net B	per 1000m	€ 45,50
Net C	per 1000m	€ 45,50
Net D	per 1000m	€ 208,00
Net E	per 1000m	€ 65,00
Labels		
Label A	per 1000 pcs	€ 8,45
Label B	per 1000 pcs	€ 8,45
Label C	per 1000 pcs	€ 8,45
Label D	per 1000 pcs	€ 8,45
Label E	per 1000 pcs	€ 6,83
Label F	per 1000 pcs	€ 6,83
Label G	per 1000 pcs	€ 6,83
Label H	per 1000 pcs	€ 6,83
Pallets		
HHP	per pc	€ 1,44
Europallet	per pc	€ 24,70
Basic pallet	per pc	€ 13,65
ISPM pallet	per pc	€ 17,55
Other		
Corners	per pc	€ 0,42
Wrapping bands	per 1000 m	€ 23,08
Stickers	per 1000 pcs	€ 11,38
Sewing thread	per kg	€ 6,83
Wrapping net	per 1000m	€ 20,35
Clips	per kg (3300 pcs)	€ 4,23

Grootpak

Item	Kgs per item	Kosten
25 kg Product X	na	€ 0,49
20 kg Product X	na	€ 0,42
15 kg Product X	na	€ 0,38
10 kg Product X	na	€ 0,36
20 kg Product Y	na	€ 0,24
15 kg Product Y	na	€ 0,24
10 kg Product Y	na	€ 0,21
5 kg Product Y	na	€ 0,20
Product Z	1100	€ 13,00
Ribbon	25000	€ 32,50
Sewing thread	50000	€ 3,64
Wrapping band	50000	€ 123,83
PALLET (EENM)	1250	€ 13,65
(ISPM) PALLET	1250	€ 17,55
(EURO) PALLET	1250	€ 25,35

Figure 14 Packaging Inputs.

Grootpak

Packaging prices

Product	Contents (kg)	Net
Product X	25	€ 0,0198
	24	€ 0,0206
	22,7	€ 0,0218
	20	€ 0,0208
	15	€ 0,0251
	10	€ 0,0364
	9	€ 0,0404
Product Y	20	€ 0,0120
	15	€ 0,0160
	10	€ 0,0215
	9	€ 0,0238
	5	€ 0,0403
	4	€ 0,0504
Product Z	1100	€ 0,0118

Kleinpak

Net prices / 100 kg

Product	Contents (g)	Buisnet (cm)	Net A	Net B	Net C	Net D	Net E
Product A	2000	35	€ 0,80	€ 0,80	€ 0,80	€ 3,64	€ 1,14
Product B	1000	29	€ 1,32	€ 1,32	€ 1,32	€ 6,03	€ 1,89
Product C	750	24	€ 1,46	€ 1,46	€ 1,46	€ 6,66	€ 2,08
Product D	500	21	€ 1,91	€ 1,91	€ 1,91	€ 8,74	€ 2,73
Product E	500	21	€ 1,91	€ 1,91	€ 1,91	€ 8,74	€ 2,73
Product F	550	34	€ 2,81	€ 2,81	€ 2,81	€ 12,86	€ 4,02
Product G	350	23	€ 2,99	€ 2,99	€ 2,99	€ 13,67	€ 4,27

Label prices / 100 kg

Product	Contents (g)	Label A	Label B	Label C	Label D	Label E	Label F	Label G	Label H
Product A	2000	€ 0,42	€ 0,42	€ 0,42	€ 0,42	€ 0,34	€ 0,34	€ 0,34	€ 0,34
Product B	1000	€ 0,85	€ 0,85	€ 0,85	€ 0,85	€ 0,68	€ 0,68	€ 0,68	€ 0,68
Product C	750	€ 1,13	€ 1,13	€ 1,13	€ 1,13	€ 0,91	€ 0,91	€ 0,91	€ 0,91
Product D	500	€ 1,69	€ 1,69	€ 1,69	€ 1,69	€ 1,37	€ 1,37	€ 1,37	€ 1,37
Product E	500	€ 1,69	€ 1,69	€ 1,69	€ 1,69	€ 1,37	€ 1,37	€ 1,37	€ 1,37
Product F	550	€ 1,54	€ 1,54	€ 1,54	€ 1,54	€ 1,54	€ 1,54	€ 1,54	€ 1,54
Product G	350	€ 2,41	€ 2,41	€ 2,41	€ 2,41	€ 2,41	€ 2,41	€ 2,41	€ 2,41

Clip Prices / 100 kg

Procut	Contents (g)	Number of Clips	Price
Product A	2000	100	€ 0,13
Product B	1000	200	€ 0,26
Product C	750	267	€ 0,34
Product D	500	400	€ 0,51
Product E	500	400	€ 0,51
Product F	550	364	€ 0,47
Product G	350	571	€ 0,73

Figure 15 Packaging calculation tables.

17 Appendix I – Cost prices Grootpak

GROOTPAK								
OPEX Grootpak	*Price/100 kg*			*Price/100 kg*			*Price/100 kg*	
Personnel costs	€	2,02		€	2,02		€	2,02
Recovery costs	€	0,97		€	0,97		€	0,97
Occupancy costs	€	0,52		€	0,52		€	0,52
Inventory & Car costs	€	0,46		€	0,46		€	0,46
General costs	€	0,29		€	0,29		€	0,29
Management fees	€	0,18		€	0,18		€	0,18
Sales costs	€	0,13		€	0,13		€	0,13
Total	**€**	**4,57**		**€**	**4,57**		**€**	**4,57**
COGS Grootpak	*Price/100 kg*			*Price/100 kg*			*Price/100 kg*	
Purchasing	€	14,78		€	14,78		€	14,78
Transport export	€	2,13		€	2,13		€	2,13
Transport import	€	1,17		€	1,17		€	1,17
Work third parties	€	0,32		€	0,32		€	0,32
Commission third parties	€	0,17		€	0,17		€	0,17
Sorting costs	€	0,15		€	0,15		€	0,15
Custody fees third parties	€	0,09		€	0,09		€	0,09
Overig	€	0,06		€	0,06		€	0,06
Total	**€**	**18,87**		**€**	**18,87**		**€**	**18,87**

Grootpak Packaging costs								
Product X		*Price/100 kg*	**Product Y**		*Price/100 kg*	**Product Z**		*Price/100 kg*
Purchase price	€ 18,87		Purchase price	€ 18,87		Purchase price	€ 18,87	
Kg in product	22,7	€ 2,18	Kg in product	20	€ 1,20	Kg in product	1100	€ 1,18
Ribbon		€ 0,13	Ribbon		€ 0,13	Ribbon		€ 0,13
Sewing thread		€ 0,01	Sewing thread		€ 0,01	Sewing thread		€ 0,01
Pallet	PALLET (EENM)	€ 1,09	Pallet	(ISPM) PALLET	€ 1,40	Pallet	(EURO) PALLET	€ 2,30
Wrapping net		€ 0,25	Wrapping net		€ 0,25	Wrapping net		€ -
Overweight	2,00%	€ 0,38	Overweight	1,00%	€ 0,19	Overweight	4,00%	€ 0,75
Total		**€ 4,03**			**€ 3,18**			**€ 4,38**
Integral cost price		**€ 27,47**			**€ 26,62**			**€ 27,82**

Figure 16 Cost prices Grootpak.

18 Appendix J – Cost prices Kleinpak

KLEINPAK								

OPEX Kleinpak	Price/100 kg			Price/100 kg			Price/100 kg	
Personnel costs	€	2,83		€	2,83		€	2,83
Recovery costs	€	1,36		€	1,36		€	1,36
Occupancy costs	€	0,58		€	0,58		€	0,58
Inventory & Car costs	€	0,49		€	0,49		€	0,49
General costs	€	0,41		€	0,41		€	0,41
Management fees	€	0,25		€	0,25		€	0,25
Sales costs	€	0,13		€	0,13		€	0,13
Total	€	**6,06**		€	**6,06**		€	**6,06**
COGS Kleinpak	Price/100 kg			Price/100 kg			Price/100 kg	
Purchasing	€	14,78		€	14,78		€	14,78
Transport export	€	2,13		€	2,13		€	2,13
Transport import	€	1,17		€	1,17		€	1,17
Work third parties	€	0,32		€	0,32		€	0,32
Commission third parties	€	0,17		€	0,17		€	0,17
Sorting costs	€	0,15		€	0,15		€	0,15
Custody fees third parties	€	0,09		€	0,09		€	0,09
Overig	€	0,06		€	0,06		€	0,06
Total	€	**18,87**		€	**18,87**		€	**18,87**

Kleinpak Packaging costs

Net		Price/100 kg	Box A - B		Price/100 kg	Box C - E		Price/100 kg
Purchase price	€ 18,87		Purchase price	€ 18,87		Purchase price	€ 18,87	
Kg in Product	15		Kg in box	14,4		Kg in box	4,95	
Kg on pallet	1000		Kg on pallet	720		Kg on pallet	475,2	
Product	Product C		Product	Product D		Product	Product E	
Net	Net D	€ 6,66	Net	Net A	€ 1,91	Net	Net C	€ 1,91
Etiket	Label B	€ 1,13	Label	Label B	€ 1,69	Label	Label G	€ 1,37
Clips		€ 0,34	Clips		€ 0,51	Clips		€ 0,51
Net size	15KG	€ 1,21	Box	Box A	€ 5,63	Box	Box E	€ 70,91
Pallet	Basic pallet	€ 1,37	Pallet	ISPM pallet	€ 2,44	Sticker		€ 0,23
Wrapping net		€ 0,20	Corners		€ 0,23	Pallet	Europallet	€ 5,20
Sewing thread		€ 0,01	Strapping bands		€ 0,03	Corners		€ 0,35
Overweight	1,00%	€ 0,19	Overweight	1,00%	€ 0,19	Strapping bands		€ 0,04
						Overweight	1,00%	€ 0,19
Total	€	**11,11**		€	**12,63**		€	**80,71**
Integral cost price	€	**36,04**		€	**37,56**		€	**105,64**

Figure 17 Cost prices Kleinpak.