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Molde University College

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Preface

As a requirement for Master of Science in Logistics program at Molde University College - specialized University in Logistics, this thesis focuses on the product standardization related to the NOBB issue in Asak Miljøstein AS. This thesis not only plans to help Asak Miljøstein AS solve the NOBB issue, but also enables me to learn related knowledge deeply.

This thesis is completed with the guidance from associate professor Johan Oppen, I sincerely appreciate Johan Oppen for advices, comments and encouragement in the whole process.

Furthermore, I would like to thank Asak Miljøstein AS for giving me the opportunity of doing master thesis, especially, I get wider perspective of the construction industry in Norway with the help of Jørn Andre Hammer who is the manager of Asak Miljøstein AS and serves as the contact person.

At last, I have to thank Molde University College - specialized University in Logistics for providing a good environment of studying and living.

Keywords: Product Variety, Product Standardization, Pareto Principle, ABC Analysis, Decision Model, Organizational Capacity

Summary

This thesis is a case study of product standardization at Asak Miljøstein AS, the company has a large variety of products and is planning to unify NOBB numbers for same products in order to avoid losing customers and increase its sales. Thesis discusses what it would take to fulfill the objective of the company.

At the beginning, I have finished the statistics of products with the NOBB issue which is mainly based on the accounting data including 870 kinds of products. The main part of this thesis is to apply Pareto and ABC analysis to find which products should be given the priority or more attention for standardization and implement the decision model to obtain the detailed solution for standardization. At the end, some attention is given to organizational capacity.

Contents

1 Introduction

1.1 Asak Miljøstein AS and Research Problem

Asak Miljøstein AS is a sales organization for five factories, its products are mainly concrete materials, for instance, pavement blocks and facing stone. These products are commonly used over the ground for pathways and patios in various patterns and styles around buildings, creating a better environment for living. These products have major benefits such as extension of the living space, visual appeal, value addition and so on. Asak's customers are a large quantity of retailers and clients such like garden professionals within Norway, the total revenue of Asak Miljøstein AS in 2011 is 240 million NOK (from now onwards, the company name would be referred as Asak).

As a sales organization for five factories, Asak is also involved in the operation management of five factories such as designing internal transportation. The five factories that Asak represents are located at Kristiansand, Fetsund, Hønefoss, Stjørdal and Bodø, the locations of the five factories can be seen in Figure 1. The factories in Fetsund, Hønefoss and Kristiansand have the same owner and the other factories have another two different owners. Most products have very high weight and low value per ton, accordingly, its transportation cost from factories to customers are very high and accounts for a large portion of total cost, therefore Asak always try to make reasonable production plans and design optimal distribution systems.

Figure 1 Locations of factories

The whole production procedure in Asak is summarized in Figure 2:

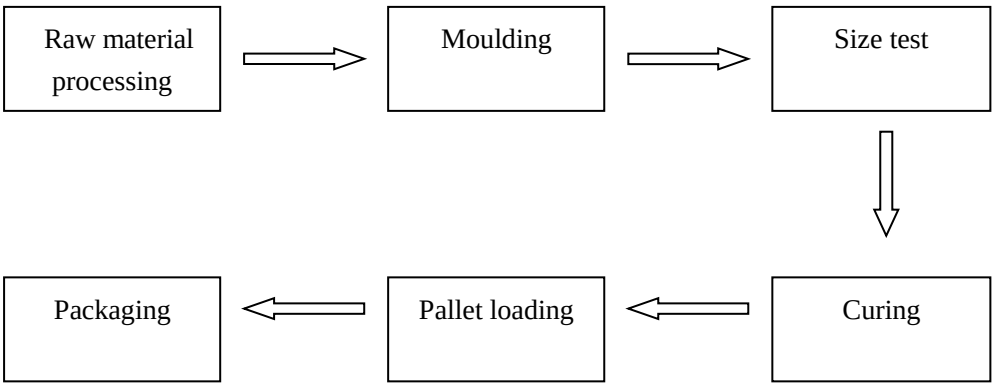

Figure 2 Production procedure

The whole production process starts with raw material processing. Then, it comes to moulding, which generates the initial products from raw material. After this step, people who are responsible for quality control make required tests, e.g. measurements of length, width and height. Following it, products are moved by forklifts to curing chamber in order to make it more solid. Finally, products are loaded to pallets and

packaged.

In terms of sales, Asak faces a challenge caused by the issue with NOBB, which is a register for building materials, as Figure 3 shows, the five factories that Asak represent do not have exactly the same machines for same products, therefore number per mould, number per pallet, price per pallet and so on are not exactly the same and identical products are given different NOBB numbers. It is a challenge for Asak's customers who have to view Asak as multiple suppliers for some products, which leads to a situation where Asak lose some of the benefits from being one single supplier. In the year 2012, Asak has lost one of biggest retailers because of the NOBB issue; consequently Asak expects to solve it with reasonable and acceptable cost.

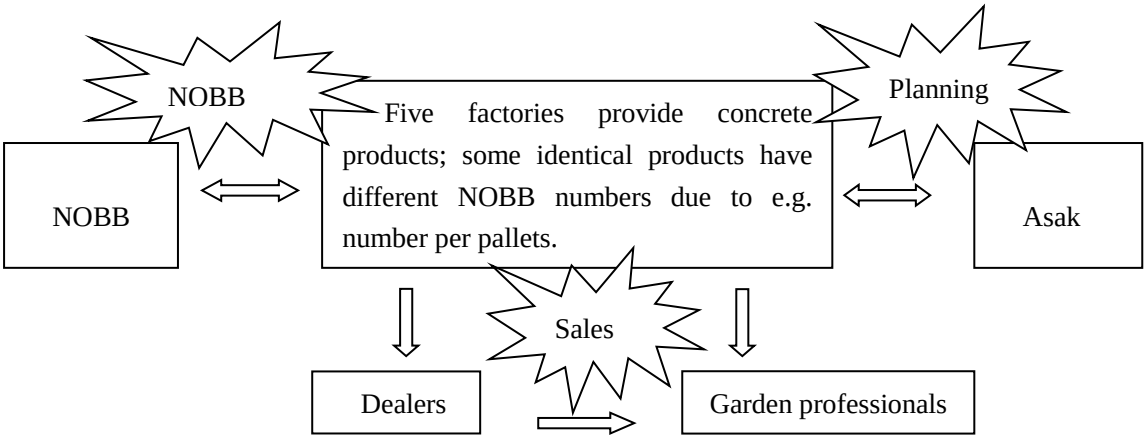

Figure 3 Asak’s network

This thesis makes a study of the NOBB issue and tries to find out what it would take to standardize products in order to unify NOBB numbers for the same products.

1.2 NOBB

NOBB is short for Norsk Byggevarebase, it is a register for building materials in Norway. NOBB reflects all types of materials information in the construction industry of Norway, for example, product color, weight, width, length, height, pallet size, number per pallet, price and so on. In other words, comprehensive product data is

registered by NOBB. The NOBB number is an arbitrary number that consists of eight digits, as shown in Figure 4, NOBB numbers are illustrated in the first column of the product brochure, and in each row, detailed product information is shown after the NOBB number.

PARKSTEIN			Byggemål LxBxH	Antall pr. m²	Vekt pr. m²	m² pr. pall	Antall pr. pall	Vekt pr. pall	NOBB pris pr. m²
23607112	Parkstein	Grå	20x10x6	50	135	10,00	500	1370	159,00
23607146	Parkstein liten pall	Grå	20x10x6	50	135	4,00	200	560	179,00
21134051	Parkstein 1/2	Grå	10x10x6	100	135	4,00	400	560	282,00
29754900	Parkstein	Koksgrå	20x10x6	50	135	10,00	500	1370	190,00
30277560	Parkstein liten pall	Koksgrå	20x10x6	50	135	4,00	200	560	210,00
29755428	Parkstein 1/2	Koksgrå	10x10x6	100	135	4,00	400	560	322,00

Figure 4 Products and NOBB numbers

As shown in Figure 5, there is information flow between NOBB and all construction material manufacturers: the NOBB number is assigned to one specific product when material manufacturers submit product information to NOBB. As a unique identification of each product, the NOBB number is available for searching when customers purchase products through electronic platforms. Besides, customers regularly place orders according to the NOBB number.

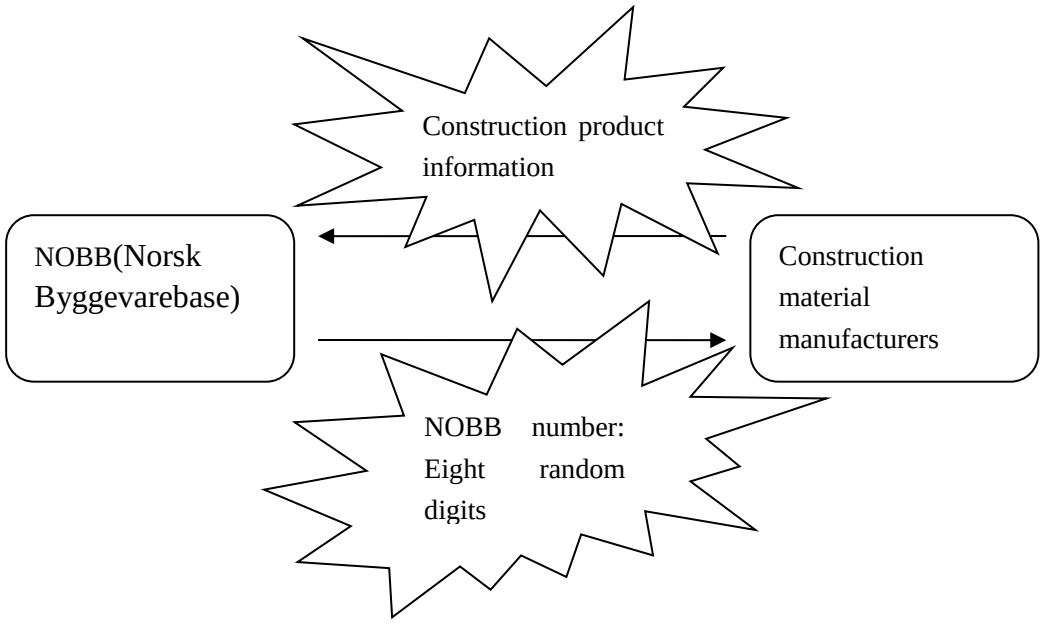

Figure 5 Information flow between NOBB and construction material manufacturers

1.3 Construction Industry in Norway

The company Asak operates within the construction industry in Norway, as the external background of the company, environment of the construction industry has impact on business activities conducted by Asak (Mason 2007).

Construction production index is a price-adjusted output of construction activities; it is regarded as a reasonable measurement of construction activities. As shown in Figure 6, output of construction activities indicates a general increasing trend with fluctuation over time. In detail, there is a continuous increasing trend from 1995 to 1998, suffering a decrease in year 1999 and 2000, it continue to increase until 2008, after a decrease in two years, it has a tendency to go up again from 2010.

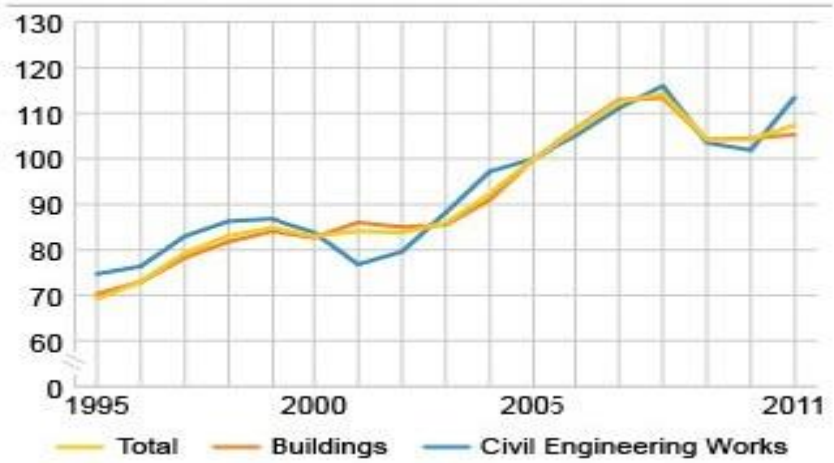

Figure 6 Production index, construction.1995-2011. Source: Statistics Norway

Figure 7 shows that the number of dwellings started is volatile from January 2000 to January 2013. From year 2000 to 2003, the number of dwellings drops a little from 2000 to 1800, after that, experiencing a period of rising trend from year 2003 to 2004, it keeps a higher level above 2500 for the next three years, and then it is falling until the lowest point below 1200 in year 2009, furthermore, it starts to rebound with fluctuation after 2011.

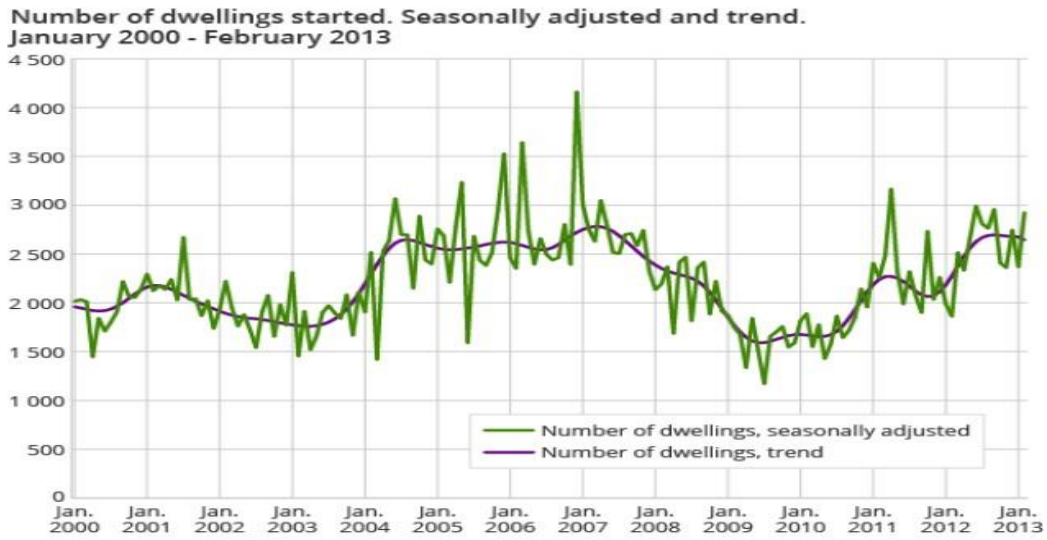

Figure 7 The number of dwellings started, seasonally adjusted and trend.

Source: Statistics Norway

2 Literature Review

2.1 Product Variety and Product Standardization

Product variety is defined as “the number of different versions of a product offered by a firm at a single point in time” (Taylor and Ulrich 2001 P1588). One kind of classification method for product variety is horizontal and vertical product variety. Shaked and Sutton (1982) pointed out the difference between horizontal and vertical product differentiation: the former one refers to developing new products that have intensive link to the current products and the latter one means producing relevant raw material, components or end products. Many papers discuss the relationship between product variety and operational performance. Rao (2008) presents key performance indicators of changing product variety by simulation models. High product variety has high requirement of operational capacity, especially inventory level (Closs, Nyaga and Voss 2010), Wan, Philip and Martin (2012) prove that the decrease of product variety has positive effect on operational performance which is measured by order fill rate.

At the basic conceptual level, product standardization can be defined as providing a unified standard for products in terms of product size, quality, raw material, production equipment and so on in order to obtain benefits for companies. Madar and Neacsu (2010) summarise that the advantages of standardization are cost reduction, prices reduction, improvement of market competence and promotion convenience whereas the main disadvantage is that standardization may not catch more customers. In addition, the standardization levels depend on different product features or industry elements (Leonidou 1996).

2.2 Application of Pareto Principle and ABC Analysis

In the nineteenth century, as an Italian economist and sociologist, Vilfredo Pareto gave birth to Pareto's Law, which is also known as the 80/20 rule. He described the situation of unequal distribution of income that existed in Italy: 80 percent of the wealth is owned by 20 percent of the people, and he found the similar phenomenon in farming: 80 percent of the peas are yielded by 20 percent of the peapods in his garden. The Pareto principle points out many kinds of outputs are dominated by few vital factors (Lai and Cheng 2009). Joseph Juran first gave the name Pareto Principle and addressed the relationship between relatively few critical elements and largest portion of the outcome are not always strictly 20/80 (Juran 1975; Juran 1989). The Pareto Principle already applies in many fields other than wealth distribution. For example, Anschuetz (1997) used the Pareto Principle to explain how to get more profit for marketers: marketers should focus more on the few vital brands which could bring large portion of total profit for company. Kuprenas and Kenney (1999) applied the Pareto Principle in quality management: focusing on a few kinds of defects that bring more unqualified products.

Dickie (1951) first used the term "ABC analysis" in 1951. ABC analysis which is also known as ABC classification is expanded by Pareto analysis (Viale 1996). It is commonly used in application such like material and quality management (Yan,

Ahmad and Yang 2013). ABC analysis divides research items into A, B and C groups that present different levels of importance. A group is very important, B group is media-important and C group is less-important. Items in group A are small in number, but occupy a large proportion of total revenue, in contrast, items in group C are much larger in number, but account for a relatively small percentage of total revenue. Items in group B are in a situation between group A and group C. Fuerst (1981) summarised the process to do ABC analysis: first, calculating total value for each kind of product, second, ranking items by the total value in descending order, third, calculating the percentage of total value for each item, last, dividing products into three groups according to certain classification criteria.

2.3 Decision Modeling

Decision modeling refers to the process of quantifying a problem scenario in order to make a choice from alternative decisions that satisfy specific criteria. In the increasingly competitive business environment, decision modeling is more important to be applied to support decision-making for organizations (Koutsoukis and Mitra 2003). Because many decision variables are restricted to be integers, integer programming (IP) such as binary integer programming (BIP) and mixed integer programming (MIP) are commonly applied in business cases (Klamroth 2002). General steps of making decision modeling is summarized by Lee, Oh and Pines (2008): defining the problem, identifying decision variables, acquiring input data, formulating the model, developing an optimal solution, analyzing solutions, updating the model and implementing.

2.4 Cost/Benefit Analysis

Cost/benefit analysis is one kind of analysis linked to benefit and cost of the program that is being carrying out or will be implemented. The following will review the cost/benefit analysis applied in research within different sorts of fields. Oxenburgh (1997) describes a method of calculating the cost of employment; some reasonable

factors of assumption are applied in the process of calculation. Plotnick and Deppman (1999) apply cost/benefit analysis in a children welfare program, as it is difficult to visualize the benefit, the saving cost are identified artistically through reverse thinking: quantification of medical and criminal justice system cost can be regarded as the measurement of the benefit. As some part of cost and benefit cannot be measured by monetary value, cost/benefit analysis can be conducted in a qualitative way (Van den Burg 2004). Zebda (2002) summarises several limitations of cost/benefit analysis shown in Figure 8, which would be helpful when applying cost/benefit analysis.

It would be impossible to realize all the consequences of a huge number of rejected alternatives.
Accounting system has a different criterion, which results in the unavailability of relevant data.
Some consequences require a relatively long period of time to be evaluated.
Consequences can be changed because of uncertainty.
Consequences would be extraordinarily successful if decision makers create a better environment in order to guarantee the success.

Figure 8 Limitations of cost/benefit analysis. Source: Zebda (2002)

2.5 Organizational Capacity

Organizational capacity plays a pivotal role in achieving objectives for enterprises (Malone 2007). Numerous elements can be discussed in terms of organizational capacity, for instance, employee attitude and employee resource. An attitude survey is a good tool to know employees' attitude including opinions, comments, plans, feelings and so on. Knapp and Mujtaba (2010) present a practical approach to implement an employee attitude survey, which consists of survey designing, steps of carrying out the survey, result analysis and feedback. Employee resource refers to if employees are suitable to do corresponding jobs, if not, the company should prefer to

train or hire new staff (Horton 2003). As the potential benefit for organization resource, employee development becomes a driving force for organizational capacity. Hameed and Waheed (2011) summarise four types of employee development: skill development, self-directed, employee attitude and employee self-learning, which affect the employee performance and further affect organizational effectiveness.

3 Methodology

This chapter outlines the methodological approach for this thesis. The first part introduces research design, following this, the second part case study research is presented, after this part, method of data collection and analysis tools and techniques are described.

3.1 Research Design

Case study was defined by Yin (2009 P18) as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real life context, especially when the boundaries between phenomenon and context are not clearly evident". The purpose of this thesis has an exploratory nature, research is expected to figure out what kind of action can be taken to help Asak to get only one NOBB number for identical products, exploratory research is considered to be suitable.

3.2 Case Study Research

This thesis is to help Asak to figure out the possible solutions for Asak to standardize products. This purpose includes statistics and analysis of products revenue, what it should take to get only one NOBB number for same products and how to realize the standardization with optimal cost; both qualitative and quantitative methods are applied to achieve the goal. Case study is applied to this thesis, it is considered appropriate to investigate solution to product standardization within a real-world environment. According to Ellram (1996), case studies could yield both qualitative

and quantitative results. In this thesis, the results are discussed from both qualitative and quantitative aspects.

3.3 Data Collection

Data collection refers to the whole process of preparing and collecting topic related information in order to serve as a basis of analysis and help to make decisions about a specific topic.

A huge amount of data was collected to understand the situation of the NOBB issue. The manager of Asak exported the revenue list of products of last year from the company's ERP system. In addition, because of necessary internal transportation within five factories, specific locations where products are actually manufactured are also provided, which is helpful to do statistics of revenue of products that are actually produced in each factory.

The variety of data can be categorized into primary data and secondary data according to the methods of finding data, both primary and secondary data can be divided into internal and external data on the basis of sources of data. In this case, the sources of data is summarised in Figure 9.

Data collection	Sources of data	
	Internal	External
Primary	• Interviews within Asak	
Secondary	• Financial figures • Strategic and introduction documents	• Industry statistics

Figure 9 Sources of data

3.3.1 Primary Data

Primary data refers to data collected from first-hand experience. Interview is a way to getting valid and reliable primary data, which is crucial to obtain understanding of the current situation. The interviews are organised face to face with the manager in Asak. The author organised two rounds of interview in Asak. First round of interviews is used to obtain an overview of Asak's current situation corresponding to the chosen topic; the second round of interviews target at obtaining deep and meticulous understanding of issues intensively linked to the topic and identified in the first round. In the time of visiting Asak, the contents of the interviews was mainly related to products with different NOBB numbers and the situation of production machines, moulds and pallet sizes in different factories are also discussed. In addition, several e-mail questionnaires with the manager of Asak play an important role to investigate the NOBB issue.

3.3.2 Secondary Data

The data that are easy and quick to get for exploratory research is secondary data. Accounting figures and reports of the company, which can be regarded as secondary data (Krishnaswami and Satyaprasad 2010), have important value in the process of analysing current products, the author made oral non-disclosure agreement with Asak in order to get sales data in year 2012. Considering internal transportation within the factories, as a strategic document, specific locations where products are actually produced is offered. Besides, some introduction documents made by the company and statistics data in the construction industry are important to investigate the issue.

3.4 Analysis: Tools and Techniques

Research is based on Pareto Principle, ABC analysis, cost/benefit analysis, decision modeling and organizational capacity adjustment. In detail, the author applies Pareto Principle and ABC analysis to find out which products should be given priority or

more attention for standardization; cost/benefit analysis is used to figure out the cost and benefit; decision modeling aims to find the optimal solution for synthesis of alternative methods to standardize products. Besides, in the process of standardization, organizational capacity has to be adjusted to adapt the new situation, organizational capacity is expected to be discussed in terms of employee attitude and employee resource.

4 Case Study Findings

4.1 The Situation of the NOBB Issue

Asak's product variety can be regarded as horizontal variety because its products are complementary products and frequently used in sets.

The NOBB numbers are not assigned to products in the initial accounting data, therefore some necessary statistics should be done at the beginning. The procedure to do statistics of revenue of products that have different NOBB numbers can be summarized in Figure 10. Products in sales data are assigned with identification numbers which is different from NOBB numbers, the initial statistics work is to give the right NOBB numbers to each kind of product and then select the products with different NOBB numbers according to the product booklets which are offered by the company.

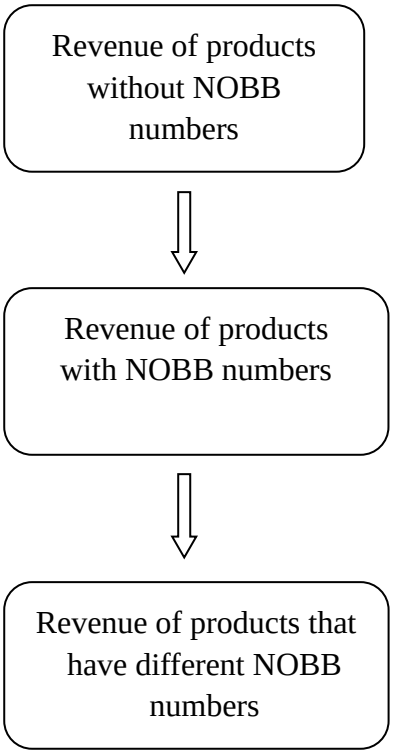

Figure 10 Initial data processing

After completing the steps summarized in Figure 10, detailed information about revenue of products with different NOBB numbers can be seen from Appendix 1. According to non-disclosure agreement, the names of products, NOBB numbers and their revenue numbers are manipulated. As shown in Figure 11, there are 870 products with revenue of 198.38 million NOK, the NOBB issue exists in 51 products, which contribute to the revenue with 41.36 million NOK.

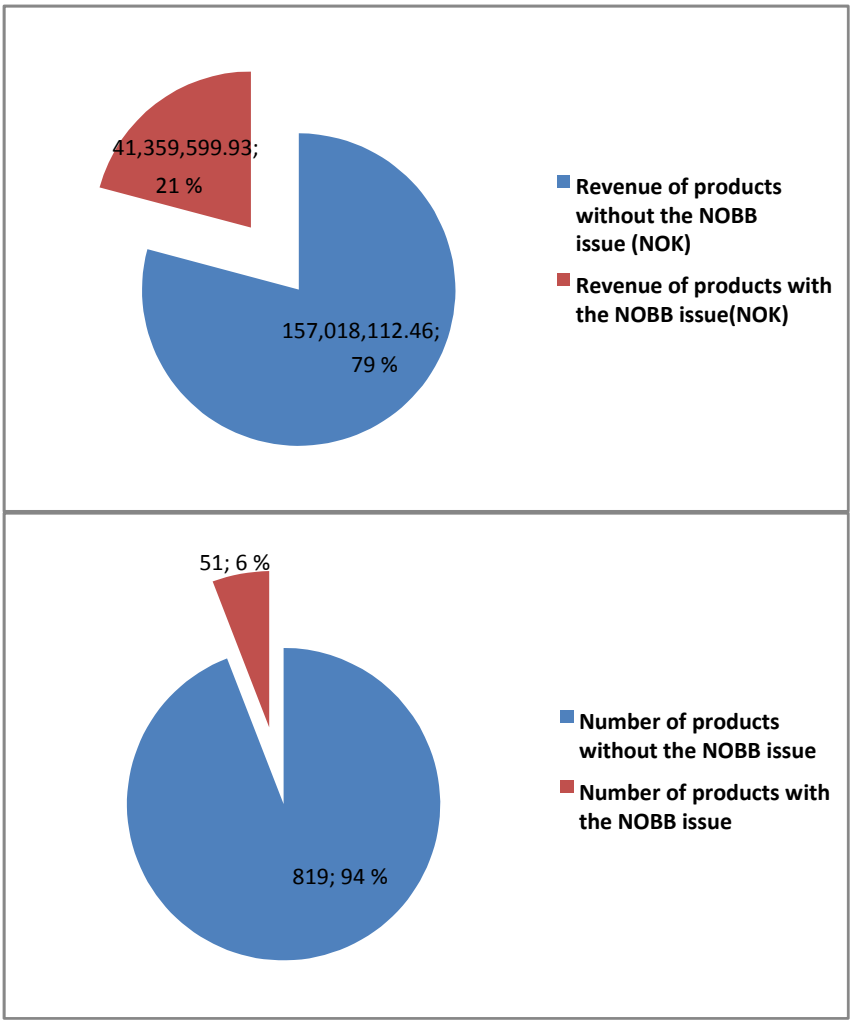

Figure 11 Products with the NOBB issue

It can be seen from Figure 11 that 6 % of products have the NOBB issue and their revenue accounts for 21% of total revenue. Figure 12 illustrates the sales of products that have different NOBB numbers in each factory, the descending order of the revenue for five factories from big to small is factory in Hønefoss, factory in Stjørdal, factoty in Fetsund, factory in Bodø and factory in Kristiansand. The sales from factories in Hønefoss and Stjørdal contribute over 50% of total revenue.

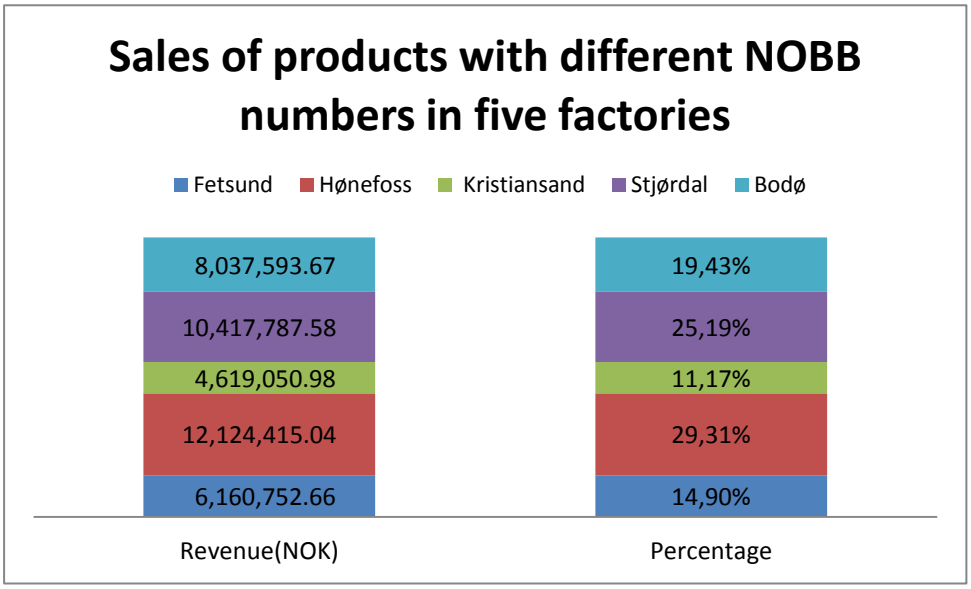

Figure 12 Sales of products with different NOBB numbers in five factories

Due to different production facilities in five factories, it is not possible for all factories to be self-sufficient with a complete assortment and some necessary internal transportation is required. For example, the factory in Fetsund cannot produce some products because of its specialised machinery. Therefore, for some products, the factory in Fetsund is supplied by the factory in Hønefoss.

Up to now all the statistics above are based on sales data of products that are sold through each factory. Because the standardization criteria for each product will strongly depend on revenue of products that are actually produced in each factory, it becomes necessary to do further statistics and give an image of the revenue data that are actually produced in each factory, the result is achieved in Appendix 2 and Figure 13 by eliminating the effect brought by internal transportation within the five factories.

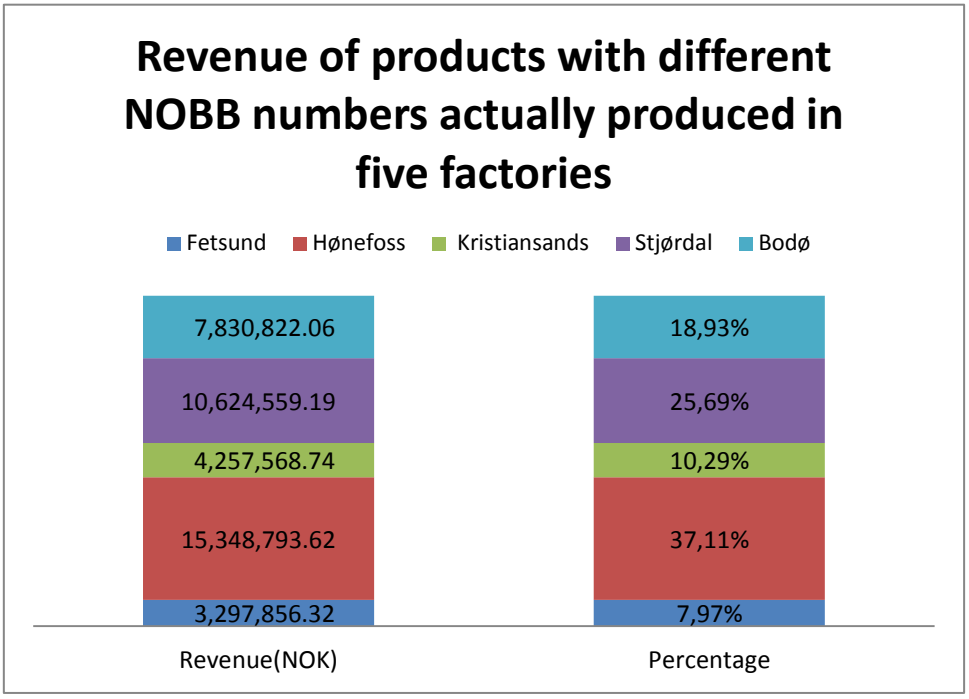

Figure 13 Revenue of products with different NOBB numbers actually produced in five factories

The difference of revenue before and after considering internal transportation is drawn in Figure 14, the revenue of the factory in Fetsund goes down 46.47% from 6.16 million NOK to 3.30 million NOK and the revenue of factory in Hønefoss increases 26.59% from 12.12 million NOK to 15.35 million NOK. However, factories in Kristiansand, Stjørdal and Bodø almost keep the same level.

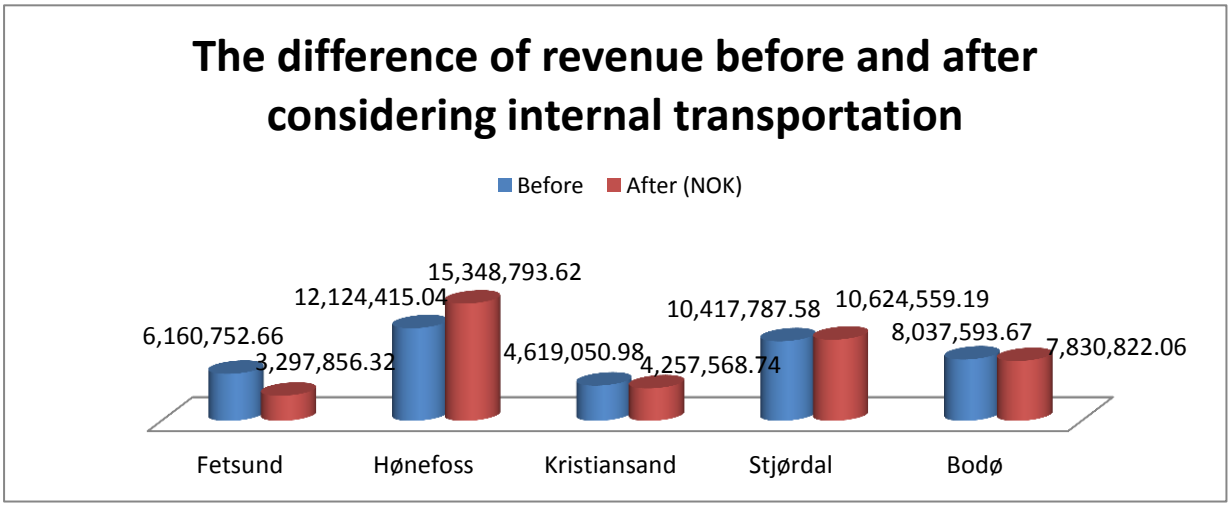

Figure 14 The difference of revenue before and after considering internal transportation

4.2 Pareto and ABC Analysis

In many situations, important factors are usually a small part of the whole factors, Pareto analysis is used to find few vital causes which result in large portion of consequences (Nankana 2005); ABC analysis is frequently applied to classify the goods into A, B and C groups according to their value. In this thesis, Pareto and ABC analysis can be applied to find out which product can be given the priority or more attention in the process of standardization.

4.2.1 Pareto Analysis

The Pareto diagram is a technical tool of the Pareto Principle; it is a graphic explanation which contains categories of outcome data in certain order from largest to smallest and a corresponding cumulative line for the histogram. As an efficient tool, the Pareto diagram is commonly used in business research. In this case, there are totally 870 products and 51 products do not have unified NOBB numbers. First of all, products with different NOBB numbers should be sorted from largest to smallest according to sales, and then calculating cumulative sales, proportion of total sales and cumulative percentage of total sales, the detailed result can be seen in Appendix 3, finally, drawing the analysis diagram Figure 15. In Appendix 3, we find that there is imbalanced distribution in sales and 19.61% of items contribute 69.26% of revenue.

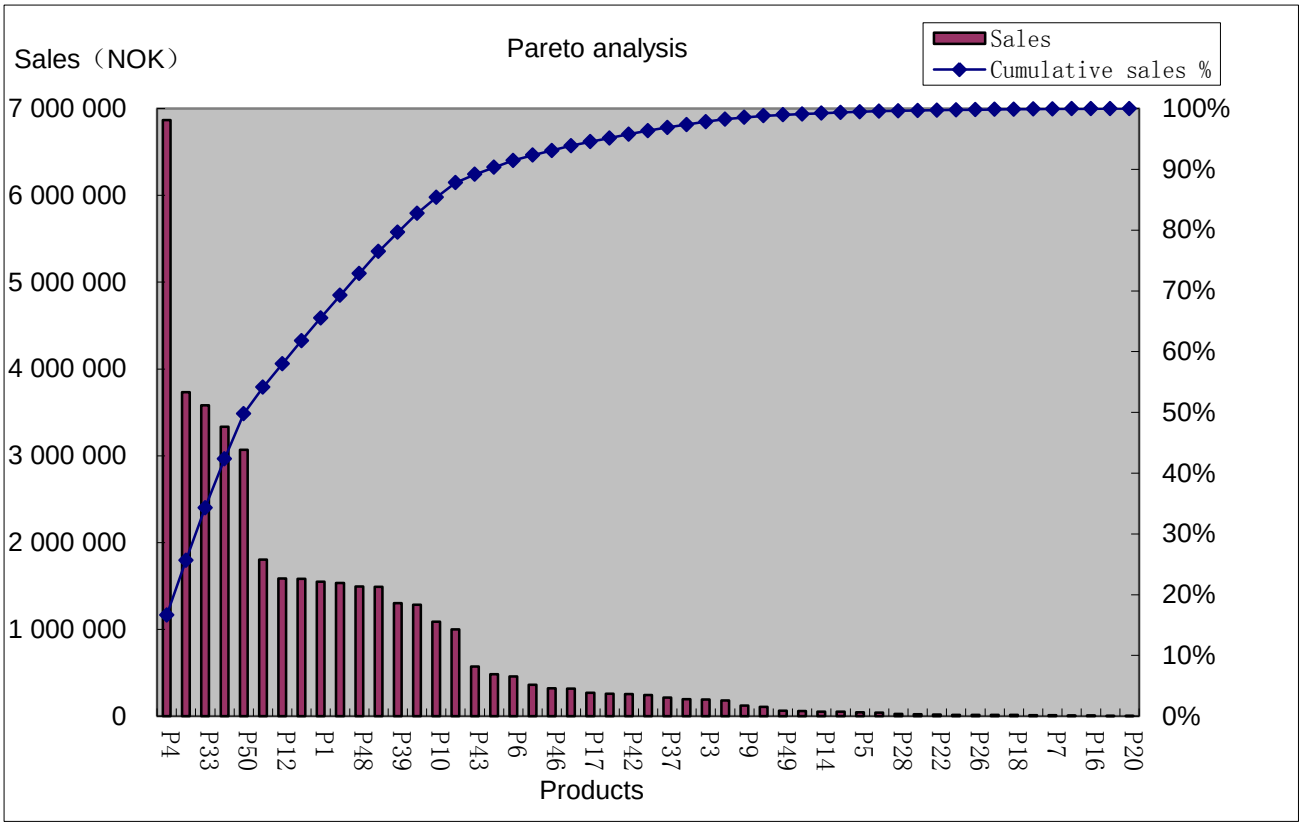

Figure 15 Pareto analysis

4.2.2 ABC Analysis

In ABC analysis, products with different NOBB numbers will be divided into A, B and C groups according to sales. Importance levels in different groups are different, group A is the most important, group B comes second and group C is the last.

Based on Appendix 3, there are different kinds of rules for ABC classification, according to Werner (2002), one kind of criteria for breakdown of ABC groups is described as following: A items are 20% of items that bring 70% of total value, B items are 30% of items that account for 25 % of total value, the rest are 50% C items and occupy 5% total value. The result can be seen in Appendix 4 and Figure 16.

ABC analysis	Number of items	Cumulative number of items	Percentage of items	Cumulative percentage of items	Sales (NOK)	Percentage of Sales	Cumulative percentage of sales
A	10	10	19.61%	19.61%	28, 644, 126.84	69.26%	69.26%
B	15	25	29.41%	49.02%	10, 964, 815.32	26.51%	95.77%
C	26	51	50.98%	100%	1, 750, 657.77	4.23%	100%

Figure 16 ABC analysis

According to the classification rule mentioned above, products are divided into three groups. Products in group A are very important, 19.61% of items occupy 69.26% of sales; products in group B are media-important, 29.41% of items make up 26.51% of sales; products in group C are less-important, 50.98% of items account for only 4.23% of sales.

4.3 Solutions for Product Standardization

4.3.1 Changing Moulds, Applying Sorting Machines and Human Handling

There are three possible methods to standardize products with different NOBB numbers: changing moulds, applying sorting machines and human handling.

Figure 17 The mould

Figure 17 shows one mould currently being used in one factory, the mould refers to a hollow container with a certain shape that can make soft raw materials become hard and take the shape. In this case, moulds, as core part of production machines, its size (LxW) determines how many “stones” get in each mould and further affect the choice

of size of the pallet. Taking product P4 as example, its detailed information is shown in Figure 18, products (NOBB numbers: 4A, 4B and 4C) in five factories are made by different moulds and have different numbers per pallet even if the single “stone” has same size(LxBxH).

Size	NOBB numbers	LxBxH	Number per.m^2	Weight per m^2	m^2 Per pallet	Number per pallet	Weight per pallet	Price per m^2
P4	4A	20x13.5x6	37	135	10.70	396	1465	176.40
	4B	20x13.5x6	37	135	10.81	400	1480	183.00
	4C	20x13.5x6	37	135	11.35	420	1553	199.00

Figure 18 Information of product P4

The fixings of machines in different factories might be different, and therefore the mould in one factory might not be installed directly in another factory even if the size is similar. New moulds used to unify NOBB numbers might need to be customized in order to be suitable to the fixings, one possible alternative to unify NOBB numbers can be altering moulds in some factory for the same products. Depending on the products and machines, price of one mould is in a range from 80, 000 NOK to 130, 000 NOK.

There is one kind of sorting machine that has the function to change display forms for products in pallets and thereby unifying pallet size and the number of products per pallet. This kind of sorting machine is already being used in a European country, but not in Norway, the cost of the sorting machine is expensive and the estimated price is around 1, 000, 000 NOK.

Number per pallet also can be changed by human handling, which means to change the number of product per pallet manually. Due to different working schedules, factories in Fetsund, Hønefoss and Stjørdal all have two shifts and the other factories have one shift. Human handling performs the same function as sorting machines.

However, compared with sorting machines, human handling is time-consuming.

4.3.2 Decision Model

As discussed in chapter 4.3.1, three are three possible methods that can be applied to standardise products in order to unify NOBB numbers. This model is implemented to quantify the problem related to the NOBB issue and find a detailed plan for combination of changing moulds, human handling and application of sorting machines. The standardization criterion is to keep the NOBB number that has biggest revenue for each kind of product. In this case, it is a binary integer programming problem because decision variables are only allowed to be either 1 or 0. The following shows the mathematical model:

Formulation

Objective:

$$MIN \sum_{i\in I}\sum_{f\in F} p_{i1f} Q_{if} a_{if} + \sum_{i\in I}\sum_{f\in F} p_{i2f} R_{if} a_{if}\, XY + \sum_{f\in F} m_f Z$$

Constraints:

$$p_{ijf} = binary, \qquad \forall i \in I \;\; \forall j \in J \;\; \forall f \in F$$

$$m_f = binary, \qquad \forall f \in F$$

$$\sum_{j\in J} p_{ijf} + m_f = a_{if} \quad \forall i \in I \;\; \forall f \in F$$

Notation (sets, parameters, variables)

Sets

I- a set of products that are planned to be standardized, numbers from 1 to N are assigned to products according to their revenue in descending order. For example, if products in group A generated by ABC analysis are planned to be standardized, I=1, 2, 3…10.

J- a set of standardization methods 1- changing moulds 2- human handling.

F- a set of factories:1- factory in Fetsund, 2- factoy in Hønefoss, 3- factory in Kristiansand, 4- factory in Stjørdal, 5- factory in Bodø.

Parameters

Q_{if} - cost for product i in factory f to be standardized by changing its mould. Cost of changing the mould depends on the product and the factory, and it is estimated in a range from 80, 000 NOK to 130, 000 NOK, an average cost 105, 000 NOK is assigned to this model.

R_{if} - revenue of product i produced by factory f. This can be seen in the Appendix 2.

Y - planning horizon (year), it means the amount of time that Asak will look into the future when preparing for the strategy of standardization. Besides, it is also related to the human handling cost which depends on time in this model. Planning horizons are different for various strategies in many companies, according to Ryan (2004), many business planning choose a 5 year as the planning horizon, in this case, Y is fixed and Y=5 is applied in this model.

X- a coefficient which is related to cost of human handling. Human handling fees is not easy to be forecasted exactly, in this model, cost of human handling is supposed to be related to revenue of products because handling operation is commonly charged according to the value of the products being handled. In this model, a reasonable assumption of X= 2% per year is applied, which means if one kind of product in certain factory plans to be standardized by human handling, its cost is to multiply 2% of its revenue for unit time (one year) by planning horizon Y.

Z- cost of a sorting machine, the estimated price 1, 000, 000 NOK is applied in this model.

a_{ij}- if product i in factory f is planned to be standardized a_{ij} =1 if not a_{ij} =0, this parameter is related to the criteria of selecting which NOBB number would be kept for each kind of product, as mentioned before, the standardization criteria is to keep the NOBB number that has biggest revenue in each product.

Variables

p_{ijf}- decision variables: if product i in factory f is standardized by method j, $p_{ijf} = 1$; if not, $p_{ijf} = 0$

m_f - decision variables: if factory f buys one sorting machine to apply in the activities

of standardization, m=1; if not, m=0.

Description

The objective function expresses to minimize the total cost of unifying NOBB numbers, which equals to the cost of changing moulds $\sum_{i\in I}\sum_{f\in F} p_{i1f} Q_{if} a_{if}$ plus the cost of human handling $\sum_{i\in I}\sum_{f\in F} p_{i2f} R_{if} a_{if} XY$ plus the cost of buying sorting machines $\sum_{f\in F} m_f Z$. The first and second constraints explain that decision variables p_{ijf} and m_f are binary. The third one means selecting one method of standardization for the product to be standardized. The difference of the cost of these three methods is summarized as following:

1) If one factory installs one sorting machine, all products in this factory can be standardized by changing the display form in pallets, the cost of sorting machines depends on how many factories will deploy sorting machines. However, the cost for changing moulds and human handling are related to the number of products to be standardized and the revenue of products to be standardized respectively.
2) Compared with the cost of human handling, the initial investment of buying sorting machine and changing moulds are more expensive.

4.3.3 Application of the Decision Model

The result generated by the decision model could be a detailed plan for synthesis of three possible standardization methods. However, it cannot be used directly because some reasonable assumptions are applied in this model. Some parameters' value such as X, Y, Z and Q should be adjusted flexibly according to the reality of situation. After necessary adjustment, the result yielded by the model will be changed and the model can be applied to support the decision-making. In practise, all the value can be checked one by one in order to get precise numbers. In a particular case, if some products are impossible to be standardised by changing mould because fixings of machines are different and moulds cannot be customized to be suitable for fixings, their corresponding value of Q would be assigned to extreme big value. Besides,

considering the high standardization cost for some kinds of products in practise, if some products are selected not to be standardised, their input data can be removed from the model or a_{ij} is set to be 0 for specific products i that are not planned to be standardized.

4.3.4 Solution Analysis

In this case, the software Xpress IVE is applied to implement the model. In this part, different proportions of products are taken to the model; the cost and benefit are discussed in the following.

If we prefer to standardize products in group A yielded by ABC analysis, product standardization will focus on these very important 10 products, the optimal cost generated by the model is 990, 356 NOK and results do not suggest to buy any sorting machine in the five factories, the detailed plan could be found in Appendix 5: M and H means standardizing by changing the mould and standardizing by human handling respectively; the red cell indicates NOBB numbers which are planned to be kept for each product. Following this way, the priority of standardization will be given to 19.61% of items and the NOBB issue would be removed in products with 69.26% revenue.

If we plan to standardize products in A and B groups generated by ABC analysis, product standardization will cover both very important products and media-important products, data about 25 products would be put into the model. The optimal cost is 1, 418, 920 NOK and the results do not suggest to buy any sorting machine in the five factories, the detailed plan is showed in appendix 6. Priority of standardization will be given to 49.02% of items, the NOBB issue would be removed in products with 95.77% revenue.

If all kinds of products are selected to be standardized, 51 products will be put into the model, the optimal cost is 1, 470,660 NOK and the results do not suggest to buy any

sorting machine in the five factories, the detailed plan is showed in appendix 7. Taking this plan, NOBB numbers will be unified for every kind of product, thus the NOBB issue will be completely solved.

In the three plans, the product P4 in Hønefoss and Bodø and the product P33 in Hønefoss are selected to be standardized by changing moulds, and its cost $\sum_{i\in I}\sum_{f\in F} p_{i1f}Q_{if}a_{if}$ is 315,000 NOK(105,000 NOK per mould). The other products are standardized by human handling, and its cost $\sum_{i\in I}\sum_{f\in F} p_{i2f}R_{if}a_{if}\,XY$ is showed in Figure 19. The three plans discussed above are summarised in Figure 19:

Target products for standardization	Number of items	Percentage of items	Percentage of revenue	Cost of changing moulds(NOK)	Cost of human handling(NOK)	Total cost(NOK)
Products in A group	10	19.61%	69.26%	315,000	675,356	990, 356
Products in A and B groups	25	49.02%	95.77%	315,000	1,103,920	1, 418, 920
All products	51	100%	100%	315,000	1,155,660	1, 470, 660

Figure 19 Summary of three plans for standardization

After implementing product standardization, some kinds of benefits summarised in the following can be achieved to different degree, which is related to the proportion of products for standardization.

1) To avoid losing customers because of the NOBB issue. In the year 2011, Asak lost one of the biggest dealers, which is caused by the NOBB issue. This benefit is identified through reverse thinking, unified NOBB number will help Asak to prevent losing customers occurring in the future in some degree, which depends on the proportion of product standardization.
2) To increase operation performance which can be measured by order-fill rate (Closs, Nyaga and Voss 2010; Wan, Philip and Martin 2012). As a well-recognised

KPI in operation management, order fill rate refers to the percentage of number of orders filled correctly to the total number of orders; it shows Asak's operational ability to satisfy customer demand. After implementing product standardization, NOBB numbers will be unified and total different NOBB numbers will decrease in some degree, therefore standardization will has positive impact on order-fill rate and the operation performance will be improved.

3) To enhance the enterprise competitiveness in order to let customers view Asak as a single supplier. In the current situation, there are different NOBB numbers for same products; therefore the customers have to view Asak as multiple suppliers for some products. After applying product standardization, the unified NOBB number for identical products will help Asak avoid making its customers view Asak as multiple suppliers.

4.4 Organizational Capacity for Change

Asak desires to get more benefit from being viewed as one single supplier in the process of standardization, it is important for Asak to be more involved in the planning of operation among the five factories and develop new organizational capacity to make use of the benefit at maximum. Organizational capacity for change needs new mindset and ways to work together (Buono and Kerber 2010). Organizational capacity such as employee attitude and employee resource should be focused in this case.

Employee attitude refers how to adjust employees' working attitude, especially in terms of how to make the communication between Asak and the five factories more efficiently. In the process of standardization, the company should develop relevant measurements in order not to let employees lose motivation when they are coordinating business activities such as distribution of revenue and cost within the factories. Implementing a survey is a good tool to know employee attitude, and the following rules are suggested:

1) Questions in the survey should have a meaningful purpose and strongly linked to the survey topic.
2) Survey should try to cover more people who are involved in Asak's network and give proper time to let them complete the survey.
3) Survey result analysis should not be influenced by personal beliefs and preferences.

In terms of employee resource, some positions would face new challenges. For example, marketers and salespersons would be expected to have a good understanding of products and let old customers realize the change of NOBB numbers for some products in order to facilitate the extension of sales; distribution planners would catch the benefit of standardization to decrease logistics cost by adjusting distribution system and inventory level for some products, the human resource department needs to arrange human resource properly: establishing comprehensive criteria to find out if employees are suitable to do their jobs. Besides, the company should pay attention on employee development: creating an appropriate environment to enhance personal development in order to improve employee performance.

5 Conclusion

In this thesis, Pareto and ABC analysis give a visual picture of the situation of products with the NOBB issue: finding that there is uneven distribution in revenue for products with different NOBB numbers. Decision modeling is an interesting attempt to find detailed decisions with optimal cost for standardization. Pareto and ABC analysis can be applied for choosing different input data for the proposed decision model, which generate alternatives for standardizing part of products with the NOBB issue. Besides, in terms of organizational capacity, some elements such as employee attitude and employee resource should be paid attention to, which would be beneficial to the company in the process of standardization. I would be glad if this thesis work helps Asak in the beginning of product standardization.

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Appendix

Appendix 1 Sales of products with different NOBB numbers

		Revenue in five factories (NOK)					
Product name	NOBB number	Fetsund	Hønefoss	Kristiansands	Stjørdal	Bodø	Total revenue
P1	1A	531,724.08	413,123.79	206,000.40			
	1B				240,803.25	159,601.11	1,551,252.63
P2	2A	18,512.73	7,856.01	8,030.67			
	2B				578.10	7,394.76	42,372.27
P3	3A	26,337.99	42,041.40	18,966.60			
	3B				36,966.42	69,128.46	193,440.87
P4	4A	626,670.24	2,035,645.08				
	4B			697,940.13	2,043,723.72		
	4C					1,464,535.17	6,868,514.34
P5	5A	9,330.78	12,597.66				
	5B			1,961.85	8,980.23		
	5C					12,010.95	44,881.47
P6	6A	89,381.64	81,877.41	67,657.38			
	6B				208,139.37	12,383.64	459,439.44
P7	7A	2,468.61	3,194.31				
	7B				6,361.56		12,024.48
P8	8A	44,528.46	271,743.90	10,678.86			

	8B				157,733.97		484,685.19
P9	9A	15,905.13	65,657.40				
	9B				39,309.57		120,872.10
P10	10A	173,609.58			288,334.14		
	10B			193,680.72		207,866.31	
	10C		226,502.04				1,089,992.79
P11	11A	6,431.67					
	11B				3,902.79		
	11C		4,897.86				
	11D					1,811.79	17,044.11
P12	12A	236,388.78			251,923.68		
	12B			83,743.32		640,245.75	
	12C		374,343.12				1,586,644.65
P13	13A	10,196.70					
	13B			499.38			
	13C				4,995.03		
	13D					1,669.11	
	13E		4,757.64				22,117.86
P14	14A	16,697.25	11,696.07	2,290.26			
	14B				10,640.73	11,814.15	53,138.46
P15	15A	14,489.40	22,052.67				
	15B			3,597.75			
	15C					21,030.54	61,170.36
P16	16A	3,055.32					

	16B			1,265.67			
	16C				654.36		
	16D					1,446.48	6,421.83
P17	17A	36,891.39			70,879.98		
	17B			31,804.11		51,245.49	
	17C		80,422.32				271,243.29
P18	18A	3,412.02					
	18B			1,100.85			
	18C				1,562.10		
	18D					1,100.85	
	18E		7,581.72				14,757.54
P19	19A	393.60	5,974.11	856.08			
	19B				5,487.03		12,710.82
P20	20A	714.63	1,349.31				
	20B					1,938.48	4,002.42
P21	21A	218,567.31	283,197.66				
	21B			93,864.99	715,183.50		
	21C					180,209.76	1,491,023.22
P22	22A	4,428.00	4,273.02				
	22B			1,161.12	7,512.84		
	22C					1,009.83	18,384.81
P23	23A	104,506.95	341,382.81				
	23B			135,919.92	532,613.37		
	23C					170,373.45	1,284,796.50

P24	24A	2,923.71	2,361.60				
	24B			1,964.31	9,237.30		
	24C					611.31	17,098.23
P25	25A	45,126.24	134,050.32				
	25B			58,974.81	95,279.49		
	25C					28,486.80	361,917.66
P26	26A	5,938.44	6,161.07				
	26B			3,457.53	1,539.96		17,097.00
P27	27A	246,279.21	97,702.59				
	27B			116,763.90	958,861.26	162,289.89	1,581,896.85
P28	28A	6,849.87	4,570.68				
	28B			5,281.62	5,121.72	3,028.26	24,852.15
P29	29A	154,818.87	13,530.00				
	29B			46,352.55	11,946.99	30,462.18	257,110.59
P30	30A	688.80					
	30B			1,815.48	2,872.05		5,376.33
P31	31A	5,304.99	37,618.32	49,132.35			
	32B					1,713,248.55	1,805,304.21
P32	32A	449,822.07					
	32B		1,227,715.89	493,691.25			
	32C				624,210.24	537,816.27	3,333,255.72
P33	33A	444,645.00	1,252,361.40				
	33B			661,968.78	837,943.65	383,652.99	3,580,571.82
P34	34A	60,610.71	145,448.73	34,266.57			

	34B				59,067.06	19,132.65	318,525.72
P35	35A	8,108.16	110,925.09	115,996.38			
	35B				10,290.18		245,319.81
P36	36A	37,237.02	39,763.44				
	36B			34,667.55	22,185.51	63,412.65	197,266.17
P37	37A	46,179.12	71,380.59	79,633.89			
	37B				16,100.70		213,294.30
P38	38A	131.61					
	38B				6,725.64		6,857.25
P39	39A	233,051.79	453,635.07	157,230.90			
	39B				460,277.07		1,304,194.83
P40	40A	660,238.17	1,228,028.31	418,653.87			
	40B				876,885.45	548,372.13	3,732,177.93
P41	41A	23,649.21	23,122.77	11,172.09			
	41B				13,236.03	34,800.39	105,980.49
P42	42A	38,506.38	105,807.06	24,326.94			
	42B				59,872.71	27,200.22	255,713.31
P43	43A	51,262.71	160,465.80	54,977.31			
	43B				112,552.38	191,908.29	571,166.49
P44	44A	5,980.26	19,329.45	3,629.73			
	44B				20,108.04	2,479.68	51,527.16
P45	45A	198,047.22	259,678.83				
	45B			101,329.86			
	45C				284,687.19	155,454.78	999,197.88

P46	46A	62,058.42	68,283.45	29,818.89	64,038.72		
	46B					98,258.55	322,458.03
P47	47A	384,555.81	443,394.09	71,600.76			
	47B				343,200.75	290,914.68	1,533,666.09
P48	48A	296,947.83	575,612.94	70,177.65	332,585.85		
	48B					218,026.11	1,493,350.38
P49	49A	3,651.87	27,137.49	6,455.04	22,966.56		
	49B					2,654.34	62,865.30
P50	50A	415,208.64	1,272,388.26				
	50B			392,726.70			
	50C				496,587.90	493,931.10	3,070,842.60
P51	51A	78,288.27	41,774.49				
	51B			11,964.21			
	51C				33,121.44	14,635.77	179,784.18
		6,160,752.66	12,124,415.04	4,619,050.98	10,417,787.58	8,037,593.67	41,359,599.93

Appendix 2 Revenue of products with different NOBB numbers actually produced in five factories

		Revenue in five factories (NOK)					
Product name	NOBB number	Fetsund	Hønefoss	Kristiansands	Stjørdal	Bodø	Total revenue
P1	1A	531,724.08	413,123.79	206,000.40			
	1B				240,803.25	159,601.11	1,551,252.63
P2	2A	18,512.73	7,856.01	8,030.67			
	2B				578.10	7,394.76	42,372.27
P3	3A	26,337.99	42,041.40	18,966.60			

	3B				36,966.42	69,128.46	193,440.87
P4	4A		2,662,315.32				
	4B			697,940.13	2,043,723.72		
	4C					1,464,535.17	6,868,514.34
P5	5A	9,330.78	12,597.66				
	5B			1,961.85	8,980.23		
	5C					12,010.95	44,881.47
P6	6A		238,916.43				
	6B				220,523.01		459,439.44
P7	7A		5,662.92				
	7B				6,361.56		12,024.48
P8	8A		316,272.36	10,678.86			
	8B				157,733.97		484,685.19
P9	9A		81,562.53				
	9B				39,309.57		120,872.10
P10	10A	173,609.58			288,334.14		
	10B			193,680.72		207,866.31	
	10C		226,502.04				1,089,992.79
P11	11A	6,431.67					
	11B				3,902.79		
	11C		4,897.86				
	11D					1,811.79	17,044.11
P12	12A	236,388.78			251,923.68		
	12B			83,743.32		640,245.75	

	12C		374,343.12				1,586,644.65
P13	13A	10,196.70					
	13B			499.38			
	13C				4,995.03		
	13D					1,669.11	
	13E		4,757.64				22,117.86
P14	14A	28,393.32		2,290.26			
	14B				10,640.73	11,814.15	53,138.46
P15	15A	36,542.07					
	15B			3,597.75			
	15C					21,030.54	61,170.36
P16	16A	3,055.32					
	16B			1,265.67			
	16C				654.36		
	16D					1,446.48	6,421.83
P17	17A	36,891.39			70,879.98		
	17B			31,804.11		51,245.49	
	17C		80,422.32				271,243.29
P18	18A	3,412.02					
	18B			1,100.85			
	18C				1,562.10		
	18D					1,100.85	
	18E		7,581.72				14,757.54
P19	19A	6,367.71		856.08			

	19B				5,487.03		12,710.82
P20	20A	2,063.94					
	20B					1,938.48	4,002.42
P21	21A		501,764.97				
	21B			93,864.99	715,183.50		
	21C					180,209.76	1,491,023.22
P22	22A		8,701.02				
	22B			1,161.12	7,512.84		
	22C					1,009.83	18,384.81
P23	23A		445,889.76				
	23B			135,919.92	532,613.37		
	23C					170,373.45	1,284,796.50
P24	24A		5,285.31				
	24B			1,964.31	9,237.30		
	24C					611.31	17,098.23
P25	25A		179,176.56				
	25B			58,974.81	95,279.49		
	25C					28,486.80	361,917.66
P26	26A		12,099.51				
	26B			3,457.53	1,539.96		17,097.00
P27	27A	246,279.21	97,702.59				
	27B			116,763.90	958,861.26	162,289.89	1,581,896.85
P28	28A	6,849.87	4,570.68				
	28B			5,281.62	5,121.72	3,028.26	24,852.15

P29	29A	154,818.87	13,530.00				
	29B			46,352.55	11,946.99	30,462.18	257,110.59
P30	30A	688.80					
	30B			1,815.48	2,872.05		5,376.33
P31	31A		92,055.66				
	32B					1,713,248.55	1,805,304.21
P32	32A	449,822.07					
	32B		1,227,715.89	493,691.25			
	32C				624,210.24	537,816.27	3,333,255.72
P33	33A		1,697,006.40				
	33B			661,968.78	837,943.65	383,652.99	3,580,571.82
P34	34A		206,059.44	34,266.57			
	34B				59,067.06	19,132.65	318,525.72
P35	35A		119,033.25	115,996.38			
	35B				10,290.18		245,319.81
P36	36A		77,000.46				
	36B			34,667.55	22,185.51	63,412.65	197,266.17
P37	37A		197,193.60				
	37B				16,100.70		213,294.30
P38	38A	131.61					
	38B				6,725.64		6,857.25
P39	39A	233,051.79	453,635.07	157,230.90			
	39B				460,277.07		1,304,194.83
P40	40A		1,888,266.48	418,653.87			

	40B				876,885.45	548,372.13	3,732,177.93
P41	41A		46,771.98	11,172.09			
	41B				13,236.03	34,800.39	105,980.49
P42	42A		144,313.44	24,326.94			
	42B				59,872.71	27,200.22	255,713.31
P43	43A		266,705.82				
	43B				304,460.67		571,166.49
P44	44A		28,939.44				
	44B				22,587.72		51,527.16
P45	45A	198,047.22	259,678.83				
	45B			101,329.86			
	45C				284,687.19	155,454.78	999,197.88
P46	46A	160,160.76			64,038.72		
	46B					98,258.55	322,458.03
P47	47A	384,555.81	443,394.09	71,600.76			
	47B				343,200.75	290,914.68	1,533,666.09
P48	48A	296,947.83	645,790.59		332,585.85		
	48B					218,026.11	1,493,350.38
P49	49A	37,244.40			22,966.56		
	49B					2,654.34	62,865.30
P50	50A		1,687,596.90				
	50B			392,726.70			
	50C				496,587.90	493,931.10	3,070,842.60
P51	51A		120,062.76				

	51B			11,964.21			
	51C				33,121.44	14,635.77	179,784.18
		3,297,856.32	15,348,793.62	4,257,568.74	10,624,559.19	7,830,822.06	41,359,599.93

Appendix 3 Pareto analysis

Name	Products NO.	% of roducts	Sales	Cumulative sales	Sales %	Cumulative sales %
P4	1	1.96%	6,868,514.34	6,868,514.34	16.61%	16.61%
P40	2	3.92%	3,732,177.93	10,600,692.27	9.02%	25.63%
P33	3	5.88%	3,580,571.82	14,181,264.09	8.66%	34.29%
P32	4	7.84%	3,333,255.72	17,514,519.81	8.06%	42.35%
P50	5	9.80%	3,070,842.60	20,585,362.41	7.42%	49.77%
P31	6	11.76%	1,805,304.21	22,390,666.62	4.36%	54.14%
P12	7	13.73%	1,586,644.65	23,977,311.27	3.84%	57.97%
P27	8	15.69%	1,581,896.85	25,559,208.12	3.82%	61.80%
P1	9	17.65%	1,551,252.63	27,110,460.75	3.75%	65.55%
P47	10	19.61%	1,533,666.09	28,644,126.84	3.71%	69.26%
P48	11	21.57%	1,493,350.38	30,137,477.22	3.61%	72.87%
P21	12	23.53%	1,491,023.22	31,628,500.44	3.61%	76.47%
P39	13	25.49%	1,304,194.83	32,932,695.27	3.15%	79.63%
P23	14	27.45%	1,284,796.50	34,217,491.77	3.11%	82.73%
P10	15	29.41%	1,089,992.79	35,307,484.56	2.64%	85.37%
P45	16	31.37%	999,197.88	36,306,682.44	2.42%	87.78%
P43	17	33.33%	571,166.49	36,877,848.93	1.38%	89.16%
P8	18	35.29%	484,685.19	37,362,534.12	1.17%	90.34%

P6	19	37.25%	459,439.44	37,821,973.56	1.11%	91.45%
P25	20	39.22%	361,917.66	38,183,891.22	0.88%	92.32%
P46	21	41.18%	322,458.03	38,506,349.25	0.78%	93.10%
P34	22	43.14%	318,525.72	38,824,874.97	0.77%	93.87%
P17	23	45.10%	271,243.29	39,096,118.26	0.66%	94.53%
P29	24	47.06%	257,110.59	39,353,228.85	0.62%	95.15%
P42	25	49.02%	255,713.31	39,608,942.16	0.62%	95.77%
P35	26	50.98%	245,319.81	39,854,261.97	0.59%	96.36%
P37	27	52.94%	213,294.30	40,067,556.27	0.52%	96.88%
P36	28	54.90%	197,266.17	40,264,822.44	0.48%	97.35%
P3	29	56.86%	193,440.87	40,458,263.31	0.47%	97.82%
P51	30	58.82%	179,784.18	40,638,047.49	0.43%	98.26%
P9	31	60.78%	120,872.10	40,758,919.59	0.29%	98.55%
P41	32	62.75%	105,980.49	40,864,900.08	0.26%	98.80%
P49	33	64.71%	62,865.30	40,927,765.38	0.15%	98.96%
P15	34	66.67%	61,170.36	40,988,935.74	0.15%	99.10%
P14	35	68.63%	53,138.46	41,042,074.20	0.13%	99.23%
P44	36	70.59%	51,527.16	41,093,601.36	0.12%	99.36%
P5	37	72.55%	44,881.47	41,138,482.83	0.11%	99.47%
P2	38	74.51%	42,372.27	41,180,855.10	0.10%	99.57%
P28	39	76.47%	24,852.15	41,205,707.25	0.06%	99.63%
P13	40	78.43%	22,117.86	41,227,825.11	0.05%	99.68%
P22	41	80.39%	18,384.81	41,246,209.92	0.04%	99.73%
P24	42	82.35%	17,098.23	41,263,308.15	0.04%	99.77%

P26	43	84.31%	17,097.00	41,280,405.15	0.04%	99.81%
P11	44	86.27%	17,044.11	41,297,449.26	0.04%	99.85%
P18	45	88.24%	14,757.54	41,312,206.80	0.04%	99.89%
P19	46	90.20%	12,710.82	41,324,917.62	0.03%	99.92%
P7	47	92.16%	12,024.48	41,336,942.10	0.03%	99.95%
P38	48	94.12%	6,857.25	41,343,799.35	0.02%	99.96%
P16	49	96.08%	6,421.83	41,350,221.18	0.02%	99.98%
P30	50	98.04%	5,376.33	41,355,597.51	0.01%	99.99%
P20	51	100.00%	4,002.42	41,359,599.93	0.01%	100.00%

Appendix 4 ABC analysis

Products in groups A, B and C are marked by the following colours:

Name	Products NO.	% of roducts	Sales	Cumulative sales	Sales %	Cumulative sales %
P4	1	1.96%	6,868,514.34	6,868,514.34	16.61%	16.61%
P40	2	3.92%	3,732,177.93	10,600,692.27	9.02%	25.63%
P33	3	5.88%	3,580,571.82	14,181,264.09	8.66%	34.29%
P32	4	7.84%	3,333,255.72	17,514,519.81	8.06%	42.35%
P50	5	9.80%	3,070,842.60	20,585,362.41	7.42%	49.77%
P31	6	11.76%	1,805,304.21	22,390,666.62	4.36%	54.14%

P12	7	13.73%	1,586,644.65	23,977,311.27	3.84%	57.97%
P27	8	15.69%	1,581,896.85	25,559,208.12	3.82%	61.80%
P1	9	17.65%	1,551,252.63	27,110,460.75	3.75%	65.55%
P47	10	19.61%	1,533,666.09	28,644,126.84	3.71%	69.26%
P48	11	21.57%	1,493,350.38	30,137,477.22	3.61%	72.87%
P21	12	23.53%	1,491,023.22	31,628,500.44	3.61%	76.47%
P39	13	25.49%	1,304,194.83	32,932,695.27	3.15%	79.63%
P23	14	27.45%	1,284,796.50	34,217,491.77	3.11%	82.73%
P10	15	29.41%	1,089,992.79	35,307,484.56	2.64%	85.37%
P45	16	31.37%	999,197.88	36,306,682.44	2.42%	87.78%
P43	17	33.33%	571,166.49	36,877,848.93	1.38%	89.16%
P8	18	35.29%	484,685.19	37,362,534.12	1.17%	90.34%
P6	19	37.25%	459,439.44	37,821,973.56	1.11%	91.45%
P25	20	39.22%	361,917.66	38,183,891.22	0.88%	92.32%
P46	21	41.18%	322,458.03	38,506,349.25	0.78%	93.10%
P34	22	43.14%	318,525.72	38,824,874.97	0.77%	93.87%
P17	23	45.10%	271,243.29	39,096,118.26	0.66%	94.53%
P29	24	47.06%	257,110.59	39,353,228.85	0.62%	95.15%
P42	25	49.02%	255,713.31	39,608,942.16	0.62%	95.77%
P35	26	50.98%	245,319.81	39,854,261.97	0.59%	96.36%
P37	27	52.94%	213,294.30	40,067,556.27	0.52%	96.88%
P36	28	54.90%	197,266.17	40,264,822.44	0.48%	97.35%
P3	29	56.86%	193,440.87	40,458,263.31	0.47%	97.82%
P51	30	58.82%	179,784.18	40,638,047.49	0.43%	98.26%

P9	31	60.78%	120,872.10	40,758,919.59	0.29%	98.55%
P41	32	62.75%	105,980.49	40,864,900.08	0.26%	98.80%
P49	33	64.71%	62,865.30	40,927,765.38	0.15%	98.96%
P15	34	66.67%	61,170.36	40,988,935.74	0.15%	99.10%
P14	35	68.63%	53,138.46	41,042,074.20	0.13%	99.23%
P44	36	70.59%	51,527.16	41,093,601.36	0.12%	99.36%
P5	37	72.55%	44,881.47	41,138,482.83	0.11%	99.47%
P2	38	74.51%	42,372.27	41,180,855.10	0.10%	99.57%
P28	39	76.47%	24,852.15	41,205,707.25	0.06%	99.63%
P13	40	78.43%	22,117.86	41,227,825.11	0.05%	99.68%
P22	41	80.39%	18,384.81	41,246,209.92	0.04%	99.73%
P24	42	82.35%	17,098.23	41,263,308.15	0.04%	99.77%
P26	43	84.31%	17,097.00	41,280,405.15	0.04%	99.81%
P11	44	86.27%	17,044.11	41,297,449.26	0.04%	99.85%
P18	45	88.24%	14,757.54	41,312,206.80	0.04%	99.89%
P19	46	90.20%	12,710.82	41,324,917.62	0.03%	99.92%
P7	47	92.16%	12,024.48	41,336,942.10	0.03%	99.95%
P38	48	94.12%	6,857.25	41,343,799.35	0.02%	99.96%
P16	49	96.08%	6,421.83	41,350,221.18	0.02%	99.98%
P30	50	98.04%	5,376.33	41,355,597.51	0.01%	99.99%
P20	51	100.00%	4,002.42	41,359,599.93	0.01%	100.00%

Appendix 5 Plan for standardizing products in group A

NO.	Product name	NOBB number	Fetsund	Hønefoss	Kristiansands	Stjørdal	Bodø
1	P4	4A		M			

		4B					
		4C					M
2	P40	40A					
		40B				H	H
3	P33	33A		M			
		33B					
4	P32	32A	H				
		32B					
		32C				H	H
5	P50	50A					
		50B			H		
		50C				H	H
6	P31	31A		H			
		32B					
7	P12	12A	H			H	
		12B					
		12C		H			
8	P27	27A	H	H			
		27B					
9	P1	1A					
		1B				H	H
10	P47	47A					
		47B				H	H

Appendix 6 Plan for standardizing products in A and B groups

NO.	Product name	NOBB number	Fetsund	Hønefoss	Kristiansands	Stjørdal	Bodø
1	P4	4A		M			
		4B					
		4C					M
2	P40	40A					
		40B				H	H
3	P33	33A		M			
		33B					
4	P32	32A	H				
		32B					
		32C				H	H
5	P50	50A					
		50B			H		
		50C				H	H
6	P31	31A		H			
		32B					
7	P12	12A	H			H	
		12B					
		12C		H			
8	P27	27A	H	H			
		27B					
9	P1	1A					

		1B				H	H
10	P47	47A					
		47B				H	H
11	P48	48A					
		48B					H
12	P21	21A		H			
		21B					
		21C					H
13	P39	39A					
		39B				H	
14	P23	23A		H			
		23B					
		23C					H
15	P10	10A					
		10B			H		H
		10C		H			
16	P45	45A					
		45B			H		
		45C				H	H
17	P43	43A		H			
		43B					
18	P8	8A					
		8B				H	
19	P6	6A					

		6B				H	
20	P25	25A					
		25B			H	H	
		25C					H
21	P46	46A					
		46B					H
22	P34	34A					
		34B				H	H
23	P17	17A					
		17B			H		H
		17C		H			
24	P29	29A					
		29B			H	H	H
25	P42	42A					
		42B				H	H

Appendix 7 Plan for standardizing all kinds of products

NO.	Product name	NOBB number	Fetsund	Hønefoss	Kristiansands	Stjørdal	Bodø
1	P4	4A		M			
		4B					
		4C					M
2	P40	40A					
		40B				H	H
3	P33	33A		M			
		33B					

4	P32	32A	H				
		32B					
		32C				H	H
5	P50	50A					
		50B			H		
		50C				H	H
6	P31	31A		H			
		32B					
7	P12	12A	H			H	
		12B					
		12C		H			
8	P27	27A	H	H			
		27B					
9	P1	1A					
		1B				H	H
10	P47	47A					
		47B				H	H
11	P48	48A					
		48B					H
12	P21	21A		H			
		21B					
		21C					H
13	P39	39A					
		39B				H	

14	P23	23A		H			
		23B					
		23C					H
15	P10	10A					
		10B			H		H
		10C		H			
16	P45	45A					
		45B			H		
		45C				H	H
17	P43	43A		H			
		43B					
18	P8	8A					
		8B				H	
19	P6	6A					
		6B				H	
20	P25	25A					
		25B			H	H	
		25C					H
21	P46	46A					
		46B					H
22	P34	34A					
		34B				H	H
23	P17	17A					
		17B			H		H

		17C		H			
24	P29	29A					
		29B			H	H	H
25	P42	42A					
		42B				H	H
26	P35	35A					
		35B				H	
27	P37	37A					
		37B				H	
28	P36	36A		H			
		36B					
29	P3	3A	H	H	H		
		3B					
30	P51	51A					
		51B			H		
		51C				H	H
31	P9	9A					
		9B				H	
32	P41	41A					
		41B				H	H
33	P49	49A					
		49B					H
34	P15	15A					
		15B			H		

		15C					H
35	P14	14A					
		14B				H	H
36	P44	44A					
		44B				H	
37	P5	5A					
		5B			H	H	
		5C					H
38	P2	2A					
		2B				H	H
39	P28	28A	H	H			
		28B					
40	P13	13A					
		13B			H		
		13C				H	
		13D					H
		13E		H			
41	P22	22A					
		22B			H	H	
		22C					H
42	P24	24A		H			
		24B					
		24C					H
43	P26	26A					

		26B			H	H	
44	P11	11A					
		11B				H	
		11C		H			
		11D					H
45	P18	18A	H				
		18B			H		
		18C				H	
		18D					H
		18E					
46	P19	19A					
		19B				H	
47	P7	7A		H			
		7B					
48	P38	38A	H				
		38B					
49	P16	16A					
		16B			H		
		16C				H	
		16D					H
50	P30	30A	H				
		30B					
51	P20	20A					
		20B					H