Balancing packaging complexity by introducing platforms

- A study at Carlsberg Breweries

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Abstract

Title: Balancing packaging complexity by introducing platforms – A study at Carlsberg Breweries

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Problem Discussion: Many consulting firms offer tailor-made solutions within complexity management, but these are not general frameworks built upon theories. Carlsberg are dealing with a large complexity within their one-way glass bottles, as they are growing by acquisitions, and are not attained enough economies of scale. Carlsberg believes that group platforms could be the solution of the problem, but has not yet examined the exact savings potential.

Purpose: The *theoretical* purpose is to discuss packaging complexity with the assumption that packaging complexity can be balanced with platforms. The *practical* purpose is to generate group glass bottle platforms at CB, and demonstrate the savings potential in using these platforms.

Methodology: The thesis has Carlsberg Breweries as a case organization and is build upon three steps, *Building Platforms, Calculating Savings Potential* and *Development of Tool.* Within each step there are sub-activities connecting the process. All steps result in outputs that are used as a foundation in following steps.

Conclusions: Balancing packaging complexity has been discussed with platform theory as a foundation. Twelve platforms have been developed at Carlsberg, containing 21 bottles, and the calculated savings potential for applying these are EUR 28,9 million.

Key Words: Packaging, Complexity, Balance, Platforms, Modularization, Savings Potential, Carlsberg Breweries, Glass bottles

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A semester crammed with writing this thesis is about to end, and graduation is coming closer. Today, all three authors are happily finishing the last lay-outs, while unbothered forgetting all previous troubles and willingly ignoring all future. Hopefully, the thesis will – like Brazilian butterflies' influencing American natural catastrophes – result in unexpected contributions in the long run.

We would like to take the opportunity to thank the following:

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Lund 08-05-08

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Introduction

1.1 Background

1.1.1 What is complexity?

"Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?"

Edward Lorenz, 1972

The quote above might seem as a work of a philosopher, but these now almost legendary words within chaos theory are from Edward Lorenz, a mathematician and meteorologist. Lorenz made a mathematical program aimed to be used for making assumptions about weather forecasts. The idea is that even the smallest variation of the initial state in a nonlinear dynamic system can have large effects in the end.[1] The metaphor about the butterfly and the tornado is applicable to many other areas than meteorology. One example is Musselman, who refers to the importance of awareness of the butterfly effect when working with issues regarding supply chain. Musselman describes how a small change in the manufacture of one component in China can have negative impact on the production of one of the products in New York.[2] Likewise this is the fact in many other functions and organizations, where complexity is present. But, what is complexity?

The definition of complexity varies. Seth Lloyd, a Professor of Mechanical Engineering at MIT, once defined complexity in 32 different ways. One commonly used definition is that complexity is the opposite of simplicity and that it expresses a condition of several different factors in a system with different relationships among all the factors.[3]

One type of complexity is called deep complexity, which refers to an organization's complexity when having many variants of one product in its portfolio, i.e. complexity in the product portfolio. Having a deep portfolio leads to logistical problems, specially cost from tied up capital and waste. One example is an organization producing lamps. They offer three kinds of shades, six different feet, three wires, two contacts, three power swifts and three various light bulbs. These alternatives result in 972 variations, and with three choices of colors the variations are 2916. The appeared few choices cause a huge complexity at the end.[4]

One reason for increased complexity within product portfolios is the commercial interests, which may require for example different packaging or branding solutions. Variations among size, colors and shapes etc. are easy and necessary ways to differ in commercial interests. Usually, the product itself is not the sell pitch but the brand and

[1] www.viewsfromscience.com, 14-02-08
[2] Musselman S. (2007), *The Butterfly Effect*, Printing Impressions, vol. 49, no. 11
[3] Lloyd S. (2006), *Programming the Universe*, Alfred A. Knopf
[4] Jonsson P. and Mattsson S-A. (2005), *Logistik, Läran om effektiva materialflöden*, Studentlitteratur, Lund

thereby the package, size, color and shape, are important parameters.[5] An increased variation may result in an increased complexity.

Another reason for increased complexity is when organizations grow. By organic growth, complexity typically grows due to an increased number of products, markets and channels. By growth through mergers and acquisitions, complexity is often added as the new organization needs to rationalize assets and product lines while integrating its processing and different cultures. If organizations want to continue growing, it is essential to learn how to manage packaging complexity.[6]

1.1.2 Can complexity be managed?

> *"Tomorrow's focus must be on complexity management, not simply complexity reduction."*

A.T Kearney, 2004

Traditionally, to handle complexity, researchers have been focusing on the standardization and optimization of production and logistics, i.e. *complexity reduction*. Many researchers have observed the possibilities of cost savings within an optimized production process, e.g. Thomas[7], Johnson et al[8], and Aronsson et al[9]. The quote above does not cite any researcher, but a consulting firm, emphasizing the importance of not only focusing on complexity reduction. In the industrial world, there are many examples of how to manage complexity. Today, many consulting firms are working with complexity within organizations, and are finding solutions on how to manage complexity.[10] Moreover, some manufacturing organizations have succeeded in managing their complexity, while it for others might be a high priority in the close future.[11]

The consulting firm A.T. Kearney emphasizes the positive correlation between financial results and performance on key complexity management activities, such as standardizations and agreements with suppliers. Dealing with complexity management requires both strategic decisions and remedial actions, and it is important for organizations to understand that complexity does not need to have a negative impact. Value-adding complexity, such as branding or after-sales services, is typically beneficial, but the challenge lies within sorting the value-adding complexity

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[5] Keller K.L. (2007), *Strategic Brand Management Building*, Measuring, and Managing Brand Equity, Pearson Education, New Jersey, 3rd edition

[6] Kearney A. T. (2004), *The Complexity Challenge – a survey on complexity management across the supply chain*

[7] Thomas A. (1963), *Optimizing a Multi-stage Production Process*, Operational Research Society

[8] Johnson G., Scholes K. and Whittington R. (2005), *Exploring Corporate Strategy*, Prentice Hall, 7nd edition

[9] Aronsson H., Ekdahl B. and Oskarsson B. (2003), *Modern logistik – för ökad lönsamhet*, Liber AB, Malmö

[10] Celen A., 06-02-08

[11] Kruse M., 15-02-08

from the non-value-adding.[12] It is necessary to distinguish different kind of complexity and thereby exploit the complexity that customers are willing to pay for and eliminate the complexity that they do not want to pay for.[13] The authors have stated their own definition of complexity management, found in section 4.5.3.

In a survey made by A.T. Kearney, almost one third of the asked organizations focused on finding new businesses and short-term profitability, which increases complexity, instead of concentrating on long-term strategic decisions. A.T. Kearney argues that a first step towards managing complexity often is to streamline current products and supply chain while continuously having a long-term strategic decision-making process to ensure that the growth only adds value-adding complexity.[14]

Another consulting firm working with complexity management is Boston Consulting Group. They have identified four different ways for organizations to manage complexity; eliminate, segregate, accommodate and innovate. To *eliminate* complexity, the variation of components, stock-keeping-units (SKU) and platforms must decrease. The *segregation* takes its form in modularized components on each platform, which boosts the number of variations since the components are allowed in different combinations. When *accommodating*, organizations find areas where their complexity cost is high and improve their capabilities in those specific areas. Lastly, *innovation* is a means to differentiate by finding new ways to manage complexity.[15]

Toyota is an ideal example of how a manufacturing organization has managed complexity through *accommodation* and *segregation*. They have focused on improving their capabilities within areas with high complexity cost, such as manufacturing and logistics. Assembly line changeover times have been reduced, and process technology and information technology are areas where investments have been high.[16] The Toyota Production System is synonyms to Lean Manufacturing and Lean Production where the goal is to maximize value by eliminating waste. Furthermore, the production is built upon a number of platforms which can be differently combined to create variation. [17]

One manufacturing organization that has managed complexity through *segregation* and *innovation* is Dell Computer, providing build-to-order personal computers. Their philosophy is to let the customer build their own computer online by providing hundreds of different combinations of modularized components. The computer is thereafter assembled and sent to the customer within 48 hours.[18]

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[12] A.T Kearney (2004)
[13] George M. L. and Wilson S. A. (2006), *The Three Rules for Conquering Complexity*, George Group
[14] A.T Kearney (2004)
[15] The Boston Consulting Group (1998), *Opportunities for Action – Managing the Hidden Costs of Complexity*
[16] ibid.
[17] Aronsson H, Ekdahl B, Oskarsson B (2003)
[18] The Boston Consulting Group (1998)

As described above, complexity is present in many situations for many organizations. Reasons to why an organization's complexity may increase are for example because of commercial interests, or because the organization has been growing. When handling complexity, researchers have traditionally focused on complexity reduction, while it in the industrial world exist many examples of other ways of managing complexity, and in this case packaging complexity.

1.2 Problem discussion

1.2.1 Theoretical

As told in the introduction, researchers have mainly been concentrating on complexity reduction within manufacturing organizations, and branding interests are seldom considered. Some consulting firms, however, offer tailor-made solutions within complexity management for their clients but these are not general frameworks built upon theories.[19] Therefore, there is a need for a theoretical discussion concerning packaging complexity. This reasoning will make packaging complexity management available beyond the consulting firms' expensive tailor-made solutions.

With the theoretical problem discussion above as a foundation, this Master thesis aims to investigate the following theoretical question:

1. *How can packaging complexity be balanced with platforms?*

1.2.2 Practical

The chosen case organization for this Master thesis is Carlsberg Breweries (CB), a fast growing organization working globally. CB has recently grown by acquisitions but has not yet attained the expected economies of scale. CB considers the reason to be the high complexity within the organization. Because of the acquisitions made, CB product portfolio has increased and is now creating huge complexity due to countless local brands. CB Europe holds around 150 different glass bottles; in some cases they use many bottles for the same brand.[20] Due to this packaging complexity, the authors believe that CB is an excellent case organization that can contribute to a deeper understanding of complexity management.

Some countries within CB have tried to manage their production complexity, but that effort has only been at a local level. At a global level most people are aware of that the packaging situation is too complex. One first step against a more simplified CB was a first global platform generation that was made year 2005. Unfortunately, most local countries did not realize the importance of the generated platforms as there were many exceptions.[21] CB believes that a global platform generation is a good solution to the glass bottle complexity problem, though they have not yet considered how this could be designed.

[19] Van der Sommen F., 12-03-08
[20] ibid
[21] Kistrup H., 14-01-08

Currently, a product simplification project is introduced at CB with the vision to "simplify Carlsberg". The project is the first of its kind at CB and the project will set product complexity into a cross-national and cross-functional context. The overall intention is to secure reductions in non material cost, drive higher asset utilization, increase innovation efficiency and reduce time to market.[22]

CB assumes that there is a great savings potential that comes with simplifying packaging on a group level. However, this is only assumptions and they have not yet examined the exact savings potential.[23]

With the practical problem discussion above as a foundation, this Master thesis aims to investigate two practical questions:

1. *How can group glass bottle platforms within CB be designed?*

2. *What is the saving potential for CB in using group glass bottle platforms?*

1.3 Purpose

1.3.1 Theoretical

The theoretical purpose of this Master thesis is to discuss packaging complexity with the assumption that packaging complexity can be balanced with platforms.

1.3.2 Practical

The practical purpose is to generate group glass bottle platforms at CB, and demonstrate the savings potential in using these platforms.

1.4 Delimitations

All empirical data will be gathered from the case organization, CB, and only cover the countries within G11 (see vocabulary). The thesis will only cover one-way glass bottles, and Sweden is stated as an example where needed.

1.5 Target group

Besides academia, the main target group for this Master thesis is people with knowledge about branding theories, production theories and complexity within packaging. These might be students, teachers or scientists with a certain interest in managing packaging complexity. The secondary target group is CB and other organizations with similar problems concerning complexity within packging.

[22] Kruse M., 14-01-08
[23] ibid

1.6 Vocabulary

Specific words and expressions used in the thesis are defined below.

Expression	Explanation
SKU	Stock Keeping Unit, one individual commodity
Primary package	Package in contact with the product, e.g. glass bottle.
Secondary package	Package in contact with primary package, e.g. crate.
Neck finish	The opening of the bottle. Decides closure type.
Closure type	The seal of the bottle.
Crown cork	The most common closure type, opens only by the use of an opener.
Twist off	A closure type common in US, opens by twisting the cork.
Pull off	A closure type where you pull off the cap from the bottle
G11	The European CB countries in scope of the simplification project: Sweden, Denmark, Norway, Finland, Germany, UK, Poland, Switzerland, Turkey, Italy and South East Europe (Serbia, Croatia, Bosnia, Bulgaria)
Cost driver	A quantifiable activity within production and/or logistics, which drives cost for the organization.
Beat bottles	New group bottles developed, but they are not yet commonly used around Europe. There are four different bottles, Beat 1, 2, 3 and 4
Global brands	Carlsberg brands existing globally; Carlsberg, Tuborg and Holsten
Local brands	Carlsberg brands only existing in a local market i.e. different brands in every country
Complexity	The author's definition is a condition of several different factors in a system with different relationships, which create an immense situation that from the beginning seems impossible to control. However, as complexity is broken down to its smallest element, it is shown to be controllable.
Management	Throughout this thesis, management stands for: handling the complexity

1.7 Structure of the thesis

Chapter 1: Introduction

This chapter aims to give the reader an introduction of the main areas in the Master thesis. Initially, the reader will be given a background and a problem discussion ending with three questions. The three questions result in two purposes: one theoretical and one practical. Lastly, delimitations and target group are defined followed by a vocabulary.

Chapter 2: Methodology
This chapter describes the methodology used when writing this Master thesis, starting with an explanation of the methodological process used during the work of the thesis. The research approach is described to give a theoretical perspective of the process. Finally, the validity and reliability is discussed.

Chapter 3: Present situation – Carlsberg Breweries
The study of present situation begins with an explanation of the methodology used in the chapter, followed by the theoretical framework and the empirical findings. Thereafter, the case organization is analyzed by a hierarchy model and all one-way glass bottles within the organization are mapped. This map is used in the following step.

Chapter 4: Step 1 – Building platforms
The fourth chapter starts with a description of the methodology used in the step, followed by the theoretical framework and the empirical findings. Two purposes are fulfilled in the following analysis. First, the group glass bottle platforms are developed. Second, in the chapter *Balancing complexity,* the authors discuss packaging complexity with the assumption that packaging complexity can be balanced with platforms.

Chapter 5: Step 2 – Calculating savings potential
The fifth chapter begins with an explanation of the methodology used to calculate the savings potential in introducing platforms, followed by the theoretical framework and the empirical findings. In the analysis, the savings potential is calculated, which fulfills one of the practical purposes. The activities identified in this second step are used in the following step, chapter six.

Chapter 6: Step 3 – Development of tool
The last step begins with a methodology covering the methods used in the step, followed by the theoretical framework and the empirical findings. The analysis results in a tool with the purpose to calculate the complexity cost of a new package. Finally, the tool is tested at the case organization.

Chapter 7: Conclusions
In this chapter, the conclusions and results of the Master thesis are presented, and further future studies are suggested.

2 Methodology

In this chapter the methodological process of the Master thesis will be described, followed by a theoretical reasoning about the chosen research approach, and a discussion about the validity and reliability of the thesis.

2.1 Process of Master thesis

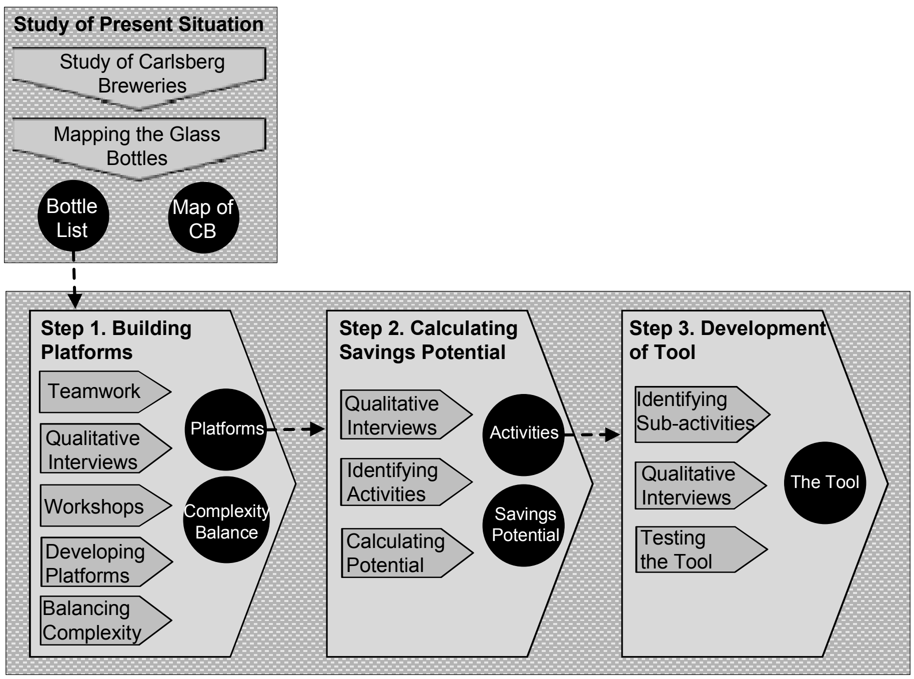

Figure 1: Methodological process of the Master thesis

The methodological process of the Master thesis is illustrated in figure 1. The process begins with a study of the *Present situation – Carlsberg Breweries*, and continues with three steps: *Step 1*, *Step 2*, and *Step 3*. This is the actual method of how the thesis has been carried out. The study of case organization is performed to give the authors and the reader an overview over the present situation at CB. The following three steps are the main activities in the thesis, all based on the findings from the study of case organization. Within each step are sub-activities, connecting the process. Every step results in outputs used as a foundation of the following steps. This means that there is more than one output of the Master thesis.

The process starts with **Present situation – Carlsberg Breweries**, including two sub-activities: S*tudying Carlsberg Breweries* and *Mapping the glass bottles*. There are two output of this study: a hierarchal map over CB and a bottle list covering all glass bottles used by CB. The bottle list is used as a foundation of the following step.

The first step is **Building platforms**, and includes five sub-activities: *Teamwork*, Q*ualitative interviews*, *Workshops*, *Developing platforms* and *Balancing complexity*. The output from the study of case organization is a necessary foundation of this step, as the developing of platforms is built upon the bottle list. There are two outputs of *Step 1*: First, the new group glass bottle platforms are presented, which fulfills one of the practical purposes. Second, the authors discuss packaging complexity with the assumption that packaging complexity can be balanced with platforms. The platforms are used when calculating savings potential in the next step.

The second step, **Calculating savings potential**, contains three sub-activities:, *Calculating potential, Identifying activities* and *Qualitative interviews*. There are two outputs of *Step 2*: First, activities used to calculate the savings potential, and secondly, the results from the calculation. The result from the calculation of savings potential is an output fulfilling the practical purpose. The activities identified are a foundation of the following step.

The last step in the process is **Development of tool**, *Step 3*, including the three sub-activities *Identifying sub-activities*, *Qualitative interviews* and *Testing the tool*. The activities from the output of *Step 2* are used as a foundation of this step to identify cost drivers. The output of *Step 3* is a general tool, aimed to be used by organizations to calculate the complexity cost of a new product/package not aligned with the platforms.

The authors have chosen to structure the Master thesis like the methodological process. Therefore, the upcoming chapters are named as in the figure above*: Present situation – Carlsberg Breweries*, *Step 1: Building platforms*, *Step 2: Calculating savings potential*, and *Step 3: Development of tool*. A more detailed methodology is included in each step, describing the exact methods used in the sub-activities. There are no separate empirical and/or theoretical chapters; instead all empirical and theoretical studies will be described in connection to where it is used. This means that all of the four following chapter will contain a methodology, a theoretical study, an empirical study, and finally an analysis resulting in the output of the step.

2.2 Research approach

Based on Gephart's description of management research paradigms, the methodological approach described above closest complies with the *interpretive paradigm*. Interpretivism is a subjective paradigm, where second order theory is built dependent on people and people's interpretations of situations. [24]

The theoretical purpose of this thesis is to position the knowledge within complexity management into a theoretical study. This theoretical positioning will correspond to a context within the theory where the authors identified a theoretical gap, and hence be a theory development. The authors used existing theories and combined them to form a theoretical framework within which their theory development had its foundation.

[24] Gephart, R. (1999), *Paradigms and Research Methods*, Research Methods Forum, vol. 4

Thus, the theory development had its framework within previous theory and literature, but was built upon the empirical study. This choice of method forced the theory development to be dependent on interpretations. The objects of the empirical study – i.e. the case organization and its employees – were interpreted to enable assumptions and conclusions. Thereby, the conclusions made are subjective.

Consequently, the methodological paradigm used in this Master thesis would be described as interpretivistic. Bryman and Bell emphasize the possibility for interpretivistic researchers to reach unexpected results if having an external approach when watching the objects of study.[25] The analysis in the Master thesis has been based upon an empirical study containing several levels of interpretations – a process described by many researchers, e.g. Andersen, Jacobsen, and Bryman and Bell.[26,27,28] At first, information was interpreted at one level internally by the case organization. Second, the authors made additional interpretations of this information.

Based on the descriptions of methodology by Nilsson, the methodology used for fulfilling the theoretical purpose in this Master thesis would be referred to as *inductive*. According to Nilsson, induction is theory development based on empirical studies. [29] In the Master thesis the results are dual: pure empirical findings as well as theory developed from empirical observations. The theoretical results in the thesis was coupled back to the empirical perspective by verification, where the theory development was applied at the case organization, a process also described by Nilsson[30]. This approach may by some researchers be described as *abductive*.[31]

The combination of using both quantitative and qualitative methods to study the same phenomenon is known as *triangulation*, a method used in this thesis. Data were collected both through qualitative interviews and quantitative questionnaires. Triangulation is a way to study different perspectives, to the purpose of an increased validity.[32,33, 34]

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[25] Bryman, A. and Bell, E. (2005), *Företagsekonomiska forskningsmetoder*, Korotan Ljublijana, Slovenia

[26] Jacobsen, D.I. (2002), *Var, hur och varför? Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen*, Studentlitteratur, Lund, Sweden

[27] Andersen, I. (1998), *Den uppenbara verkligheten – Val av samhällsvetenskaplig metod*, Studentlitteratur, Lund, Sweden

[28] Bryman, A., et al (2005)

[29] Nilsson, C-H. (1994), *Methodological Reflections*, Extended Version

[30] ibid.

[31] Wallén G. (1996), *Vetenskapsteori och Forskningsmetodik*, Studentlitteratur, Lund

[32] Bryman, A., et al. (2005)

[33] Andersen, I. (1998)

[34] Jacobsen, D.I. (2002)

2.3 Validity and reliability

2.3.1 Theoretical study

To the theoretical study, mainly academic sources have been used. However, the acceptance and recognition of these are varying. The authors have attempted to cover as wide theoretical field as possible within the scope, to not overlook any important references, but some vital sources might have been missed out.

To enhance the validity and reliability of the theoretical study, the process has been iterative. The theoretical studies have constantly been matched with the empirical observations, to secure the consistency and thereby the validity and reliability.

2.3.2 Empirical study

There are some noticeable weaknesses with using case study research. The often large amount of gathered data can be all too complex and result in a loss of simplicity and perspective – leading to a less reliable outcome. Also, a case study research may not lead to theory building that is sufficiently general. The case study is a “bottom up” method, and the development of theory may just not reach a level high enough, and thereby not be valid.[35] All these risks are present in this Master thesis as well.

Furthermore, this Master thesis is built upon only one studied case organization. Even though the results will be empirically valid on this organization, they may not be valid on others. The lack of diverse empirical observations and the trust in the interview objects is probably the largest weakness of this thesis. A risk is that the interview objects might forget any vital information which thereby is left out in this thesis. In addition, the daily work in the process of the Master thesis is carried out at the case organization. Thereby, the authors can be influenced by the culture, way of work, and opinions in the organization. This is also a large risk, as the ability of critically reviewing the studied organization decreases. The thesis is done at group level, which might have influenced the results. The authors have mostly been studying this part of the organization, and critical information from other levels might have been missed out.

However, there are also many benefits with case study research. Eisenhardt argues that theory generation from case studies tends to be less biased by the researchers' preconceptions than other methods – the constant exchange with reality has the potential of "open the eyes" of the researcher. Another strength is the opportunity of receiving direct feedback on the research, as the theory generated are likely to be constructed to easily measure. Lastly, generating theory out of case study is probably empirically valid.[36]

To avoid the risks and exploit the benefits of the case study method, and thereby secure the validity and reliability of the study, some activities have been performed.

[35] Eisenhardt, K. M. (1989), *Building Theories from Case Study Research*, Academy of Management Review, vol. 14, no. 4

[36] ibid.

Firstly, the use of triangulation is of great value. The quantitative data about glass bottles are supplemented and compared by qualitative data collections from interviews and workshops, and vice versa. Secondly, the authors have met and gathered information from people working at different divisions within the case organization, to receive different perspectives on their work. All data collections have been verified by more than one respondent and all conclusions are discussed with people from different divisions. Lastly, the authors themselves have intentionally tried to question and challenge all results during the process.

2.3.3 Background of the authors

All three authors are studying Technology Management at Lund University, and are about to finish their last semester. Their common backgrounds with firm university degrees have influenced the choice of subject and methodology. However, their different educational backgrounds prior to Technology Management – within Mechanical Engineering, Business Administration and Biotechnology – have increased their possibility to approach the problems with diverse perspectives.

3 Present situation – Carlsberg Breweries

3.1 Present situation – methodology

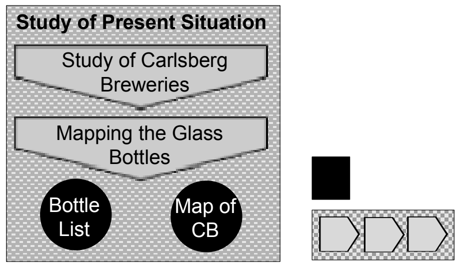

Figure 2: Study of present situation in detail, followed by a small picture showing where in the methodology process the study is located

The study of present situation has two intentions. Firstly, the first study will give a firm background of the studied case organization, and the mapping of case organization will clarify where within the organization the thesis is carried out. Secondly, the mapping of glass bottles is carried out to give an overview of what kind of complexity problems the case organization is struggling with, and hence what this Master thesis can contribute with to manage this complexity.

3.1.1 Study of Carlsberg Breweries

To identify the need of this Master thesis, the authors began with interviews and brief studies at the case organization. Thereafter, a wide-ranging theoretical study was made to find the possibility to contribute to the academia, and thereby identify the purpose and the scope of this Master thesis. By further qualitative interviews at the case organization and discussions with supervisors, the purpose was ultimately defined.

The daily work of the Master thesis was carried out at the case organization. Therefore, most of the qualitative data gathering was made in close connection with the organization. Most of the data gathering herein known as *qualitative interviews* is both based on formal interviews and on meetings, observations, corridor debates, and informal dialogues.

3.1.1.1 Mapping of Carlsberg Breweries

One major part of the study of case organization – Carlsberg Breweries, was to map the organization. This was done by gathering empirical data about the case organization through qualitative interviews, meetings, and by organization internal information. The hierarchy of the case organization has been visualized by a theoretical hierarchy model. This model gives an overview of the case organization and place the scope of the Master thesis in its context.

3.1.2 Mapping the glass bottles

As the scope of the thesis covers one-way glass bottles, it was of high importance to map the complexity of one-way glass bottles within the case organization. Today, the case organization does not hold any overall standardized information covering its glass bottles in Europe. Therefore, this mapping was valuable for the case organization as well as for the author's continued studies. The mapping of one-way glass bottles within the case organization was made by a data questionnaire developed by the authors. The data questionnaire was built on an excel-sheet, containing columns for every wanted parameter, e.g. diameter, weight, neck finish and color. The parameters were carefully considered before the questionnaires were handed out to the respondents. To facilitate for the respondents, the authors filled in all available data in advance.

The data questionnaire was sent to all European country offices to verify existing data and insert all missing data. This was an iterative process, as it was done by a close contact with the country offices by e-mail and phone. During the process, the data was transformed to standardized parameters by the authors. The outcome result was a large collection of quantitative data from all countries, containing information about every bottle used in the organization.

3.2 Present situation – theoretical framework

The mapping of an organization is a hierarchical breakdown of the organization's structure. To systematize the breakdown, the mapping is based on a hierarchy model, described below.

3.2.1 Hierarchy model

ISA is a global, non-profit organization setting the standard for automation world wide. Organizations can be certified by ISA to prove that they are using a well known and approved standard in their production.[37] ISA defines different hierarchy models to describe organizations. Figure 3 illustrates the levels in an e*quipment hierarchy*, which can be used to map the structure of an organization. A hierarchy model can sometimes be recursive, i.e. one level can exist twice. For example, in some organizations one site includes another site. [38]

[37] www.isa.org, 10-03-08

[38] ANSI/ISA–88.01–1995, *Batch Control Part 1: Models and Terminology*, ISA – The Instrumentation Systems, and Automation Society

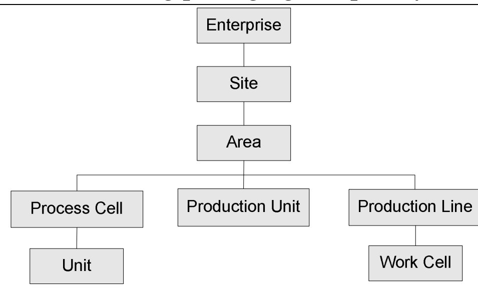

Figure 3: Equipment hierarchy

The levels in the equipment hierarchy typically deal with different decisions. Table 1 below describes the levels and explains their belonging decisions.[39]

Table 1: Descriptions and decisions in the equipment hierarchy

Function Level	Description	Decisions
Enterprise	– Top of the hierarchy – A set of one or more sites or areas	– *What* products in the global portfolio? – *Where*, at which site, are they going to be manufactured? – *How* are they going to be manufactured?
Site	– Covers a geographical area or main production capability (decided by the enterprise) – Consists many production units, lines and process units	– *What* products in the local portfolio? – *Where*, at which area, are they going to be manufactured? – *How* are they going to be manufactured, and *what* are our manufacturing capabilities?
Area	– Covers a physical, geographical or logical area determined by the site – Consists many production units, lines and process units, but within the same area e.g. packing or production	– *How* to schedule production? – *How* to assure production reliability?
Process Cell/ Production Unit/ Production Line	– Unique activities e.g. one filling line	– *How* to schedule every cell, unit and line? – *How* to assure production reliability of cell, unit and line??

[39] ANSI/ISA–88.01–1995

3.3 Present situation – empirical findings

3.3.1 Carlsberg

Carlsberg was found in 1847 by J.C Jacobsen, and named after his son Carl and the hill in Valby, Copenhagen. Carl Jacobsen later found his own brewery, *Ny* (new) *Carlsberg*, and the two breweries fused in the beginning of the twentieth-century. In 1970, Carlsberg acquired Tuborg, and the parent company today known as *Carlsberg A/S,* was formed. In 2001, Carlsberg A/S and Orkla ASA joined their brewing activities to gain synergies and formed *Carlsberg Breweries A/S*. Three years later, the partnership between Carlsberg and Orkla ended as Carlsberg A/S bought the entire Carlsberg Breweries A/S. Besides Carlsberg Breweries, Carlsberg A/S owns e.g. research centers and charitable foundations. Hereafter in the thesis, the name CB is used, which refers to the subsidiary Carlsberg Brewery, owning and operating all brewing facilities. Today, Carlsberg Brewery includes more than hundred associated companies – both in Denmark and worldwide. It is the number one brewery in Northern Europe, and among the top ten largest worldwide. CB sells beer in more than 150 countries.[40]

During the last decade, the brewery industry in Western Europe has experienced a strong consolidation trend. CB has unquestionably followed that trend.[41] They have a strategic focus on expanding[42], and in the past years they have made a considerable growth due to mergers and acquisitions. One of the most recent acquisition is Scottish & Newcastle. The acquisitions made, would likely have resulted in lower costs due to economies of scale in production and distribution. However, every business purchase also results in a purchase of all belonging SKU:s, and the growth by acquisitions have thereby led to a large growth of the SKU portfolio. Today, CB holds around 2700 SKU:s in its G11 SKU portfolio. The growing number of SKU:s increase the complexity within packaging and thereby counteract the economies of scale.[43]

The brewery industry has traditionally been an industry with strong local connection, where most drinks are consumed in the same country as it is produced. Even if this is changing today, many activities are still managed locally.[44] Within CB, local breweries are managing e.g. local SKU:s, marketing and procurement. Local CB breweries have had their own optimization programs, which has led to less optimization on group level. The organization has traditionally been decentralized and lacked transparency between the countries.[45] However, as a first move towards a more united organization, CB in 2005 developed a first draft of four group platforms named Beat (1, 2, 3, and 4). These platforms were applied throughout the organization but

[40] Carlsberg Intranet, 02-04-08
[41] Eiken, A. et al. (2005)
[42] www.carlsberggroup.com, 02-04-08
[43] Eiken A., Preijde D., Rambert M. and Thomsen S. (2005), *Carlsberg Strategy Project*, Copenhagen Business School
[44] ibid.
[45] Kistrup H., 14-01-08

there were neither incitements nor punishments connected to them and therefore the use of them has been modest.

Due to the strong consolidation trend in the past years, future possibilities to merge or make acquisitions will be reduced. Thus, increased margin will be enabled mainly by reducing costs. Furthermore, CB has the leading position in mainly relatively small profit-providing countries, in contrast to some of its competitors. Hence, they would gain a lot from increasing their economies of scale. CB has a large number of SKU:s in its portfolio, and locally optimized breweries, and are thereby struggling with a huge complexity on group level. To reduce costs and to increase the benefits of economies of scale, they must deal with this complexity.[46]

Sweden is one of the G11 countries within CB with high packaging complexity. With two breweries, many one-way glass bottles in use, and a high production volume, Sweden is a great example of a country where reduction of packaging complexity hopefully will increase economies of scale.[47] Sweden moderately started to use the Beat platform bottles when they were developed in 2005, but they were never truly accepted. One example is the bottle used for the brand *Xide*, where a Beat-bottle was considered but rejected by branding before launch.[48]

3.3.1.1 Mapping of Carlsberg

By using the hierarchy model, CB has been mapped and the large scope of the organization is illustrated in figure 4 below. At the top of the hierarchy, the enterprise is shown, which in this case is Carlsberg Breweries. At this level, all enterprise level decisions are made, such as what will be included in the product portfolio. However, CB is a decentralized organization and therefore many decisions are taken at a site level instead of an enterprise.[49] The next level in the hierarchy is the site level that covers a specific geographic area, in the case of CB this is all different countries. The scope of this thesis is the G11 countries which can be seen in the figure 4 at the site level. The sites are responsible for which products that shall be included in the local portfolio and at which area these shall be produced[50]. As an example, Sweden has been further broken down into areas and production lines. Sweden has two areas, Falkenberg and Ramlösa. The countries, more specific two areas, are responsible for e.g. the production and the delivery of products.[51] Within each area at CB there are a number of production lines, containing filling and packaging. Falkenberg has ten production lines and Ramlösa has five production lines.[52]

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46 Eiken, A. et al. (2005)
47 Langen H., 10-04-08
48 Örtegren, J., 05-05-08
49 Kruse M., 06-02-08
50 Blacks E., 19-02-08
51 ibid.
52 Abrahamsson J., 13-02-08

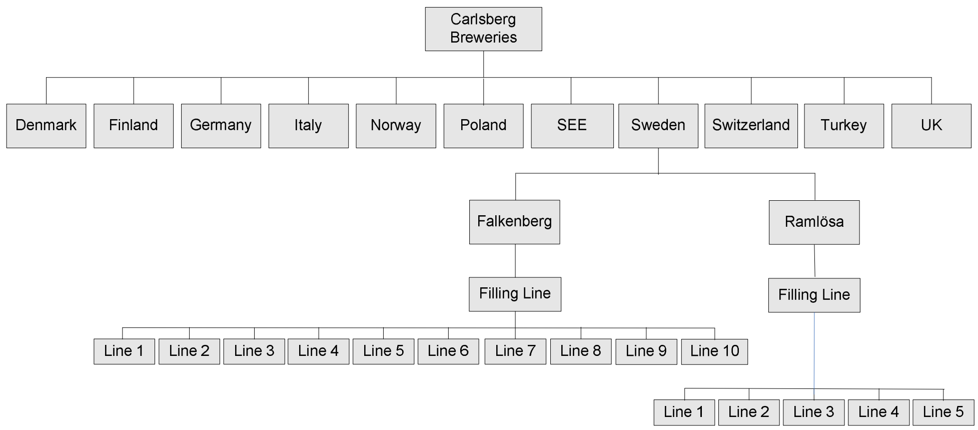

Figure 4: A hierarchy map of CB with the details focusing on Sweden and its production lines

As can be seen in figure 4, even if only Sweden is in focus, the organization is both wide and deep. Wide as CB has many geographical sites and deep as every site includes many areas and production lines. If the figure had been complete for all countries the amount of production lines would have been large.

3.3.2 Mapping of bottles

The mapping of bottles resulted in a list containing all bottles used within the G11 countries. The bottle list can be found in appendix 1. It includes totally 81 one-way glass bottles, from the countries within G11, and their dimensions and colors. Some dimensions are missing for some bottles, due to incomplete answers from the respondents. It can be noticed in the bottle list that Norway and Finland are not present. This is due to the fact that there are no one-way glass bottles in these countries.

3.4 Present situation – output

The map over CB illustrates the scope of the organization with country offices and breweries. It indicates that economies of scale can be made, but it has to be managed at enterprise level. This due to the fact that the organization is decentralized and the communication between the site offices and breweries is minimal. As an output, the bottle list illustrates huge complexity for the one-way glass bottles used by CB since there are many different colors, volumes and dimensions. This indicates that there might be a cost savings potential in reducing and managing the complexity.

4 Step 1 – Building platforms

There are two purposes to be fulfilled in this first step: the building of new group glass bottle platforms at CB, and the positioning of the practical knowledge within complexity management in a theoretical context. The first purpose is to solve a practical problem at the case organization. The process of doing this is mainly based on empirical studies at CB, but also with help from the theoretical framework. The other purpose is to solve a theoretical problem. The analyzing process is based on the theoretical framework, the empirical studies and the knowledge achieved during the platform building.

4.1 Step 1 – Methodology

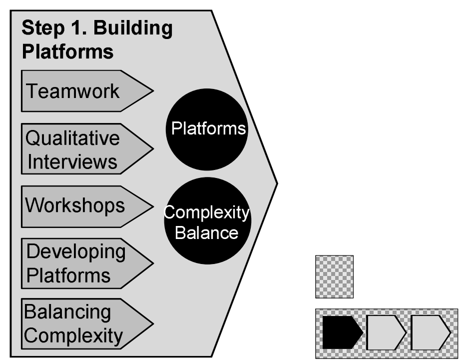

Figure 5: First step of the methodology process in detail, followed by a small picture showing where in the process the first step is located

The sub-activities performed in the step are *Teamwork*, *Qualitative interviews*, *Workshops*, *Development of platforms* and *Balancing Complexity*. These activities describe the methodology that was used when developing the platforms at CB. With help from the knowledge achieved during the development of platforms, the analysis could cover the other purpose as well.

4.1.1 Teamwork

The platform development was done together with a team at the case organization. The team, packaging platform team, included people from different divisions and countries within the case organization, e.g. innovation, supply chain and procurement, to ensure the validity of the generated platforms. The team was managed at group level and had access to large resources – both financial and human, which enhanced the probability of success of the project.

4.1.2 Qualitative interviews

To increase the knowledge of important parameters when generating platforms, qualitative interviews with people from both group and country level throughout the organization was carried out. The data gathering is both based on formal interviews and on meetings, observations, corridor debates, and informal dialogues.

4.1.3 Workshops

To gather further information about platform parameters, the authors together with the packaging platform team arranged three workshops with employees from the G11 countries.

4.1.3.1 Kick-off simplification project, February 6, 2008

This workshop had two purposes. Firstly, it was of great importance that the local country offices realized the extent of the complexity problem and thereby no longer disagreed with the platforms developed at group level. Thereby, it was ensured that all employees were involved and motivated. Secondly, the authors received empirical data concerning possible ways to develop platforms. Strengths and weaknesses with the different possible ways were gathered for the bottle platform analysis.

The data was collected in brainstorm sessions performed in three groups of about ten people. The groups both included headquarter employees from the team and local country employees. The team presented their thoughts and concerns regarding the subject and all participants brainstormed for possible solutions. Halfway through the workshop all groups presented their solutions and concerns for the rest of the group. This gave more suggestions and ideas for the participants and the brainstorming within the three groups was continued. The team also presented the next steps for the project and stressed the importance off all local offices to help the team with the needed information about the glass bottles. This information was gathered from the country offices in data questionnaires, presented in the previous chapter.

4.1.3.2 Bottle platform workshop, March 5, 2008

During the second workshop, employees from packaging, procurement and supply chain on group level were gathered. The purpose was to arrange all existing glass bottles and to bundle them by their characteristics. Glass bottles with similar characteristics were bundled together to become one unique bottle in the potential platforms. First, the international brands, Carlsberg, Tuborg and Holsten, were distinguished from the other glass bottles. Thereafter, all remaining glass bottles, i.e. all local brands, were bundled in different platforms. The workshop was done with real glass bottles in an imaginary giant excel sheet, formed with scotch tape on the floor. Everyone was active in the game and the idea of letting people actually move the bottles around truly facilitated the bundling. The workshop also illustrated the wide range of glass bottles within CB as there were about 150 different glass bottles on the floor, where 81 was one-way glass bottles.

4.1.3.3 Platform workshop, March 31, 2008

Before the third workshop, the authors had matched each bottle at the bottle list with the new potential platform bottles decided at the second workshop. By matching color, dimensions and neck finish, the authors had a fairly good knowledge about which platform every bottle in the list could belong to.

At the workshop, the participants were divided in three groups together with headquarter employees. The concerned country representatives in every group were questioned about their bottles. A list with the current bottles matched with the new platform bottles was gone through, and the country representatives could give a *go* or *no go* for every change that the team had suggested. If there was a *no go*, it also needed to be presented with a good reason for why it could not be changed to the suggested platform glass bottle.

4.1.4 Developing platforms

Bundling of glass bottles was made using the data collected from the data questionnaire. The different glass bottles were quantitatively bundled by some of their characteristics, e.g. diameter, weight, neck finish and color. This bundling was later compared and matched with the bundling done at the second workshop. The two different ways of bundling ensured that no bottles were overlooked. It was a way to verify the result, and to identify potential platform dimensions. Further verification was then made at the third workshop.

4.2 Step 1 – Theoretical framework

In the following sections, the theoretical framework used in this step is described. As two purposes are to be fulfilled, theories supporting both of them must be presented. The following theories are therefore carefully selected to support the analysis in the end of this step, where both the practical purpose and the theoretical purpose are fulfilled.

To clarify why packaging complexity is a problem in many firms today, and to give a background to why and how complexity management is needed, two theories are in focus: *production strategies* and *branding strategies*. As the reader will notice, theories concerning production commonly stress that the lack of variance and complexity is the most advantageous, while theories concerning branding stress the opposite. Therefore these theories are presented, and the two conflicting interests will be discussed in the analysis. The last theory presented is about modularization and platforms, to support the building of platforms at CB and to give another perspective to the analysis.

4.2.1 Production strategies

4.2.1.1 Flow vs. function

Imagine an organization with the most efficient storage, production and transportations. Is this organization the most efficient possible? Probably not. To have an efficient organization, the sum of the part is more important than the parts alone. This is even more vital when the complexity within the product portfolio increases. It is central to both exploit the advantages of large scale productions and have a diverse product portfolio. There are different ways of handling production. Two of them are illustrated in the figure below: function oriented production and flow oriented production.[53]

In a functional oriented production each function, see figure 6, e.g. drilling or painting, is located together. This is usually used when producing many different or customer-specific products. Large economies of scale can be attained as elements demanding the same machines can be produced together.[54] ISA describes this production setup as a network structure where the paths may be either fixed or variable.[55] Flow oriented production, see figure 6, focuses on the flow between the functions. The machines are grouped to suit the production flow. This is often useful when producing products in large batches and with low differentiation, when every product needs its own production line.[56] ISA describes this production set up as a single-path structure where a batch passes the production sequentially. A combination of single-path structure and network structure is multiple-path structure. This is when the production lines are linked and the batches share the production flow but have individual paths.[57]

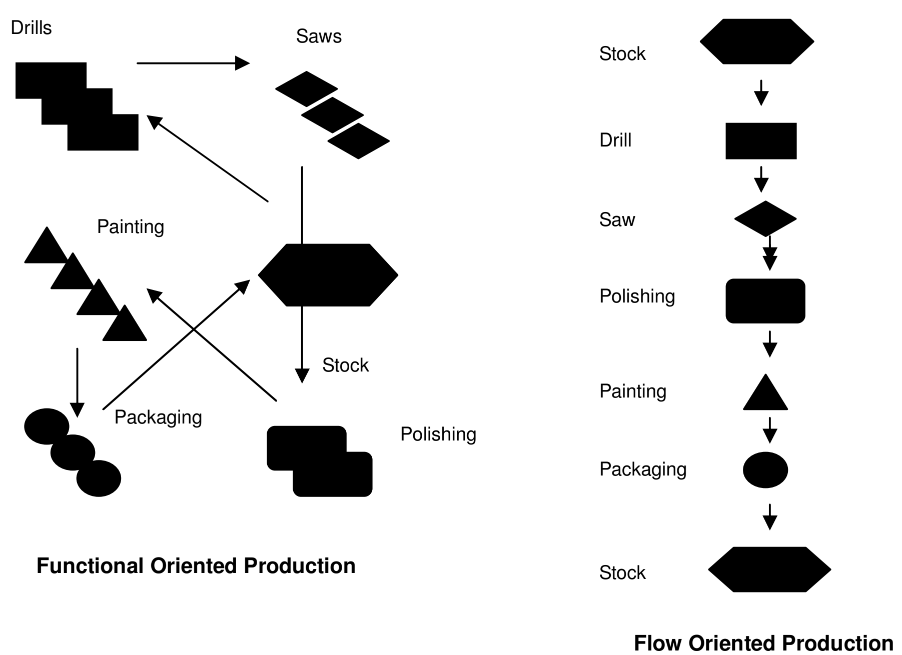

Figure 6: Functional and flow oriented production

[53] Aronsson H. et al. (2003)
[54] ibid.
[55] ANSI/ISA–88.01–1995
[56] Aronsson H. et al. (2003)
[57] ANSI/ISA–88.01–1995

4.2.1.2 Lean production

Lean production is a way to make the production more efficient within an organization. Recently, "lean thinking" has become more and more important within management theories and not only in production and logistic theories. The reason for this is because lean focuses on the flow through the organization instead of the functions. Thereby, it is central to connect all different parts in an organization to achieve the most efficient and profitable way of managing it.[58] Womack and Jones submit the five principles of lean production:[59]

1. Accurately specify value from the customer's perspective for both products and services
2. Identify the value stream for both products and services and remove the non-value-added waste along the value stream
3. Make the products and services flow without interruptions across the value stream
4. Authorize the production of products and services based on pull by the customers
5. Strive for perfection by constantly removing layers of waste

As Womack and Jones conclude, lean production is much about finding the value and avoiding the unnecessary waste. Seven categories of waste and how to handle it are described by Aronsson et al. below.[60]

1. *Producing to much* – produce by demand
2. *Obsolescence* – high quality first time leads to no waste
3. *Waiting time* – minimize the queue time
4. *Transportations* – avoid unnecessary transports between different activities, i.e. flow oriented production
5. *Maximal utilization* – of the material
6. *Stocks* – small batches and high delivery accuracy
7. *Unnecessary movements* – standardize the work processes

Just in Time (JIT) is an important aspect within lean production, as well as *set up time reduction*, *product design* and *supplier relationships/involvement*. In lean production, one objective is to eliminate waste by concurrently reduce both suppliers and internal variability. It is beneficial to have few suppliers with long term contracts. By that each supplier can be tailor-made to fit the organization and also be involved in research and development activities. The internal variability can be managed by for example JIT, and aims to focus on standardization and low number of variation within the product portfolio.[61]

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[58] Tracey J. and Knight J. (2008), *Lean Operations Management: Identifying and Bridging the Gap between Theory and Practice*, Journal of American Academy of Business, Cambridge, vol. 12, no. 2

[59] Womack J. and Jones D. (2003), *Lean Thinking*, Free Press

[60] Aronsson H. et al. (2003)

[61] Shah R. and Ward P. (2007), *Defining and developing measures of lean production*, Journal of Operations Management 25

4.2.2 Branding strategies

4.2.2.1 Brand personality and package

> *"Brand identity is a unique set of brand associations that (…) represent what the brand stands for and imply a promise to customers from the organizations member".*
>
> Aaker, 1996

To build a strong brand identity, an organization must consider the physical features of its product[62]. The physical features are the first attributes a consumer recognizes, and they consist of the brand personality and the package[63].

The brand personality typically takes its foundation in emotional values instead of a conceived strategy, a consumer often selects a product with a personality that is close to his/her own self-perception. This means that even if an organization's positioning transforms, it is crucial that the brand personality stays the same to attract existing consumers.[64]

The package works as a silent salesperson by attracting customers and helping them sort among a huge supply of products that for the untrained eye often seems the same[65]. In average, a customer spends seven seconds on each purchase and many similar packages can easily be confusing. Kapferer and Thoening show that the factors of confusion are color, size, key design and brand name. This emphasizes the importance of visible attributes on a product.[66] To succeed, the package needs to capture the consumer's attention immediately and have something that no other package has, i.e. it must be unique[67, 68].

4.2.2.2 Uniqueness and visual identity

Porter's differentiation strategy involves creating products that are perceived as unique. The unique attributes ought to be better than or different from the products of competition.[69] If a package is unique, the organization possesses a competitive

[62] Kapferer J. (2004), *The New Strategic Brand Management*, Cambridge University Press, 3rd edition
[63] Solomon M., Bamossy G. and Askegaard S. (1999), *Consumer Behaviour – An European Perspective*, Pearson Education Inc.
[64] ibid.
[65] Smith P. R. and Taylor J. (2001), *Marketing Communications: an integrated approach*, London, Cogan Page
[66] Kapferer J. and Thoenig JC. (1992), *La Confusion des Marques*, Prodimarques, Paris
[67] Conolly and Davidsson (1996), *How does design affect decisions at point of sales*, Journal of Brand Management, vol. 4, no. 2
[68] Underwood R. L., Klein N. and Burke R.R. (2001), *Packaging communication: attentional effects of product imagery*, Journal of Product and Brand Management, vol 10, no. 7
[69] Porter M. E. (1998), *Creating and Sustaining Superior Performance*, Free Press

advantage which adds value to the organization. Thereby, the uniqueness of products and packages is important and often necessary.[70]

However, uniqueness is not enough; it is also of highest importance that the organization is aware of *how* it is perceived by its surroundings – i.e. its visual identity. People should know that the organization exists and remember its name and core business at the right time. Packaging and branding are the most important ways for an organization to influence its visual identity.[71] Further on, if the organization possesses more than one brand, it is central that these brands are aligned, to avoid confusing the customer by having brands that can be perceived as having different identities.[72]

To stay unique and to keep a strong visual identity, a brand must be renewed continuously[73]. By innovation, an organization can adapt to the constantly changing needs of the market and maintain the uniqueness of its products[74]. Furthermore, innovation is a method of finding new ways to fulfill previously unsatisfied customer needs.[75]

4.2.3 Modularization

As mentioned before, differentiated products demand a functional oriented production. However, there are always exceptions, and so also within production strategy. Some organizations manage to have customized products in spite of a flow oriented production strategy. Their production is lean with minimized waste and short cycle times. This is possible due to platforms built up by standardized modules, which can be combined in many ways to achieve several variations of the same product. The production needs to be flexible to be able to make this.[76]

There are three ways of managing modular production. The first one, to modularize the *products*, is when there are specific modules for each kind of product. This is non-flexible. The second is to modularize the *product group*, which is when there is a range of modules to choose from when building a product. The last way to manage modular production is to modularize the *process*, i.e. for each new product add or remove steps in the manufacturing process, and by that achieve different products.[77]

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[70] Underwood R.L. et al (2001)
[71] Van den Bosch A., De Jong M. and Elving W. (2005), *How corporate visual identity supports reputation*, Corporate Communications: An International Journal, vol. 10, no. 2
[72] Olins W. (1989), *Corporate Identity: making business strategy visible through design*, Thames & Hudson, London
[73] Kapferer J. (2004)
[74] ibid.
[75] Hill E. and O'Sullivan T. (1999), *Marketing, Addison Wesley Longman Limited*, New York, USA, 2nd edition
[76] Aronsson H. et al. (2003)
[77] Skjött-Larsen T., Schary P., Mikkola J. and Kotzab H. (2007), *Managing the Global Supply Chain*, Copenhagen Business School, Third Edition

Ulrich and Eppinger stress the fact that modularization will increase the number of variants possible of a product by combining components or building blocks[78]. Further on, a platform refers to a group of similar products that comes from the same group of modules. All products within the platform shall possess specific features/functionalities to satisfy different customer needs.[79] To be able to gain economy of scale at the same time as differentiation is achieved, platform based variety is the most effective way.[80] The fact that 80% of the manufacturing costs of a product are decided by the design of the product is a strong evidence of how profitable it might be to use platforms. By using platforms, the design cost will almost disappear as the design will be reused by other products.[81] Also, there is no need to reinvent the wheel every time a new feature adds to a product. If a feature already exists within the organization, i.e. a module, a lot of time and money can be saved by copying the feature to the new product instead of reinventing it.[82]

4.3 Step 1 – Empirical findings

The bottle list in appendix 1 is the main empirical data used in the first step. Empirical data regarding how to bundle bottles into platforms were also collected during the first workshop. Further data regarding the design of the platforms, e.g. suitable colors for the bottles within each platform, was collected through qualitative interviews and workshops and this data is presented, combined with the analysis and presentation of the platforms.

4.3.1 Possible platform types

The participants at the kick-off workshop agreed on five possible alternatives to develop platforms within CB, illustrated in figure 7. The first alternative was to develop standardized glass bottles that were supposed to be used by whole CB-group, with same bottles in every country in G11. The second alternative was to develop the platforms from the dimensions of the bottles, i.e. to reduce the number of changeovers. The third option was to convert all one-way bottles to the existing refillable bottles and to standardize those within the group. The fourth platform type was to develop regional platforms to be used by the countries within that region, e.g. Scandinavia, to solve language issues and enable tailor-made bottles in each region. The last option was to simply map the glass bottles within CB produced in the largest volume and make those the platform bottles.[83]

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[78] Ulrich K. and Eppinger SD. (2000), *Product design and development*, McGraw-Hill, Boston
[79] Meyer M. and Lehnerd A. (1997), *The power of product platforms, building value and cost leadership*, Free Press, New York
[80] Moore WL, Louviere JJ. and Verma R (1999), *Using conjoint analysis to help design product platforms*, J Prod Innov. Manag. 16:27–39
[81] Clark K.B. and T. Fujimoto T. (1991), *Product Development Performance*, Boston, MA: Harvard Bus. Sch. Press
[82] Andersson J., Czerwinski P., Fang Y., Gunsjö L. and Wiklund P. (2007), *Listen to your Heartbeat – a resource based study of the recycling of know-how at Sony Ericsson*
[83] Workshop 06-02-08

Platform type	Description
"Group"	• Standard group packaging formats
Dimension	• Packaging platform driven by dimensions (e.g., diameter, height, fill level), and other features
Refillable only	• Shifting more volumes to refillable bottles and use them as a standard platform
Regional	• Regional packaging platforms (e.g., bottles with multi-country legal text etc.)
Volume	• Selecting, e.g., the 25 highest volume bottles as the Carlsberg platform

Figure 7: Possible future platforms at CB

4.4 Step 1 – Analysis

4.4.1 Choosing platform type

The result from the kick-off workshop showed that the two platform types fulfilling most requirements for standardized platforms were platforms built upon *bottle dimensions* and *group* platforms. Dimensions are the far most important parameter for the supply chain, if all bottles have similar dimensions it will simplify both production and logistics. If similar dimensions are used, all breweries around G11 could fill all glass bottles and same logistics tools, such as pallets, can be used. To procurement, group bottles are the best alternative as it will be easier to lower the purchasing prices when purchasing for the whole group instead of different glass bottles for every country. The alternative to convert all glass bottles to refillable bottles would limit branding opportunities as they are more inflexible. The regional platform type is not on an enterprise level and limits the possible economies of scale, which counteracts one of the main intentions with the platforms. The volume alternative, that might be the first one that comes to mind, is the alternative that turned out to have the lowest potential. This due to branding options would be lower as many of the volume bottles are strict connected to a brand. Furthermore, these volume bottles would all have different dimensions, which would harden production and flexibility throughout the organization according to the workshop participants.[84]

4.4.2 Present bottle complexity

The output from the study of present situation was including a master data sheet consisting of all one-way glass bottles used in the G11 countries by CB brands. The

[84] Workshop 06-02-08

list contains 81 one-way glass bottles in G11. They all differ in combinations of weight, height, diameter, neck finish color and volume and by that drive complexity in the product portfolio. In table 2, the variations within each parameter are presented.

Table 2: Number of variations of bottle parameters[85]

Bottle Parameters	Number of Variations
Weight	37
Height	42
Diameters	31
Neck Finish	3
Color	9
Volume	9

Figure 8 and 9 show the number of variations of diameter and color for 33 cl and 50 cl one-way glass bottles.

Many variations were present. This gave a first hint how to approach the platform building. Weight, height and diameters were the parameters with most variations and therefore drove complexity the most. However, according to production set up, diameter was the parameter driving complexity more than height and weight. The reasons for this are more and longer changeover times and complications in the production flow. Color is a parameter found to not drive complexity as much as weight, height and diameter. However, there are *unnecessary* variations among the colors as similar colors do not provide any additional value to consumers. As can be seen in figure 8, there are four kinds of green, and brown and amber are almost the same color. Even though color does not drive complexity as much as the other parameters, it has high potential compared to the effort needed when reducing the variation of colors. The same reasoning as for color was applied on volume, where many bottles had volumes within a small range. There is no need of having both 33 cl and 35 cl bottles. Consequently, three parameters were used when building the platforms: *diameter, color* and *volume.*

[85] Bottle List, see Appendix 1

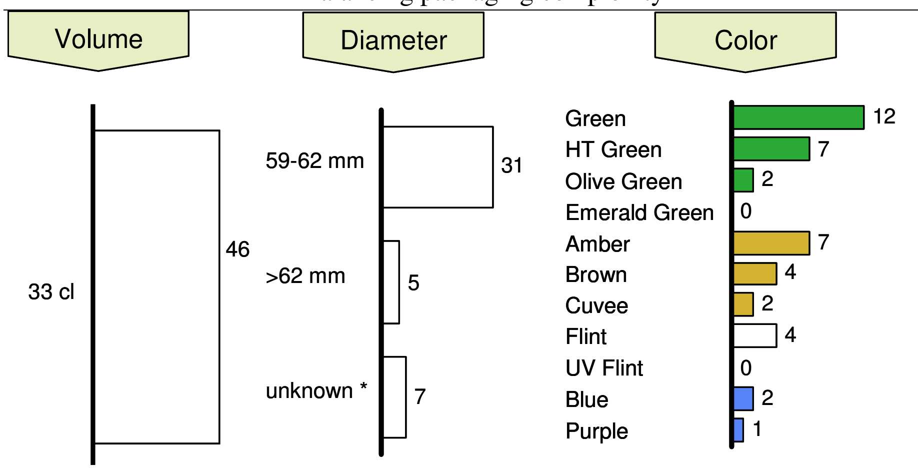

Figure 8: Classification of 33 cl glass bottles built upon volume, diameter and color. [86]
*** Data requests returned without diameter data**

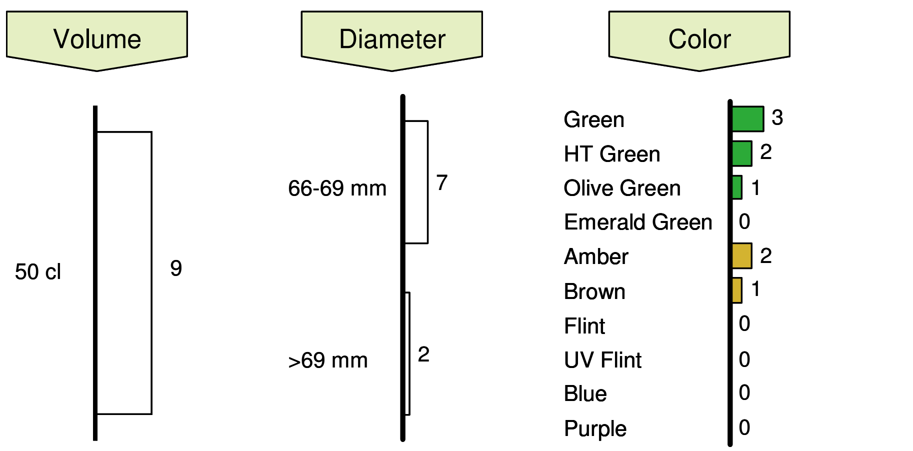

Figure 9: Classification of 50 cl glass bottles built upon volume, diameter and color. [87]

These three parameters corresponded well with what the workshop participants believed. The result from the workshop showed that platforms built upon bottle dimensions and group platforms are the two platform types most likely to succeed. Even though dimensions were one of the main suggestions of platform type, it was not clarified *which* dimensions that were important. After the bottle list analysis, the most critical dimension was developed, i.e. diameter. Further on, all of the bottle parameters are suitable for building group platforms, including the three chosen parameters diameter, color and volume. After choosing parameters there is still an issue in deciding which e.g. color to use in the platform.

[86] Bottle List, see Appendix 1
[87] ibid.

4.4.3 Developing possible platforms

The lead bottles, i.e. the ones that the others shall convert to, were determined after discussions within the workshop group and branding, and all one-way glass bottles was bundled and sorted under these chosen platform bottles. To satisfy different customer needs, Meyer and Lehnerd argue that the platforms shall contain products with different features or functionalities. The features and functionalities at CB are color, volume and neck finish. Diameter is not one of these features as it will not satisfy any customer need. Customer needs for each platform were mapped to be able to take those needs under considerations when developing the platforms. The needs were matched with the existing bottles at the workshop and possible dimensions were distinguished. This gave the volumes, colors and neck finish for each platform. As discussed in the theory, a package's uniqueness and visual identities are important to attract the customers. To not lose the uniqueness and to ensure all needs were fulfilled, there were as many as twelve internally different platforms developed. After this sorting, there were 21 platform glass bottles within twelve platforms, see table 3. The reduction of one-way glass bottles was significant, from 81 to 21.

Table 3: CB Platforms

Platform	Bottle variants in platforms
Carlsberg	3
Tuborg	3
Holsten	2
Beat 1	6
Beat 2	2
Beat 3	1
Beat 4	2
Bock	1
Stubby	1
Total	**21**

After the customer needs was mapped, it was clarified that only two volumes were needed: 33 and 50 cl. This decision was no hard battle, as all involved divisions (e.g. branding and procurement) agreed on the volumes. As stated before, diameter is driving complexity and must therefore be standardized between all platforms. Therefore, the lead bottles were decided after their diameters, so that all final lead bottles should have the same diameters. For the 33 cl platform bottles, the diameter 58,9 mm was chosen. The reason for this was that the 33 cl Beat-bottles developed in 2005 had this diameter, and that the diameters similar to 58,9 mm (see figure 8) was common in bottle list. This means that the bottles probably can be filled and packed in many lines throughout the organization. However, no Beat-bottle has yet been developed for 50 cl. But in bottle list it can be noticed that many of the bottles have a diameter of or are similar to 67 mm. Therefore, the authors suggest the diameter 67 mm for the 50 cl one-way glass bottles. A more detailed description of each platform will be done in chapter 4.4.3 – *Suggested Platforms*. Two platforms are not compliant with this diameter standard, namely Bock and Stubby. The only reason for allowing this is that these bottles are used for discount beer and are sold in very large volumes for cheap price. This low-cost demands means that the beer really needs a simple and logistically effective bottle with no extra features. Both Bock and Stubby are already existing bottles, optimized for these needs, and they need no further developments. Further on, compliant with *CB procurement project* and their mission to decrease material costs by using as lightweighted bottle as possible, all developed platform bottles are lightweighted[88].

There were bottles that could not be matched to any of the platforms. After discussions with employees at CB, three explanations for these were found: first, the bottles did not exist within G11; second, the bottles were old and not in use anymore; or third, the bottles were so specific that they would be exceptions from the platforms. The major difference with an exception bottle from a platform bottle is that no other brands can use that glass bottle; i.e. they are used but are not group platforms.

The exceptions were grouped in four groups:[89]

- Unique shaped bottles
- Super premium bottles
- Small sizes (25 cl and 27,5 cl)
- Large sizes (66 cl, 75 cl, and 100 cl)

The reason for these bottles to still exist outside the group platforms is that they all can prove that they are profitable. The *unique shaped bottles* group includes bottles with an individual and distinct design closely connected to the brand making them show at the shelves. The *super premium bottles* group includes bottles belonging to the super premium brands within CB, such as Jacobsen and Duckstein. As they are super premium brands, the visual identity and uniqueness of these bottles are essential as the customers are willing to pay for it. The *small size bottles* group is an exception for UK, due to how beer is sold there. The profit for these is high as they sell the beer for the same price as the 33 cl, even though it contains less beer volume. The *large sizes* group is needed in some countries, but CB does not want to encourage new brands to use large bottles and therefore they will not be included in the platforms. Large sized bottles are less profitable due to high purchase cost and transportation difficulties.[90] The exceptions are well aligned with what many of the branding theories are underlining; a package needs to be unique to possess a competitive advantage and by that attract consumers to buy the product.

In the future, there will probably be more exceptions within CB glass bottles. Some of them might even be included in the group platforms if there is a group need for the glass bottle.

4.4.4 Suggested platforms

After the three workshops and many internal discussions within the complexity management team, the following platforms have been proposed.

[88] Carlsberg Brewery Group, *Procurement project analysis*, 2007
[89] Langen H. 10-04-08
[90] ibid.

4.4.4.1 Brand bottles

The Carlsberg platform includes three bottles, all green. These bottles are only to be used for Carlsberg brand beer. Branding finds it necessary to have both crown cork and twist off at the 33 cl bottle due to different needs in different countries. The 50 cl bottle is more difficult as it is almost only sold in Poland where it has been launched and branded with a twist off, and the commercials are focusing on the twist[91]. However, in the rest of the G11 countries the crown cork is used and it will take more effort to change to a twist off than stay with the crown cork and that is why both probably will be included within the platform.

Bottles Included
One-way, 33 cl, Crown cork
One-way, 33 cl, Twist off
One Way, 50, Crown cork * * Might also be with twist off

Figure 10: Carlsberg platform

[91] Langen H., 10-04-08

The Tuborg platform includes three bottles and should only be used by Tuborg brand beer. Branding has taken part in deciding which colors and volumes that is most suitable for the Tuborg platform.

Bottles Included
One-way, 33 cl, Crown cork
One-way, 33 cl, Crown cork, Green
One-way, 50 cl, Crown cork, Brown

Figure 11: Tuborg platform

The Holsten platform includes three bottles, all green and all only containing Holsten brand beer. One problem is that all Holsten bottles exported are green and the ones sold in Germany are brown. However, interviews with concerned peoples at CB suggested it was better to stay with the global bottles and force Germany to change.

Bottles Included
One-way, 33 cl, Crown cork
One-way, 33 cl, Twist off
One-way, 50 cl, Crown cork

Figure 12: Holsten platform

4.4.4.2 Group bottles

The Beat 1 platform is a group platform to be used by brands throughout CB and it includes six bottles. It is planned to contain refreshment beer of all kinds. Refreshment beer is beer positioned as trendy and easy to drink[92]. Beat 1 is the largest platform as it is a simple glass bottle design and can be used for many kinds of beers. It is already launched in some markets with some colors and branding founds it better to keep them and make the platform more varied as Beat 1 is predicted to be used by many brands within CB.

Bottles Included
One-way, 33 cl, Crown cork, Flint
One-way, 33 cl, Crown cork, Brown
One-way, 33 cl, Crown cork, Green
One-way, 50 cl, Crown cork, Brown
One-way, 25 cl, Crown cork, Flint
One-way, 25 cl, Crown cork, Green

Figure 13: Beat 1 platform

The Beat 2 platform is a group platform to be used by brands throughout CB and it includes two bottles. It is planned to contain authentic beer of all kinds, i.e. more traditional, usual and historical beer[93]. Branding founds it necessary to have the bottle in both brown and flint, however, 33 cl was the only volume needed.

Bottles Included
One-way, 33 cl, Twist off, Brown
One-way, 33 cl, Twist off, Flint

Figure 14: Beat 2 platform

[92] Langen H. 28-04-08
[93] ibid.

The Beat 3 platform is a group platform to be used by brands throughout CB and it includes one bottle. It is planned to contain non alcoholic drinks of all kinds, which is seldom sold in larger volumes than 33 cl, therefore it is only necessary to have one volume. Further on, non alcoholic drinks, especially soft drinks, are preferred in flint bottles by the end users according to branding.

Bottles Included
One-way, 33 cl, Crown cork, Flint

Figure 15: Beat 3 platform

The Beat 4 platform is a group platform to be used by brands throughout CB and it includes two bottles. It is planned to contain alcoholic, none beer drinks of all kinds. Like the case of the Beat 3 Platform, alcoholic, none beer drinks are seldom sold in larger volumes than 33 cl and therefore no other volumes are necessary in the platform. However, branding founds it useful to have two colors, flint and brown
.

Bottles Included
One-way, 33 cl, Crown cork, Flint
One-way, 33 cl, Crown cork, Brown

Figure 16: Beat 4 platform

The Bock platform is a group platform, even though it is a brand bottle, to be used by brands throughout CB and it is including one bottle. The Bock platform is included as it is selling very well and it is potential to earn much money by letting other brands using the same bottle. The bottle is not brand specific and the brand Bock is owned by CB and there are therefore no legal issues for other brand to use the bottle[94]. It is simple and has been proven for a long time to meet the customers' needs at the markets. It is only needed in one size and color as it is supposed to be a bottle for low cost solutions.

Bottles Included
One-way, 33 cl, Crown cork, Brown

Figure 17: Bock platform

The Stubby platform is a group platform to be used by brands throughout CB and it is including one bottle. It is a platform for low cost solutions and does not need more than one color and size. This bottle is aimed to be used when logistic costs are high and therefore the need for a cheap bottle and low transportation cost are vital aspects. It is today very common in the Middle East[95].

Bottles Included
One-way, 33 cl, Crown cork, Brown

Figure 18: Stubby platform

4.4.4.3 Verification Sweden

The goal with the third workshop was to verify the draft platforms with the local complexity managers, the last step in the process of developing the glass bottle platforms. The authors had matched each bottle in every country with the new platforms and given suggestions on which bottle platform it could be replaced with. In the table 4 below, the Swedish list is illustrated as an example.

[94] Langen H., 10-04-08
[95] ibid.

Table 4: Swedish bottle list

Current Bottle	Suggested Platform Bottle	Go or No go
Carlsberg 33 cl Green OW	Carlsberg: OW, 33 cl, Crown Cork	Try to go
Carlsberg 50 cl OW HT-green	Carlsberg: OW, 50 cl, Crown Cork	Go*
Cube 27,5 cl OW Flint	Beat 1: OW 33 cl, Flint, Crown Cork	Go**
Beat 1, 33 cl, OW, Flint	Beat 1: OW 33 cl, Flint, Crown Cork	Go
Xider bottle 33 cl flint	Exception – Unique Shape	Go
Blå 75EG tomflaska	Exception – Large	Go
Carlsberg 900 25 cl flint	Exception – Unique Shape	Go
Blå 33EG tomflaska	Exception - Large	Go

*Probably ok, but must verify with branding. A short term reasonable solution is bottle from Poland with twist off.
** Not decided if a 25 cl or a 33 cl bottle

The first bottle, *Carlsberg OW, 33 cl, Crown cork* is a "try to go" because it is much up to Systembolaget (the only retail store allowed to sell alcoholic beverages in Sweden) if they approve on the new bottle. The bar code is located differently and therefore it might be a problem. However, the purchase price for Systembolaget will be lower with the new bottle and therefore CB believes they will accept the bottle change.[96]

Twelve platform glass bottles were developed, based on group needs and dimensions on existing bottles. There are three brand platforms for the global brands, and nine multi brand bottles. This means that only the three global brands, i.e. Carlsberg, Tuborg, Holsten, are allowed to have brand specific bottles. Other brands must have brand neutral bottles, and market the brand with labels, caps or secondary packaging. The platforms are fulfilling different needs, like volume, shape and colors.

4.5 Balancing complexity

4.5.1 Why is complexity a problem?

In the background, the authors stated that packaging complexity is causing problems to many organizations today, and that managing complexity is about to become a high priority in the industrial world. But *why* is complexity a problem? The answer can be found in two different theoretical areas, both essential to manufacturing organizations. Within an organization, *production strategies* and *branding strategies* are two conflicting interests when it comes to complexity.

Within theories about *production strategies*, no variation of products/packages is the optimal state. For example, a flow oriented production in a brewery gain great benefits by having only one glass bottle. The theory even says that a flow oriented production is *only* used when low diversification is present. With only one kind of

[96] Abrahamsson J., 31-03-08

glass bottle, the flow will never be interrupted. The number of change over times will be minimized, and the stocking will be easier. Moreover, as it is important to only produce on demand, it is much easier to keep track on one product type instead of many. Similarly, many important activities within lean production are facilitated when removing the product/package variation; such as obsolescence, queue time, unnecessary transportation and utilization of the material. Further on, less products/packages variants can hopefully result in a smaller number of suppliers – within lean production, the connections to suppliers should be lean and optimized, which is easier done with a smaller number. Consequently, according to the production strategies, many benefits can be gained by reducing the variation of products/packages – i.e. *reducing the complexity*.

Theories within *branding strategies* are expressing the opposite. A brand must be unique to attract the customer's attention, and branding is a way to control the organization's visual identity. Brand association is strongly related to the package; the physical features of the product are often the determining factor for the customer when there is little diversity between brands. This is particularly important within some industries where the package is the *only* way to differ products, for example in the brewery industry. As every product needs to be unique, an organization providing many products must also provide many unique visual identities – one for each product. When every product must have its own distinctive package the numbers of package variants will increase. Furthermore, the present uniqueness is not enough; to *stay* unique in a constantly changing environment, the brand must be frequently renewed. Product and packaging innovation is an important instrument in renewing the brand, and needed when finding new and keeping old customers. Consequently, according to the branding strategies, organizations will survive only if they can provide variations among their products/packages – i.e. an *increased complexity*.

Thus, the problem is not the complexity itself, but the conflicting interest between production strategies and branding strategies. Production will gain from a reduced complexity at the same time as branding will profit when an increased packaging complexity is accepted. The challenge is to find the *balance* between these interests.

4.5.2 One way of solving the complexity problem

At the case organization, the authors' purpose was to introduce platforms and by that solve the complexity problem within one-way glass bottles. In what way does introduction of platforms solve the complexity problem described above?

Production will gain from the introduction of platforms as it will result in a large complexity reduction. Fewer variants of glass bottles lead to larger volumes, and thereby lower costs of suppliers, procurement, and non-material. Furthermore, having standardized bottle dimensions also optimizes filling line efficiency, and simplifies the flow. The most complexity reduction is between countries, the platforms will ensure that the same brand is having the same bottle within all countries, instead of one each.

Branding will also benefit from the introduction of platforms. The visual identity of the brands will strengthen, as the brands have the same appearance in all countries. Within the platforms, there are different packages to be chosen for new products, the platforms should have enough variance to cover every customer need. This will save money in developing costs for the bottle and shorten the time to market. The authors believe that the platforms can include more modules, such as labels and closures, in the future. The modules can be used as a "tool box" for branding, with modules possible to mix and match into a final package. As long as modules are able to be matched with each other, the bottle complexity will not cause any problem but the number of possible variants of end packages will be very large.

This means that with packaging platforms, an organization can satisfy both the production's need of less packaging complexity *and* the branding's need of more complexity. Hence, the introduction of platforms at CB is a practical example of how to solve the complexity problem. In theory, modularization and platforms are beneficial as it provides opportunities to satisfy different customer needs at the same time as gaining economies of scale, and shorten time to market. However, in platform and modularization theory, complexity is not mentioned, and platforms are not explicitly used as a way of solving the packaging complexity problem.

Some of the consulting firms and the manufacturing organizations described in the introduction have used the modularization and platform theories to solve complexity problems. They use platforms and modularization on their way to a more lean production. However, these theories have not been developed in the same pace as they have been used, and therefore there is a gap in platform theories regarding how to balance complexity. Consequently, to achieve a further approach to platform theories, this area need to be developed to also include the balancing of complexity. A theoretical development will make packaging complexity management available beyond the consulting firms' expensive tailor-made solutions.

4.5.3 Platform theory and complexity

The authors argue that the development of platforms is a good way of solving complexity problems within CB glass bottles, and believe that this is applicable for other organizations as well. The authors believe that the *development of platforms* is *balancing complexity*; to develop platforms in a complex situation it is necessary to reduce non value-adding and maybe increase the value-adding complexity. For CB glass bottles, the reduction of bottles from 81 to 21 is a proof that the development of platforms also is a reduction of non value-adding complexity. According to the authors it is, however, important that when balancing complexity, an organization must find the optimal balance between production and branding interest. Reduction of non value-adding complexity is of no good if this balance is neglected; to only reduce complexity, branding interests will probably be overseen and the complexity will risen shortly due to branding needs. The authors even argue that the reduction of non value-adding complexity *must* be done by finding the balance, and that one way of finding this balance is through the development of platforms.

However, when the platforms finally are implemented, the challenge lies within managing the present and needed complexity and not only reducing it anymore. This means that the organization must maintain the complexity packaging balance in order to achieve the advantages of the platforms. The authors consider this *maintaining of balance* as *complexity management*. This maintaining is not about denying branding new ways of marketing the organization or the products. It is about knowing *when* to allow the platforms to be overlooked or extended and when not to i.e. to find a way to know when the extended packaging complexity is value-added or not for the organization. Branding theories are all underlining the importance of uniqueness and innovations within products and packaging. Platforms might be seen as a way to prohibit this. Hence, the authors stress that it is a need for organizations to know when to allow this to happen and that is maintaining and renew the balance which can be seen as complexity management. For CB glass bottles, to maintain the platform without accepting too many exceptions, will be the future challenge after the platform implementation and will require complexity management skills.

According to the authors, there is a clear connection between balancing complexity and complexity management; complexity management is the superior activity and balancing complexity is a previous activity to make complexity management possible. The authors' definitions of complexity balancing and complexity management within platform theory are:

Complexity balancing is to *find* the balance between production and branding interest. This is done by the introduction of platforms.

Complexity management is to *maintain* and *renew* the balance between production and branding interest by revising the platforms.

Once the complexity is balanced, branding will try to increase the complexity to be able to market the product in more innovative and unique ways. Branding will try to innovate products not always aligned with the platforms. When they succeed, the balance will be disturbed. This *must* be allowed as a brand needs to continuously change to fit the ever changing surrounding, i.e. branding innovation is necessary. However, the organization must know *when* to allow this balance to be disturbed, i.e. when to allow products not included in the platforms.

4.5.4 Complexity management as a process

The authors have defined complexity balacing and complexity management. To further clarify the connections between them, a *complexity management process* has been developed. This process is intended to be used by organizations not yet able to handle their packaging complexity problems. In the process, the authors aim to position practical knowledge in a theoretical context. The practical knowledge from consulting firms and manufacturing firms presented in the introduction are sorted and positioned under the activities in the process below. Further on, every activity is explained by an example from the study done at the case organization. The process aims to push the theory one step closer the practical knowledge about complexity management within platform theory.

1. **Decide focus area –** Identify the focus area that seems to cause the most complexity and where it is possible to gain the largest savings in handling non value-adding complexity within the product portfolio. Is could be for example the products, packages, brands, or suppliers that drives complexity? This area should be the future focus of complexity balacing and complexity management. In this activity, Boston Consulting Group's way of managing complexity, namely *accommodation*, can be positioned. Accommodation is when organizations identify where their complexity cost is high, and improve their capabilities in these areas. Their process, however, is covering the whole organization while deciding focus in this process only includes the focus within the product portfolio. In the case of CB, the focus area is one-way glass bottles. The focus area was decided after complications arising from too many variations among one-way glass bottles.

2. **Map the complexity –** Collect all data of the units' parameters within the decided focus area. Ensure the data is standardized, i.e. having the same terminology, so all data belonging to the same parameter can be compared accurately. Group the data and sort after the numbers of variances of each parameter. In the case of CB, the focus area is one-way glass bottles, the units are each glass bottle and the parameters are color, volume, weight, height and diameter of the present glass bottles. The data is for example green, 33 cl, 150 g, 178 mm and 63 mm. The next move in mapping the complexity is identifying how the parameters influence the complexity within the organization. At CB, the *weight* of the bottle does not influence the complexity as much as the *diameter* due to requirements in the production. The last move in mapping the complexity is to prioritize the parameters by identifying which complexity the customers actually want to pay for. This is where the authors want to position what the consulting firms A.T Kearney and George Group underlines when describing the importance of separating the value-adding complexity from the non-value-adding. At CB, the variance among colors is an example of this. The simplest way would have been to only offer one color, but branding knowledge shows that bottle color is a complexity that customers are willing to pay for, i.e. value adding.

3. **Balance the complexity, i.e. develop platforms –** Group the units after the, for the organization, most important similarities. Choose the most appropriate units within each group to be the platform packages, or design new ones, and eliminate all others within the group. The platforms should be developed to suit both the production and the branding interest, and might include modules. In this activity, what the Boston Consulting Group refers to as *eliminate* and *segregate* can be positioned. To eliminate complexity, they mean that the variations of e.g. components must decrease, and the authors argue that this is done by the introduction of platforms. To segregate complexity is to use modularization. In the case of

CB, platforms have been developed but no modules. However, the platforms can be extended to include modules in the future. Next move in balancing the complexity is to calculate the potential savings potential by using the developed platforms. By doing this, the organization can ensure the benefits of introducing the platforms. If the calculation shows no savings, the platforms should not be implemented and the process must restart by finding a new focus area. If the savings potential is ensured, the platforms can be implemented.

4. **Manage the complexity, i.e. maintain and renew the platforms –** To ensure the continued success of the developed platforms, the authors argue that the organization must provide a clear governance model of how to use them. This model could include for example working processes, milestones, rules of action or business case structures, and will help maintaining the platforms. Further on, as innovations are necessary to organizations the platforms must be renewed to meet the changing surroundings. However, some innovations might not be aligned with the platforms and will thereby bring complexity to the organization. If it still should be included in the portfolio, it must be value-adding complexity. This means that it cannot bring more complexity cost to the organization than it can pay for. Hence, there is a need for a tool that calculates the added complexity cost from the innovation, to identify what the innovation needs to achieve to be allowed in the portfolio. Today, the authors have found no such tool in the theory. This is a way for organizations to renew the platforms; the organization must decide if the new innovation should be a part of an existing platform, create a new platform for others to build on, or be an exception and not to be used by any others than in this specific case. As branding always will require new innovations, this step is an everlasting procedure. The authors claim that this tool could be what the Boston Consulting Group call *innovation*. With innovation within complexity management, they stress the importance of differentiate by finding new ways to manage complexity. Further on, A.T. Kearney emphasizes that complexity management is, and will be, more important than complexity reduction. The authors believe that this complexity management process correlates to what A.T. Kearney states, and would therefore like to position that practical knowledge in this theoretical context.

The complexity management process is visualized in the figure 19. To illustrate that the renewing of platforms is an everlasting procedure, the arrows continue outside the figure.

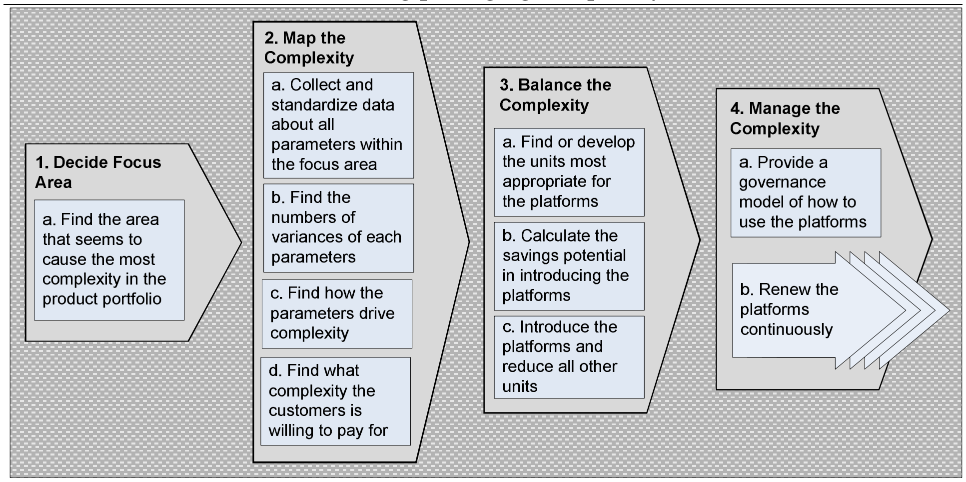

Figure 19: The complexity management process

4.6 Step 1 – Output

This step has two outputs, one fulfilling a practical purpose and one fulfilling a theoretical purpose.

Firstly, twelve glass bottle platforms were developed, based on group needs and dimensions on existing bottles. Out of them, there were three brand platforms for global brands and nine multi brand bottles, in total 21 bottles.

Secondly, the authors have discussed complexity balancing within the platform theory by defining *complexity balancing* (as finding the balance between production and branding interests by introducing platforms) and *complexity management* (as maintaining and renewing the balance between production and branding interest by revising the platforms). To connect these definitions, a complexity management process has been developed. The process includes the following steps: *decide focus*, *map the complexity*, *balance the complexity*, and *manage the complexity*.

5 Step 2 – Calculating savings potential

Many companies in the food industry have managed to reduce their packaging complexity, with great profit as an effect. Therefore, CB packaging platform team has assumed that the potential that comes with reducing complexity, on a group level, by developing glass bottle platforms is huge. Therefore, twelve platforms have been developed in step one. However, CB has not examined the savings potential in implementing and using these. In step two, the savings potential in implementing platforms for one-way glass bottles is calculated. By doing this, CB can ensure the benefits of introducing the platforms.

5.1 Step 2 – Methodology

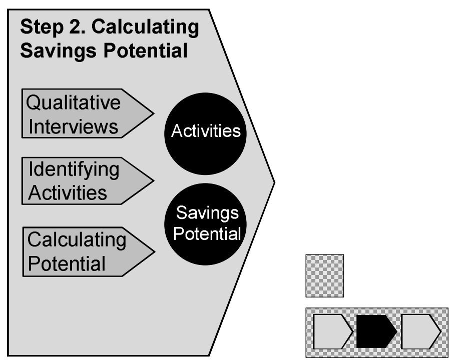

Figure 20: Step 2 of the methodology process in detail, followed by a small picture showing where in the process the second step is located

The sub-activities performed in this step are *qualitative interviews, identifying activities* and *calculating potential*. By these sub-activities, the savings potential was calculated.

5.1.1 Qualitative interviews

The source of all information presented in this step was qualitative interviews with CB employees from different areas in the organization such as supply chain, procurement and innovation. The interviews were open and all answers were verified by more than one person.

5.1.2 Identifying activities

The theoretical studies provided a framework to build the calculations on, namely to structure data in activities. After the qualitative interviews, four activities were identified by assumed savings potentials within CB packaging value chain. All four activities were broken down into sub-activities and savings potential was calculated for each breakdown. Lastly, a total cost saving in applying the developed platforms was calculated.

5.1.3 Calculating potential

When calculating a cost savings potential, a situation where all bottles are included in a platform is compared to the current situation with no platforms. For each sub-activity, a savings potential was determined based on the information gathered at the qualitative interviews. This was done by finding possible savings areas within each activity. Instead of calculating the absolute costs of the two situations, the focus was on finding the differences between the two situations. The savings potential was calculated as a sum of all those differences.

5.2 Step 2 – Theoretical framework

To structure the cost breakdown in different areas and activities within CB packaging there was a need for a cost model. Activity based costing (ABC) was the most appropriate model since it allocates cost to the correct activity which make it possible to allocate cost to each product and unit.[97]

5.2.1 Activity based costing

ABC is a method of assigning an organization's resource costs through activities to its products and services. The aim is to obtain an accurate cost break down by identifying and objectively allocating costs. ABC was defined by Cooper and Kaplan in 1987 who described it as an approach to solve the problems of traditional cost management systems. Managers often make decisions based on incorrect data since traditional costing systems often are unable to reveal the actual costs of production.[98]

According to Ax and Kullvén there are three apparent benefits when using ABC compared to other costing systems. Firstly, when gathered all activities and cost drivers in an organization it is possible to perform numerous of different analysis. Secondly, the activities and cost drivers used in an ABC are often easy to understand for all employees which create good understanding for the used costing system. Lastly, ABC is not only a costing system, it is also a useful tool for improving an organizations activities and processes. A shortcoming with ABC might be that the costing system can be expensive and complex to implement in an organization.[99]

There are two central aspects when applying ACB; *Activity* and *Cost Driver*.

5.2.2 Activity

When applying ABC an organization is divided into activities. An activity can be either a work task or a step in a process, such as production planning, procurement, changeovers of machines, control of quality, transport etc.[100]

The cost of every activity is divided and allocated to each product but only to the extent that the product actually uses the activity. By breaking the cost down, ABC

[97] Cooper R., and Kaplan R. (1998), *Cost & Effect*, Massachusetts
[98] Ax C, Johansson C, Kullvén H (2005), *Den nya ekonomistyrningen*, Liber Ekonomi
[99] ibid.
[100] ibid.

identifies areas of high overhead costs per unit. There are direct costs that are fairly straightforward to locate since they always can be traced directly to a specific product or service, for example labor and material costs. However, indirect costs where products use the same resources in a different amount are more difficult to allocate, such as maintenance cost and handling of raw material costs.[101]

5.2.3 Cost drivers

Troutt et al. identify cost drivers as a tool for allocation of cost to an exact cost object. More precise, Troutt et al. see cost drivers as variables that quantifies the amount and scope of the activity carried out.[102] Shank and Govindarajan divide cost drivers into two categories; structural and executional. On the one hand, structural cost drivers link costs to business strategic choices such as scope of operations, complexity of products and use of technology. On the other hand, executional cost drivers link cost to the performance of business activities such as capacity utilization and plant layout.[103] This Master thesis will focus on the executional cost drivers.

A cost driver has to be quantifiable for each activity. It also has to be independent from other cost drivers, i.e. a cost driver should not interact with any other cost driver. To be accepted by the whole organization it is also favorable if a cost driver is clear and understandable.[104]

To ease the discussions in this Master thesis, the authors' definition of a cost driver, based on the reasoning above, is the following:

> *A quantifiable activity, within production and/or logistics, which drives costs for the organization.*

All organization, depending on what kind of organization it is, has different cost drivers. As shown in table 5, Ax and Kullvén have come up with examples of cost drivers for a producing organization.[105]

Table 5: Activities and cost drivers

ACTIVITY	COST DRIVER
Procurement	The amount of procurement hours
Production planning	The amount of orders
Machine maintenance	The amount of machine hours
Quality control	The amount of quality controls
Supply of products	The amount of supplies

[101] Cooper R., and Kaplan R. (1998)
[102] Troutt M., Gribbin D., Shanker M. and Zhang A. (2000), *Cost efficiency benchmarking for operational units with multiple cost drivers*, Decision Sciences
[103] Shank J. and Govindarajan V. (1993), *Strategic Cost Management: The New Tool for Competitive Advantage*, The Free Press, New York
[104] Troutt M. et al. (2000)
[105] Ax C. et al. (2005)

5.3 Step 2 – Empirical findings

5.3.1 Activities

After several discussions and workshops with CB employees about packaging and the possibility of reducing complexity for glass bottles, the most crucial activities for packaging was identified by selecting four areas in the packaging value chain for a more in depth review; Procurement (1), Production (2), Working Capital (3) and Capital Expenditures (4). These four areas where chosen because they are assumed to have most complexity costs allocated to them. During discussions and workshops, these four areas were continuously put on the agenda regardless of who the CB participants were. Without any further analysis, these four areas were chosen as they are assumed to have largest impact on complexity costs.

5.3.1.1 Procurement

As concluded in step one, a probable savings potential lies within reducing the number of different one-way glass bottles from 81 to 21, and procurement was one of the main sources for potential savings.

CB employees have found two areas within procurement where they believe the savings potential is the greatest. They argue that by *reducing the bottles weight* and by *sourcing bottles from fewer suppliers* there is an opportunity for large savings.[106]

Lightweight

All recently introduced bottles at CB has been lightweighted which means that the bottles, after considering all different aspects such as production, logistics, consumers handling the bottle etc., are as lightweight as possible. All platforms, developed in step one, contain bottles that are light weight.

CB procurement team has recently run a project analyzing the probability of changing its current glass bottles that are not lightweight into lightweight. They estimated an average possible weight reduction of four percent. Since material costs are a direct cost, the procurement costs changes with the weight of bought material. Therefore a change to more lightweight bottles would enable a cost saving of four percent.[107] However, not all CB bottles can be included in the developed platforms. The development of platforms will approximately enable lightweighting of 74 percent of all heavier bottles. Total spend of one-way glass bottles is EUR 120 million.[108]

[106] Langen H., 10-04-08
[107] Carlsberg Brewery Group, *Procurement project analysis*, 2007
[108] Celen A., 10-04-08

Table 6: Lightweighting

SUB-ACTIVITY	QUANTITY
Total light-weighting savings	4 percent
Portion of heavier bottles that turn into lightweight when using platforms	74 percent
Total spend	EUR 120 million

Sourcing from preferred suppliers

Currently, each country sources its own bottles which limit possible advantages from economies of scale. High volumes have the benefit of enabling favorable supplier contracts. Moreover, by using the same bottles in most countries there is a possibility of cross-border sourcing which can increase utilization of breweries.[109]

By sourcing high volume from preferred suppliers it is possible for CB to negotiate and obtain a low purchase price. Out of total spend, 60 percent is prospected to be sourced from preferred suppliers and if using the new platforms, as much as 55 percent out of 808 million glass bottles can be sourced from these suppliers. With this large amount of bottles sourced from preferred suppliers, CB has been able to negotiate and the suppliers have agreed on a discount of 21 percent.[110]

Table 7: Sourcing from preferred suppliers

SUB-ACTIVITY	QUANTITY
Portion of all glass bottles sourced from preferred suppliers if applying platforms	55 percent
Portion of total spend sourced from preferred supplier	60 percent
Discount	21 percent

5.3.1.2 Production

With the use of platforms comes less variations in bottle dimensions. Employees within CB have identified three major sub-activities within production where they believe the savings potential is the greatest; *line downtime reduction, changeover time reduction* and *machine maintenance & support.*

Line down-time

All glass bottle lines cost EUR 77 million. An average line downtime is 40 percent of total capacity. However, only 75 percent of all downtime is for one-way glass bottles. The rest of the downtime is for returnable glass bottles, which is out of scope for this thesis. When dividing the downtime into sub-activities it is possible to see that as much as 50 percent of total downtime for one-way glass bottles is due to bottle change. Moreover, after developing platforms, the one-way bottle count will be

[109] Kistrup H., 14-01-08

[110] Carlsberg Brewery Group, *Procurement project analysis*, 2007

reduced by approximately 25 percent because platforms create less variation among all bottles.[111] All percentages are illustrated in table 8.

Table 8: Line downtime

SUB-ACTIVITY	QUANTITY
Average line downtime	40 percent
Downtime for one-way bottles	75 percent
Total downtime due to bottle change	50 percent
Reduction of one-way bottle count	25 percent

Changeover time

It is possible to use the same argumentation for *changeover time reduction* as for *line downtime reduction*. However, changeover time refers to the time it actually takes to change a line set-up from one bottle to another. It is necessary to include the cost of line downtime when calculating the potential cost savings in a reduction of changeover time due to the use of platforms and harmonization of bottle dimensions. Because of the new platforms, 40 percent of all one-way glass bottles will only require 50 percent of the current changeover time.[112] All percentages are illustrated in table 9.

Table 9: Changeover time

SUB-ACTIVITY	QUANTITY
Average line downtime	40 percent
Downtime for one-way bottles	75 percent
Total downtime due to bottle change	50 percent
Portion of one-way glass bottles that reduce changeover time	40 percent
The decrease in changeover time for some one-way glass bottles	50 percent

Filling line support

In production the greatest savings potential lies within *filling line support*. Current support cost for filling lines is estimated to be EUR 112 million. 70 percent of all production support cost are allocated to filling, the other is allocated to brewing. The glass bottle portion of total filling line support is 60 percent, while both can and pet are 20 percent each. All glass bottles are divided into one-way glass bottles and returnable bottles where the portion of one-way glass bottles is 75 percent.[113] Lastly, the reduction of one-way glass bottle types is 48 percent due to the developed platforms. All percentages are illustrated in table 10.

[111] Celen A., 10-04-08
[112] ibid.
[113] ibid.

Table 10: Filling line support

SUB-ACTIVITY	QUANTITY
Production support cost allocated to filling	70 percent
Glass portion of the filling line support	60 percent
One-way portion of glass line support	75 percent
Percentage of one-way bottle types reduced by the developed platforms	48 percent

5.3.1.3 Working capital

Stock of empties will decrease due to the developed platforms and less variation among glass bottles. It will no longer be necessary for CB to have as wide range of different bottles as they currently have, the number will reduced from 81 to 21. This will reduce the needed square meters for empty glass bottle inventory since the number of needed safety stocks will reduce.[114]

CB uses 808 million of glass bottles per year in G11. Every square meters in inventory contains two pallets and it is possible to have 2500 glass bottles per pallet. To always be able to produce, CB has a safety stock of glass bottles of approximately 10 days per bottle type used[115]. The inventory space cost is EUR 30 per m^2 and month.[116] See all figures in table 11.

Table 11: Empty inventory of glass bottles

SUB-ACTIVITY	VALUE
Units of glass bottles	808000000 units
Units per pallet	2500 units
Pallets per m^2	2 per m^2
Safety stock	10 days
Inventory space cost	EUR 30 per m^2 and month
Discount	21 percent

Current tied up capital for the safety stock is EUR 1,77 million. For all platform bottles (55 percent) sourced at preferred suppliers (60 percent), CB receives a discount of 21 percent.

5.3.1.4 Capital expenditures

When introducing new glass bottles it is sometimes necessary to invest in new machines. When it comes to capital expenditures it is not possible to do any short-term cost savings due to use of the developed platforms. CB has already invested in their current assembly of machines. However, long-term savings are possible due to glass bottle platforms. Most of current assembly of machines is able to fill and pack all platform glass bottles which reduce the need for investment in new machinery

[114] Kruse M., 29-04-08
[115] Johansson S., 05-05-08
[116] Celen A., 10-04-08

when introducing a new product, as long as it uses a package that is a platform bottle.[117]

5.4 Step 2 – Analysis

This section will calculate the savings potential in using platforms. By applying activity based costing, CB packaging production has been divided into activities and cost drivers. The aim is to obtain an accurate cost break down by identifying and objectively allocate cost savings.

5.4.1 Procurement

In this section the cost savings potential in using the developed platforms will be calculated. The activities within procurement that have greatest influence on the cost savings are; to change heavy glass bottles to more *light weighting glass bottles* and to source larger amount of glass bottles from *fewer suppliers*.

Lightweighting
As was said in section 5.3.1.1, CB procurement project analyzed the cost savings potential in changing heavy bottles into a more lightweight platform glass bottle. Their estimation shows that a four percent saving is possible for CB Group if all bottles are moved to current group weight standards.

When building new platforms in step one, it was revealed that as many as 74 percent of all heavy glass bottles could be changed to a lightweight glass bottle compliant with a new platform. The total spend of all glass bottles is EUR 120 million.

By multiplying the total spend with the potential saving and the portion of bottles changeable to a platform glass bottle, a total cost saving in using a lighter alternative is estimated to EUR 3.6 million, see figure 21. For more in-depth calculations, see appendix 2.

Sourcing from preferred suppliers
The prospect is that as much as 60 percent of total spend (EUR 120 million) should be bought from preferred suppliers. If using the developed platforms, 55 percent of all glass bottles bought from preferred suppliers could be platform glass bottles. This would enable an estimated cost saving of 21 percent which result in EUR 8.3 million, see figure 21. For more in-depth calculations, see appendix 2.

[117] Blacks E., 22-02-08

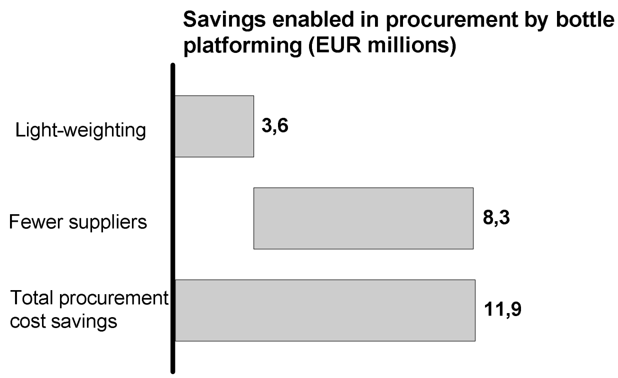

Figure 21: Procurement savings

5.4.2 Production

In this section the production cost savings potential in using the platforms will be calculated. Three sub-activities within production where CB employees believe the savings potential is the greatest will be analyzed; *line downtime reduction, changeover time reduction* and *machine maintenance & support.*

Line down-time
To calculate the total line down-time cost savings in using the developed platforms, total cost of one-way glass bottles, EUR 77 million, is multiplied with the average line downtime, which sums up to the total cost of downtime (EUR 30,9 million). However, only 75 percent of total downtime is for one-way glass bottles and 50 percent of all one-way glass bottles downtime are due to bottle change. As a result, the cost for line down-time for one-way glass bottles is EUR 11.6 million.

When using platforms, the one-way bottle count will be reduced by approximately 25 percent since platforms creates less variation among all bottles. The total cost saving therefore ends up to EUR 2.9 million, see figure 22. For more in-depth calculations, see appendix 2.

Changeover time
Less variation among glass bottles is needed if using the developed platforms. Fewer bottle dimensions make it easier to change between different bottles which decrease the changeover time. By using the cost for line down-time for one-way bottles EUR 11.6 million (see section Line down-time) the cost saving in reducing changeover time can be calculated.

Because of the new platforms, 40 percent of all one-way glass bottles will only require 50 percent of current changeover time. As a result, the total cost saving for reduced changeover time sums up to EUR 2.3 million, see figure 22. For more in-depth calculations, see appendix 2.

Filling line support

Total support cost is estimated to be EUR 112 million. Out of the total support cost it is EUR 61 million (54,5 percent) that is related to production. Furthermore, 70 percent of all production support cost is actually allocated to filling. The other 30 percent is allocated to brewing. The filling line support cost therefore adds up to EUR 42.7 million.

The glass bottle portion of total filling line support is 60 percent and the portion of one-way glass bottles are 75 percent of all glass bottles. As a result the cost for one-way glass bottles is EUR 19.2 million.

If applying the developed platforms, a reduction of 48 percent of the one-way glass bottle filling line support is possible. As a result, by using platforms a total cost saving of EUR 9.2 million is achievable in the filling line, see figure 22. For more in-depth calculations, see appendix 2.

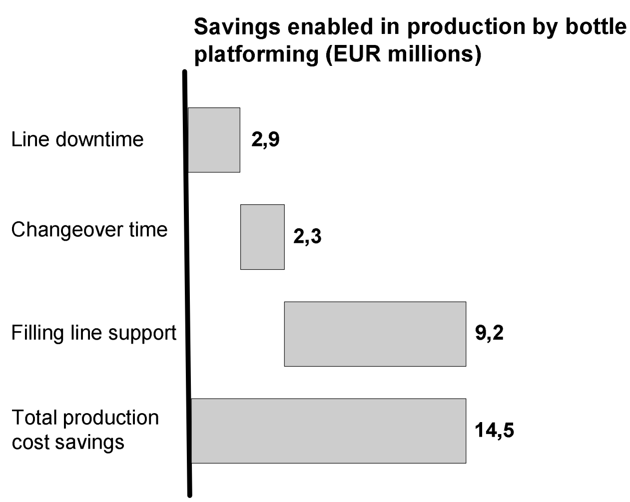

Figure 22: Production savings

5.4.3 Working capital

Apart from the empty stock, every used glass bottle needs to have a safety stock. As the number of used bottles decrease upon using platforms, so do the number of different safety stocks which reduce the needed square meter for empty glass bottle inventory. Currently, CB uses 81 different one-way glass bottles that all need a safety stock. When applying the developed platforms that number is decreased to 21 which reduces the safety stock by 74 percent. If anything unpredictable occurs, a safety stock must hold for approximately 10 days. Every square meter can hold two pallets that each contains 2500 units. The inventory space cost is EUR 30 per square meter and month. The use of platforms therefore results in a cost saving of EUR 1,2 million, see figure 23.

Tied up capital in empty inventory will be reduced by the reduction of safety stock. Current average tied up capital for the safety stock is EUR 1,77 million, while the tied up capital when using the developed platforms would be EUR 459000, which results in a cost saving of EUR 1,3 million (figure 23) For more in-depth calculations, see appendix 2.

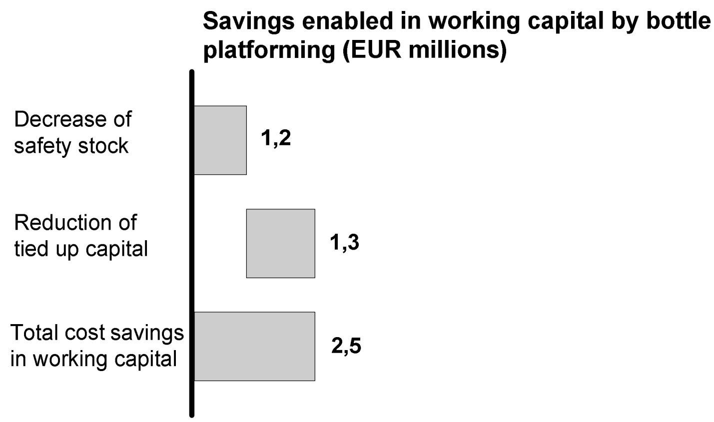

Figure 23: Savings in working capital

5.5 Step 2 – Output

The activities identified as having most impact on complexity costs were; Procurement, Production, Working Capital and Capital Expenditures.

As CB had predicted, there will be cost savings if applying the developed platforms. It is calculated by adding *Procurement cost savings* with *Production cost savings* and *Working capital cost savings,* as is illustrated in figure 24. The total cost saving is EUR 29.1 million.

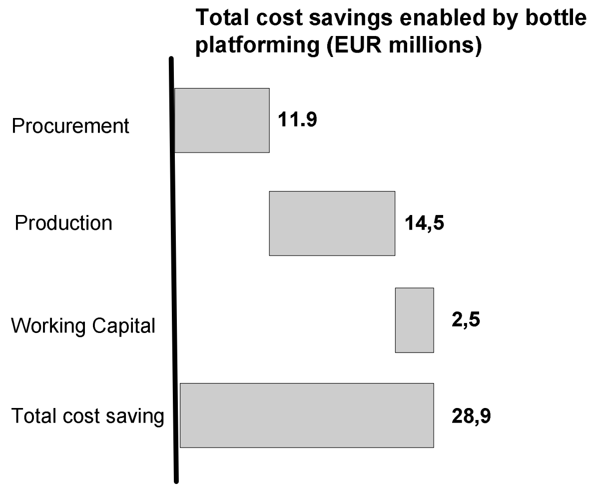

Figure 24: Total cost saving

As can be seen above, there is a large annual savings potential in introducing platforms. However, some costs have not been included in the calculations. One of these is the implementation cost. To realize the project of introducing platforms, a significant one-time payment will be necessary. However, as the calculated savings potential is annual, the authors believe that the payback time of the implementation cost will be relatively short even thought this one-time payment might be high. Other costs not included in the calculations are the phase out costs of the old glass bottles, machines, suppliers, etc.

The calculation of savings potential has its weaknesses. All information building up the step is gathered from CB internal sources, which might have resulted in non-valid results. For example, some areas of possible savings might have been forgotten as the sub-activities are all CB-specific and not compared to any external information. Furthermore, the sources of information might have selected their information, and thereby the sub-activities, to only show optimistic results. To avoid incorrect information, qualitative interviews with employees within different areas had been carried out.

6 Step 3 – Development of tool

The analysis of step one stressed the importance of managing packaging complexity. New innovations are necessary to organizations, but some of them might not be aligned with the platforms and will thereby bring complexity to the organization. If an innovation not aligned with the platforms still should be included in the portfolio, it must be value-adding. This means that it cannot bring more complexity cost to the organization than it can pay for, i.e. the innovation needs to pay for its own complexity cost to be allowed in the portfolio. In the first step (section 4.5.4), the authors identified a need for a tool that calculates the added complexity cost from the innovation. In this step, the authors aim to continue the analysis from step one by developing a general tool for this. The tool – hereafter named the Tool – should facilitate for organizations to differ value-adding complexity from non-value-adding, by calculating the cost of the packaging innovation's complexity cost.

6.1 Step 3 – Methodology

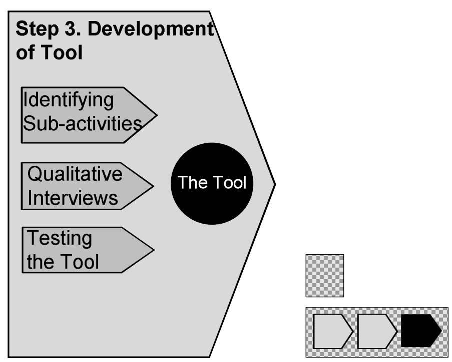

Figure 25: Step 3 of the methodology process in detail, followed by a small picture showing where in the process step 3 is located

The sub-activities performed in this step are *identifying sub-activities, qualitative interviews* and *testing the tool*. These activities describe the methodology that was used when developing the Tool. The development of the Tool is mainly done from an analysis using empirical data from the case organization, but also from the theoretical framework used earlier. The result is a general tool, calculating the complexity cost of a new innovation, aimed to be used by any organization where complexity within packaging can be present.

6.1.1 Identifying sub-activities

The four activities from step two, *Procurement, Production, Working capital* and *Capital expenditures,* were used in this step as a foundation of the Tool. However, to not be CB-specific, the sub-activities in the Tool had to be on a more general level. To identify these sub-activities, the CB-specific sub-activities were raised to a general level. Further on, the sub-activities was broken down to cost drivers by using the theoretical framework.

6.1.2 Qualitative interviews

Qualitative interviews were hold at CB to verify the identified sub-activities and cost drivers for the Tool. The sub-activities and cost drivers had to be applicable to other organizations than the case organization. Therefore, the qualitative interviews had to be on a more general level instead of on a CB-specific level. The interviews were held with people from production, procurement, supply chain and innovation.

6.1.3 Test the tool on case organization

When the Tool was developed it was tested at CB, to further verify it and to illustrate the use of it. The test was also done to show CB how much complexity costs a potential new bottle could add. The test was carried out by applying the Tool at CB on a *hypothetical* new glass bottle on the market not compliant with the platforms. This glass bottle is already existing in CB portfolio today (therefore *hypothetical* new) but it is not compliant with the platform and is an exception. The reason for using an already existing glass bottle is to increase the validity and accuracy of the result.

The Tool was sent to a CB employee working at the Group Innovation department, with deep knowledge in both packaging and costs connected to introducing innovations. The Tool provided the added complexity cost for using the hypothetical new bottle instead of using a platform bottle.

6.2 Step 3 – Theoretical framework

In this step most of the previous presented theories in this Master thesis are used. That includes: Production Strategies (Flow vs. Function and Lean Production) and Activity Based Costing. Even though the reason for using the Tool is to facilitate the conflict between the production and branding interests, Branding Strategies are not included. Branding interests, such as uniqueness and innovation, often add complexity costs and the Tool calculates this added complexity cost. Therefore, Branding Strategies are the reason to why it should be used (as complexity costs depend on branding interests), but branding will not be quantified in the Tool. No additional theories are presented in this step.

6.3 Step 3 – Empirical findings

No further empirical data was gathered for this step. All data used can be found earlier in the Master thesis, mainly in step two.

6.4 Step 3 – Analysis

6.4.1 Identifying cost drivers

Table 12 below illustrates and compares the sub-activities within each activity from step three with the sub-activities from step two. As described, the sub-activities from step two were raised to a general level in step three. An overview is presented in the table below; a further discussion is made in the following sections.

Table 12: Sub-activities in Step 2 and 3

ACTIVITY	SUB-ACTIVITIES STEP 2	SUB-ACTIVITIES STEP 3
Procurement	• Sourcing from fewer suppliers • Lightweight	• Need of new supplier • Material costs
Production	• Line downtime • Changeover time • Filling line support	• Line downtime • Changeover time • Line Capacity • Line support
Working Capital	• Tied up capital • Cost of space	• Tied up capital • Cost of space
Capital Expenditures	No activities influencing short-term savings	• New machines • New buildings/tools

6.4.1.1 Procurement

The sub-activities identified within procurement were *the need of new suppliers* and *material costs*.

Need of new supplier

An important factor within lean production is reducing the number of suppliers and by that achieving long-term contracts and tailor-made solutions optimized for the organization. A new package requiring a new supplier can be costly. The relationship with current suppliers might weaken as the supplier base grows. With only a few suppliers the relationship is usually close but as soon as the supplier base grows it becomes harder for the organization to keep the close relationship. A new supplier can hurt the relationship with the current supplier and result in increased sourcing price. As it is hard to quantify a relationship, this increased cost will be included in the increased material cost instead. An additional supplier means more administrative work for the organization, as contact with the supplier, negotiate contracts, make orders etc. must be handled. Furthermore, shipping costs usually increase with the number of suppliers. There is a possibility that the supplier is situated far from the organization which increases transportation costs. The new package might not be able to be shipped at standard pallets, or with less number of packages at each pallet.

From the discussion above, the following cost drivers has been identified:

- Time for administrative work connected to the new supplier.
- Transportation time.

Material costs

From interviews at the case organization, it is understood that it is important to only buy as much material as necessary. This is shown as CB tries to change as many of their old heavy bottles into a lighter alternative. This is applicable to lean thinking where waste reduction is an important factor and heavier packages can be seen as waste both considering the material cost itself, but also higher shipping cost due to higher weight. Just-In-Time (JIT), which is a part of the lean production, stresses the value of not having large stocks. Stocks ties up capital and obsolescence is a risk with many units in stock. If adding a new package, both the need for more packages in stock, due to an increased safety stock, and the value of tied up capital increases. Flow oriented production, as well as lean production, underlines the importance of having a constant flow with no stops throughout the production. Further on, if the material is rare, there is always a risk of lack of material or that the supplier not can provide the material for the production. This might recall a back-up supplier for the vital material which means more administrative costs. Further on, other actions needed for securing the material to the production shall be consider as costs that increases the complexity cost for the new package.

From the discussion above, the following cost drivers have been identified:

- Amount of material
- Cost of material
- Transportation time
- Administration time of back-up supplier

6.4.1.2 Production

The cost drivers identified within production were; *line downtime, changeover time, capacity changes* and *filling line support*.

Line downtime and changeover time

As mentioned before, flow oriented production and lean production highly stress the importance of having a constant flow without interruptions throughout the production. An additional package might interrupt this flow and cause extra line downtime and changeover time; hence it will add complexity costs. As the changeover time increases because of new package dimensions, the line downtime increases because of more changeovers.

From the discussion above, the following cost drivers have been identified:

- Line downtime
- Cost of line downtime
- Changeover time
- Number of changeovers
- Cost of changeover time

Line capacity

According to employees at CB there is a possibility that a new glass bottle will change the line capacity at the filling line. If the capacity is less than with a platform package it will increase the complexity cost.

From the discussion above, the following cost drivers have been identified:

- Number of packages filled per time
- Operational cost per time

Line support

Line support refers to all costs connected to having the line operating. When adding a new package there might be additional administration cost. Further on, the new package might require extra labor activities in the production. Lean production emphasizes that unnecessary activities should be removed to attain a better flow and by that save time and money. Therefore, these unnecessary activities are a factor that increases the complexity cost.

From the discussion above the following cost drivers have been identified:

- Time of administration
- Cost of time for administration
- Time of labor activities
- Cost of time for labor activities

6.4.1.3 Working capital

It is important to have a small number of packages in stock, both empty and finished goods, according to lean production. Both due to tied up capital and as the needed stock space increase. Safety stock is totally reduced if an organization is using JIT all the way, if not JIT is totally used the safety stock will increase and therefore also the complexity cost, if a new package is used.

From the discussion above the following cost drivers have been identified:

- Number of packages in empty stock
- Number of packages in finished goods
- Number of packages in safety stock
- Cost per unit
- Space cost

6.4.1.4 Capital expenditures

Some new packages could require new machines and/or tools, i.e. filling lines. Further on, there is the possibility of a need for new buildings due to the need for new machines and extra capacity. With that comes extra maintenance cost of new buildings and property.

From the discussion above the following cost drivers have been identified:

- Expenditures of a new machine and/or tools
- Expenditures of a new building and/or property
- Maintenance cost of a new building and/or property

6.4.1.5 Presentation of the tool

The Tool is built upon the four activities and more specific the ten sub-activities mentioned above. Every sub-activity is broken down to a number of questions, aiming to cover the cost drivers of every sub-activity. The Tool is illustrated in appendix 3, but it is supposed to be used as an excel-sheet. The respondent shall answer each question by filling in the numbers of the new package in the intended place. All *additional costs* of the new package are compared to a platform package. Thereafter, the complexity cost for each activity will be automatically calculated and shown together with the total complexity cost. The calculated total complexity cost is the cost that the new package must pay for to be allowed in the portfolio. As the Tool is aimed for packages, and packages are changed regularly due to branding strategies and innovations, the time horizon for the bottle use is often short. Therefore, the authors found no need for considering price and salary increases.

This Tool has its weaknesses. The building of the Tool is based only on empirical studies at only on one single case organization, and only tested on this organization. Even if the cost drivers derive from the authors' analysis based on both empirical and theoretical studies, the Tool is not sufficiently supported by theory. However, the authors' ambition is that the Tool is general enough to be applicable to other organization than the case organization. Further, the Tool does not optimize the package portfolio as it never compares complexity costs for already existing bottles with new bottles. Once a bottle is in the platform it is never evaluated and the Tool does not eliminate any existing bottle. Moreover, the Tool is limited to only include a few tangible parameters and no intangible. For example, the value from the experience that an organization can gain from introducing an innovation is not included.

6.4.2 Test tool on case company

The Tool was applied on the *Xide* bottle. Xide is sold in Sweden and is the second best selling CB product in Sweden.[118] It has already been on the market for about seven years and has been launched in many different flavors. All different flavors are filled in the same bottle: a 33 cl, flint with crown cork. [119] The Tool applied on the Xide bottle can be found in appendix 4. The total additional complexity cost of the Xide bottle, compared to a platform bottle, was calculated in the Tool to be EUR 56 900 400, in the time horizon of 20 years. The total complexity cost was broken down to EUR 0.2 per bottle. To justify the use of the Xide bottle instead of a platform bottle, each Xide bottle must have an increased sale price of EUR 0.2, i.e. pay for its own complexity cost. According to the respondent, the Tool was easy to use and

[118] Örtegren J., 05-05-08
[119] Langen H., 07-05-08

understand and the total complexity cost seemed probable. However, the respondent misunderstood the question considering the time horizon. The intention was to have the time horizon of the use of the *bottle*, but the respondent filled in the time horizon of the use of the *brand*. The bottle will probably change more often than the brand. For a package, 20 years is a long time horizon and the price increases will not be negligible, as assumed in the Tool. Because of this, the instruction of the Tool was further clarified.

A discussion about the results follows where the Tool is broken down into the four activities used throughout the thesis. The discussion starts with the results from the general questions on top of the Tool.

6.4.2.1 General questions

The time horizon for the use of Xide bottle is 20 years and the prospect number of units sold is about 273 million bottles for this time horizon.[120]

6.4.2.2 Procurement

Procurement includes costs of new supplier and material. For the Xide bottle, no new suppliers were needed as CB's current suppliers could provide this bottle as well. The Xide bottle is a glass bottle made of standard glass, therefore no material costs were added compared to a platform bottle.[121] The total procurement complexity cost is EUR 0.

6.4.2.3 Production

Production includes line downtime, changeover time, line capacity and line support. There is no additional line downtime for the Xide bottle. However, there are additional numbers of changeovers. The responded answered it to be five additional changeovers per months, which sums up to 1 200 changeovers during these 20 years. One changeover takes one hour and the cost per hour is EUR 5 000. Line capacity will decrease from 40 000 platform bottles/hour to 30 000 Xide bottles/hour and the operational cost per hour is EUR 5 000. There is additional line support needed because of more administrative work and extra labor connected to the line. It is two extra hours needed for administrative work and ten extra hours of labor connected to the line per month, which adds up to 480 and 2400 hours. The cost per hours is EUR 30.[122] The total production complexity cost is EUR 56 086 400.

6.4.2.4 Working capital

Working capital includes tied-up capital and space costs. The purchase cost of a Xide bottle is EUR 0.1 and the purchase cost of a platform bottle is EUR 0.08. Xide bottles needed in empty stock is 300 000 bottles, i.e. additional tied-up capital is EUR 6 000. No additional tied-up capital in finished goods is present due to a very small stock and therefore is negligible. The safety stock is 200 000 bottles, which increase the tied-up capital with EUR 20 000. Space cost will increase due to extra bottles in

[120] Langen H., 07-05-08
[121] ibid.
[122] ibid.

safety stock the additional space needed is 40 m^2 and the cost per m^2 is EUR 30 per month and m^2 which adds up to EUR 288 000 for the time horizon.[123] The total working capital complexity cost is EUR 314 000.

6.4.2.5 Capital expenditures

Capital expenditures include new machines and tools but also new buildings and properties. When producing Xide, there was a need for a new machine with a purchase cost of EUR 500 000. However, no further tools, buildings or properties were needed.[124] The total complexity capital expenditure is EUR 500 000.

[123] ibid.
[124] Langen H., 07-05-08

7 Conclusions

Complexity management is crucial. Even though this Master thesis only has covered packages, and more specific one-way glass bottles, it has proven large savings potentials in using platforms. Imagine the cost savings of applying complexity management within all areas of an organization. During the process, hidden complexity was found in many unexpected and unnecessary areas, for example the amount of different bottles within the global brands.

The Master thesis has three purposes, one theoretical and two practical. During the process of the thesis, the purposes have been fulfilled one by one. In this chapter, two conclusions are presented, one theoretical and one practical.

7.1 Theoretical

The theoretical purpose was to discuss packaging complexity with the assumption that packaging complexity can be balanced with platforms. At CB, the introduction of platforms is a practical example of how to solve the packaging complexity problem arising due to different interest between production and branding. In theory, modularization and platforms are beneficial as it provides opportunities to satisfy different customer needs at the same time as gaining economies of scale, and shorten time to market. Today, consulting firms and manufacturing organizations often use platforms and modularization on their way to a more lean production. However, in platform theory, complexity is not mentioned, and platforms are not explicitly used as a way of solving the complexity problem. No discussion about platforms as a method of solving the packaging complexity problems has been found in academia.

The authors have discussed complexity management within the platform theory first by defining *complexity balancing* as finding the balance between production and branding interests by introducing platforms, and *complexity management* as maintaining and renewing the balance between production and branding interest by revising the platforms. Second, to connect these definitions, a complexity management process has been developed. The process includes the following steps: *decide focus*, *map the complexity*, *balance the complexity*, and *manage the complexity*.

When developing this process, the authors identified the need for a tool that calculates the additional complexity cost when introducing a new package, and by that manage complexity. Exceptions from the platforms must be allowed, the question is *when* to allow it. When the complexity cost is calculated, it is possible for the organization to force the new package to prove that it can pay for its own complexity, before it will be included in the package portfolio as an exception. This helps the organization to know *when* to allow exceptions, and when not to. Such tool was developed and tested in step three. The authors claim that the tool is general enough to be applicable to all kinds of packages; however, this has not been examined as the tool has only been tested at glass bottles at the case organization. Furthermore, the tool is not sufficiently supported by theory.

7.2 Practical

7.2.1 Platforms

CB has recently grown by acquisitions but has not yet attained the expected economies of scale, and considers this to be a result of their huge complexity due to countless local brands. Some countries within CB have tried to manage their production complexity, however, that effort has only been at a local level. CB believes that the development of group platforms is a good solution to the packaging complexity problem. The purpose was to generate group glass bottle platforms at CB.

To develop group platforms, a mapping of all present bottles had to be done. At group level, no standardized information about all existing bottles within CB existed, which surprised the authors. The glass bottles are a key part of CB's products, and therefore the authors believe that a map of these is vital to CB. The authors strongly suggest the glass bottle information at CB to be collected in a data base. This is important to be able to continuously update the information and to make the information available throughout the organization.

Twelve glass bottle platforms were developed, based on group needs and dimensions on existing bottles. Three brand platforms, for the global brands, and nine multi brand platforms. This means that only the three global brands, i.e. Carlsberg, Tuborg, Holsten, are allowed to have brand specific bottles. Other brands must have brand neutral bottles, and market the brand with labels, caps or secondary packaging. The platform bottles are fulfilling different needs, like volume, shape and colors. However, not all products will use the platforms bottles, but instead use exception bottles.

7.2.2 Savings potentials

CB assumed that there was a great savings potential that comes with introducing glass bottle platforms on a group level. Until now, however, no examination of the savings potential has been done and the possible savings potential has only been an assumption. The purpose was to demonstrate the savings potential in using the developed platforms. To calculate the savings potential of introducing platforms, four activities have been identified (procurement, production, working capital and capital expenditures), and those have been broken down into CB specific activities and cost drivers.

The total cost savings have been calculated to be EUR 28,9 millions, split between the activities as follow: EUR 11,9 millions for procurement, EUR 14,5 millions for productions, EUR 2,5 millions for working capital, and nothing for capital expenditures.

7.3 Suggested future studies

A suggested future study is to further develop the *complexity management process* by studying more practical examples of how complexity can be solved and managed. Furthermore, a future study would be to develop a process managing complexity within other areas of on organization than the product portfolio, e.g. organizational structure, suppliers and supply chain.

An important future study is to further support and develop the Tool by theories and to test the applicability of it on other organizations. The Tool must further be tested to verify that it is applicable to other packages than glass bottles. Furthermore, a future study might be to extend the tool to also cover other activities and cost drivers, such as sales, marketing or after sales service. Moreover, the Tool can be developed to not only calculate the added complexity cost of a new package, but also optimize the entire package portfolio by evaluating existing platform packages. Another future development of the Tool might be to somehow include intangible parameters.

The authors suggest that CB expands the platforms to include not only glass bottles but also labels, closures and secondary packaging. The modules could be used as a "tool box" for branding, with modules possible to mix and match into a final package. The number of possible variants of end packages would thereby be very large. Furthermore, a similar platform development can be done for PET-bottles and cans.

At CB, a future study would be to do a future calculation to identify the implementation cost for the platforms, and reduce that cost from the savings potential. Costs of phase out of old glass bottles, machines, suppliers, etc, could also be identified and reduced from the calculations.

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8.4 Carlsberg Brewery Internal

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Appendix 1 – Bottle List

Country	Reference Name	Colour	Vol (cl)	Weight (g)	Height (mm)	Neck finish	Diameter (mm)
Bulgaria	Holsten 33cl	Green	33	200	225	Crown Cork	58,9
Bulgaria	Shumensko 33cl	Brown	33	215	215	Crown Cork	61,5
Bulgaria	Shumensko 36cl	Brown	36	260	192	Crown Cork	69
Bulgaria	Tuborg Green 33cl	Green	33	200	225	Pull off	58,9
Bulgaria	Tuborg-Xmas 33cl	Blue	33	200	226	Pull off	59,9
Croatia	PAN 0,25	Green	25	164	181,5	Pull off	57,5
Croatia	Carlsberg 25 cl, OW, HT-gr	HT-green	25	165	201,5	Crown Cork	54
Denmark	Jacobsen 33 cl OW Amber	Brown	33	247	224,1	Crown Cork	62
Denmark	Tuborg 33 cl OW Olive gree	Olive Green	33	200	225	Crown Cork	58,9
Denmark	Jacobsen 75 cl OW Amber	Brown	75	465	290,5	Crown Cork	82
Denmark	33 cl Carlsberg Club 225 mi	HT-green	33	215	225	Crown Cork	58,9
Denmark	33 cl Ht-grön Carlsberg exp	HT-green	33	200	225	Crown Cork	58,9
Denmark	33 cl Ht-grön Tuborg Silketr	HT-green	33	200	225	Crown Cork	58,9
Denmark	33 cl Carlsberg Jacobsen B	Olive Green	33	247	224,1	Crown Cork	62
Denmark	75 cl Carlsberg Jacobsen B	Olive Green	75	465	290,5	Crown Cork	82
Germany	33 cl Holsten 211er TC	Brown	33	187	211,6	Twist off	66,2
Germany	Multibrand 33 cl OW Ambe	Brown	33	140	164,5	Crown Cork	65,3
Germany	Carlsberg 35,5 cl OW Em. (	Em. green	35,5			Crown Cork	
Germany	Holsten 50 cl OW Amber	Brown	50	258	252,6	Twist off	66
Germany	33 cl Holsten Embossing C	Green	33	235	229	Crown Cork	60,2
Germany	33 cl Holsten Embossing T(	Green	33	235	229,6	Twist off	60,2
Germany	33 cl Club bottle - german v	Green	33	280	238,6	Crown Cork	60
Germany	35,5 cl Malta-Flasche	Green	35,5	330	219,5	Crown Cork	66,7
Germany	Duckstein 50 cl OW Spec.	Brown	50	350	241	Crown Cork	61
Italy	Poretti, 33 cl, OW, Amber	Brown	33	240	225	Crown Cork	
Italy	Splugen, 33 cl, OW, Em. G	Em. green	33	150	178	Crown Cork	
Italy	Stubby, 33 cl, OW, Amber	Brown	33	136	159	Crown Cork	65,3
Italy	Poretti, 25 cl, OW, Amber	Brown	25			Crown Cork	
Italy	Multibrand, 66 cl, OW, Amb	Brown	66	260	222	Crown Cork	
Italy	Carlsberg, 33 cl, OW, HT-gı	HT-green	33	200	225	Crown Cork	58,9
Italy	Club, 66 cl, OW, Green	Green	66	350	272	Crown Cork	74,4
Italy	Carlsberg Vischy, 66 cl, OV	Green	66	325	272	Crown Cork	
Italy	Tuborg, 33 cl, OW, HT-gree	HT-green	33	240	225	Crown Cork	
Italy	66 cl, OW, Amber	Brown	66	310	260	Crown Cork	
Italy	Tuborg, 66 cl, OW, Green	Green	66	340	272	Crown Cork	74,4
Poland	Karmi 40 cl OW Flint	Flint	40	255	252	Twist off	62,6
Poland	Okocim 50 cl OW Amber	Brown	50	280	258,5	Crown Cork	67,4
Poland	Carlsberg Club bottle 0,33l	HT-green	33	225	225	Twist off	58,9
Poland	Carlsberg Club bottle 0,5l	HT-green	50	280	259	Twist off	67,5
Poland	Beat 4 0,33l	Brown	33	200	225	Crown Cork	58,9
Serbia	Carlsberg bottle 500ml (Rus	Green	50	340	270	Twist off	68,5
Serbia	Carlsberg bottle 330ml (Rus	Green	33	255	237	Twist off	60
Serbia	Holsten 330ml	Green	33	200	225	Crown Cork	58,9
Serbia	Tuborg 330ml	Green	33	200	225	Pull off	58,9
Serbia	DDC (Vichy) 330ml	Brown	33	220	224	Twist off	59,6
Serbia	Tuborg 330ml	Purple	33	200	225	Pull off	58,9
Sweden	Cube 27,5 cl OW Flint	Flint	27,5	210	218	Crown Cork	57,5
Sweden	Carlsberg 50 cl OW HT-gree	HT-green	50	325	248	Crown Cork	69,0
Sweden	BLÅ 33EG TOMFLASKA	Blue	33	185	195	Crown Cork	57,0
Sweden	BLÅ 75EG TOMFLASKA	Blue	75	395	254,7	Screw Cork	73,8
Sweden	Xider bottle 33 cl flint	Flint	33	218	231	Crown Cork	60,4
Sweden	Carlsberg 33 cl Green OW	Green	33	218	231	Crown Cork	58,9
Sweden	Carlsberg 900 25 cl flint	Flint	25	275	208	Crown Cork	58,9
Sweden	Beat 1, 33 cl, OW, Flint	Flint	33	200	225	Crown Cork	58,9

Country	Reference Name	Colour	Vol (cl)	Weight (g)	Height (mm)	Neck finish	Diameter (mm)
Switzerland	33 cl FHH DKK grün	Green	33	198	199,5	Twist off	63,5
Switzerland	33 cl Moussy DKK braun	Brown	33	150	178	Twist off	63
Switzerland	33 cl FHH KK cuvée	Cuvée (olive)	33	198	199,5	Crown Cork	63,5
Turkey	SISE 33CL TROY NRB TW	Flint	33	200	220	Twist off	60
Turkey	SISE 50CL TUBORG PILSE	Green	50	295	259	Crown Cork	67,5
Turkey	SISE 33CL NRB TUBORG I	Green	33	200	225	Pull off	59,8
Turkey	SISE 75CL NRB YESIL	Green	75	400	284	Crown Cork	78,5
Turkey	SISE 33CL CARLSBERG C	Green	33	218	231,8	Crown Cork	58,9
Turkey	SISE 25CL F5 NRB	Flint	25	163	182,5	Crown Cork	57,5
Turkey	SISE 33CL NRB T-BEER	Flint	33	200	225	Crown Cork	59,8
Turkey	SISE 33CL NRB SKOL	Brown	33	200	220	Twist off	60
Turkey	SISE 33CL NRB T-BEER LI	Flint	33	200	225	Pull off	58,9
Turkey	SISE 50CL TUBORG FIÇI N	Brown	50	290	214,2	Pull off	78
Turkey	SISE 33CL CARLSBERG C	HT-green	33	218	231,8	Crown Cork	58,9
Turkey	SISE 50 CL CARLSBERG	Green	50	350	260	Crown Cork	67,8
Turkey	ŞİŞE 66CL TUBORG GOLD	Brown	66	450	268,5	Crown Cork	77,3
UK	Carlsberg Export 275	Green	27,5	175	207,4	Crown Cork	57
UK	Carlsberg Lager/Light/Eleph	Green	27,5	175	207,4	Crown Cork	57
UK	Tuborg 275	Green	27,5	175	207,4	Crown Cork	57
UK	Holsten 275	Brown	27,5	175	207,4	Crown Cork	57
UK	Special Brew 275	Brown	27,5	175	207,4	Crown Cork	57
UK	Carlsberg Export 660 ml	Green	66			Crown Cork	
UK	Skol Special 330	Brown	33			Crown Cork	
UK	275 ml Flint	Flint	27,5	175	207,4	Crown Cork	57
UK	Jacobsen	Brown				Crown Cork	
UK	Holsten 330	Green	33			Crown Cork	
UK	Club 330 Green	Green	33			Crown Cork	
UK	Okocim 500	Brown	50			Crown Cork	

Appendix 2 - Calculations

PROCUREMENT

Lightweighting
$120 * 0{,}74 * 0{,}04 = \mathbf{3,6}$

Using preferred suppliers
$120 * 0{,}6 * 0{,}55 * 0{,}21 = \mathbf{8{,}3}$

Total procurement savings
$\mathbf{3,6 + 8,3 = 11,9}$

PRODUCTION

Line downtime
$77 * 0{,}4 * 0{,}75 * 0{,}5 * 0{,}25 = \mathbf{2,9}$

Changeover time
$77 * 0{,}4 * 0{,}75 * 0{,}5 * 0{,}4 * 0{,}5 = \mathbf{2{,}3}$

Filling line support
$112 * 0{,}55 * 0{,}7 * 0{,}6 * 0{,}75 * 0{,}48 = \mathbf{9,2}$

Total production savings
$\mathbf{2,9 + 2,3 + 9,2 = 14,5}$

WORKING CAPITAL

Space
$$\left(\frac{808}{2500 * 2} * 30 * 12 * \frac{10}{365}\right) - \left(\frac{808}{2500 * 2} * 30 * 12 * \frac{10}{365} * \frac{21}{81}\right) = \mathbf{1,2}$$

Tied-up capital
$$\left(808 * \frac{10}{365} * 0{,}08\right) - \left(808 * \frac{10}{365} * 0{,}08 * \frac{21}{81}\right) = \mathbf{1{,}3}$$

Total savings in working capital
$\mathbf{1,2 + 1,3 = 2,5}$

TOTAL COST SAVINGS

$\mathbf{11,9 + 14,5 + 2,5 = 28,9}$

Appendix 3 – The Tool

Product name: ____________

General considerations:
Please fill in the numbers below as accurate as possible.
All questions should be answered for the total time horizon, e.g. if a product is supposed to be on the market for three years, the respondent should fill in the total hours of line downtime during these three years.
All additional costs of the new package are compared to a standardized platform package.

General questions:
What is the time horizon for the use of the package? ______ Years
What is the prospect of numbers of units sold? ______ Packages

Procurement	New supplier	Does the new package require a new supplier?		
		If yes:		
		What is the hours needed for administrative work connected to new supplier?	______ Hours	
		What is the cost per hour?	______ EUR/Hours	
		What is the additional transportation cost due to new supplier?	______ EUR	
	Material	Is it a non-standard material?		
		If yes:		
		What is the additional material cost?	______ EUR	
		What is the additional transportation cost due to heavier material?	______ EUR	
		What is the cost of increased tied-up capital?	______ EUR	
		What is the cost of having a secondary supplier?	______ EUR	Total Procurement Complexity Cost is:
Production	Line downtime	What is the additional line downtime?	______ Hours	
		What is the cost per hour?	______ EUR/Hours	
	Changeover time	What is additional numbers of changeovers?	______ Changeovers	
		What is the additional time per changeover?	______ Hours/Changeover	
		What is the cost per hour?	______ EUR/Hours	
	Line capacity	Is the cycle time longer than the cycle time for producing platform packages?		
		If yes:		
		What is the number of packaged filled per hour?	______ Packages/Hour	
		What is the number of platform packages filled per hour?	______ Packages/Hour	
		What is the operational cost per hour?	______ EUR/Hours	
	Line support	Is the production more work intense than when producing platform packages?		
		If yes:		
		What is the additional hours needed for administrative work connected to line support?	______ Hours	
		What is the cost per hour?	______ EUR/Hours	
		What is the additional hours needed for labor connected to line support?	______ Hours	
		What is the cost per hour?	______ EUR/Hours	Total Production Complexity Cost is:
Working capital	Tied-up capital	What is the number of packages needed in empty stock?	______ Packages	
		What is the number of packages needed in finished goods?	______ Packages	
		What is the purchase cost of a platform package?	______ EUR/Package	
		What is the number of additional packages needed in safety stock?	______ Packages	
		What is the purchase cost of one package?	______ EUR/Package	
	Space	What is the additional space needed in empty stock?	______ m^2	
		What is the additional space needed in finished goods?	______ m^2	
		What is the additional space needed in safety stock?	______ m^2	
		What is the cost per m^2?	______ EUR/m^2/month	Total Working Capital Complexity Cost is:
Capital expenditures	Machines and tools	Does the new package require new machines and/or tools?		
		If yes:		
		What is the purchase cost of new machines and/or tools?	______ EUR	
	Building and/or property	Does the new package require new buildings and/or properties?		
		If yes:		
		What is the maintenance cost of new machines and/or tools?	______ EUR	
		What is the purchase cost of new buildings and/or properties?	______ EUR	
		What is the rental cost of new buildings and/or properties?	______ EUR	
		What is the maintenance cost of new buildings and/or properties?	______ EUR	Total Complexity Capital Expenditures:
				Total Complexity Cost:

Appendix 4 – The Tool applied on Xide Bottle

Product name: Xide

General considerations:
Please fill in the numbers below as accurate as possible.
All questions should be answered for the total time horizon, e.g. if a product is supposed to be on the market for three years, the respondent should fill in the total hours of line downtime during these three years.
All additional costs of the new package are compared to a standardized platform package.

General questions:
What is the time horizon for the use of the package? 20 years
What is the prospect of numbers of units sold? 273000000 packages

Procurement	New supplier	Does the new package require a new supplier? If yes: What is the hours needed for administrative work connected to new supplier? What is the cost per hour? What is the additional transportation cost due to new supplier?	 	 Hours EUR/Hours EUR	
	Material	Is it a non-standard material? If yes: What is the additional material cost? What is the additional transportation cost due to heavier material? What is the cost of increased tied-up capital? What is the cost of having a secondary supplier?		 EUR EUR EUR EUR	Total Procurement Complexity Cost is: **EUR 0**
Production	Line downtime	What is the additional line downtime? What is the cost per hour?		Hours EUR/Hours	
	Changeover time	What is additional numbers of changeovers? What is the additional time per changeover? What is the cost per hour?	1200 1 5000	Changeovers Hours/Changeover EUR/Hours	
	Line capacity	Is the cycle time longer than the cycle time for producing platform packages? If yes: What is the number of packaged filled per hour? What is the number of platform packages filled per hour? What is the operational cost per hour?	 30000 40000 5000	 Packages/Hour Packages/Hour EUR/Hours	
	Line support	Is the production more work intense than when producing platform packages? If yes: What is the additional hours needed for administrative work connected to line support? What is the cost per hour? What is the additional hours needed for labor connected to line support? What is the cost per hour?	 480 30 2400 30	 Hours EUR/Hours Hours EUR/Hours	Total Production Complexity Cost is: **EUR 56 086 400**
Working capital	Tied-up capital	What is the number of packages needed in empty stock? What is the number of packages needed in finished goods? What is the purchase cost of a platform package? What is the number of additional packages needed in safety stock? What is the purchase cost of one package?	300000 0 0,08 200000 0,1	Packages Packages EUR/Package Packages EUR/Package	
	Space	What is the additional space needed in empty stock? What is the additional space needed in finished goods? What is the additional space needed in safety stock? What is the cost per m^2?	0 0 40 30	m^2 m^2 m^2 EUR/m^2/month	Total Working Capital Complexity Cost is: **EUR 314 000**
Capital expenditures	Machines and tools	Does the new package require new machines and/or tools? If yes: What is the purchase cost of new machines and/or tools?	 500000	 EUR	
	Building and/or property	Does the new package require new buildings and/or properties? If yes: What is the maintenance cost of new machines and/or tools? What is the purchase cost of new buildings and/or properties? What is the rental cost of new buildings and/or properties? What is the maintenance cost of new buildings and/or properties?		 EUR EUR EUR EUR	Total Complexity Capital Expenditures: **EUR 500 000**
					Total Complexity Cost: **EUR 56 900 400**