A conversion from sales in money into volume in cubic meter

A prerequisite to Mid Term Capacity Planning within the IKEA sub process Plan & Secure Capacity

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Preface

This Master thesis has been carried out as a final part of a Master of Science degree in Mechanical Engineering at the Faculty of Engineering, LTH, at Lund University. The thesis was written during a 20 weeks period during the summer/autumn 2010 and had not been possible without the support of some people.

We would like to thank our supervisor at IKEA, Paul Björnsson, for giving us the opportunity to write our master thesis at IKEA and his commitment during the working process. We would also like to give a special thanks to our supervisor at LTH, Fredrik Olsson, for his support, guidance and valuable feedback.

We are also grateful for the people working at IKEA that took the time to give us instructive information about the organisation of IKEA in general and areas concerning the conversion factor especially.

Hopefully, this thesis will help IKEA during future development of the prerequisite to the Mid Term Capacity Planning.

Lund, October 2010

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Abstract

Title: A conversion from sales in money into volume in cubic meter – A prerequisite to Mid Term Capacity Planning within the IKEA sub process Plan & Secure Capacity

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Keywords: Prerequisite to capacity planning, Capacity planning, Top-down, IKEA, Conversion factor, Money per cubic meter.

Purpose: The purpose of the project is to recommend one common way of how to calculate a conversion factor that should be used to convert sales into the corresponding volume in cubic meter. The conversion factor is a forecasted average value per cubic meter of an IKEA product and could be seen as a model of the future. The authors of the thesis have no intensions to provide a perfect model that is an exact projection of the reality but the model should be a good approximation of the future average value per cubic meter of an IKEA product. The model should also be easy to grasp and easy to use.

Methodology: Different scientific approaches have been chosen for the three different research parts; exploratory, descriptive and explanatory. The study is inductive, qualitative and data was mainly received from semi structured interviews with people within IKEA.

Conclusions: Since the unit of the conversion factor consists of value and volume, all factors or parameters that affect the conversion factor must affect the value, the volume or both the value and volume. The factors that have been identified to consider when calculating the conversion factor are *Product range changes, Price investments, Price adjustments and Volume improvements.* The factors have all different characteristics and need to be considered differently.

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1 Introduction

The purpose of this chapter is to provide a background to the problem of this master thesis, an understanding for the problem area and to communicate the purpose of the thesis. The disposition of the thesis and the delimitations are also introduced, as well as a presentation of the target groups and the company.

1.1 Company description

IKEA is a Swedish home furniture company founded 1943 by Ingvar Kamprad. With its 123 000 co-workers in 25 countries, for the stores wholly owned by IKEA, and a turnover of 21.5 billion euro per year, it is world leading in its business. IKEA stands for Ingvar Kamprad (IK), Elmtaryd (E) and Agunnaryd (A). Elmtaryd and Agunnaryd is the name of the farm and the village where Ingvar grew up. [1]

The company is divided into three groups; the IKEA Group, the Inter IKEA Group and the IKANO Group. The IKEA Group is what most people refer to as IKEA today and encompasses all operations from raw material to finished and delivered products. The Inter IKEA Group owns everything that has to do with the concept and trademarks and the IKANO Group primarily deals with financial matters. All IKEA stores are divided into two groups, called *blue* and *red group*. The blue group includes stores that are wholly owned by IKEA while the stores within the red group are operated in a franchise basis.

In 1986 Ingvar Kamprad retired from Group Management and became a senior advisor to the company INGKA Holding B.V. This company is the parent company for all IKEA Group companies and is owned by a non-profit foundation called Stichting INGKA Foundation. The foundation replaced the concern in 1982 to

[1] IKEA webpage (a)

guarantee that the ownership of IKEA should stand for independency and long-term goals.[2]

1.2 Background

For all companies, planning of different activities is necessary in order to stay competitive in a global market. Planning means decision making about future activities and events. It concerns decisions about all parts of the organisation, such as short term decisions about orders as well as long term decisions concerning supplier structure and replenishment solutions. The time horizons for planning normally stretch from planning at an operative level for the nearest days or weeks, to planning on a strategic level for several years ahead.[3]

One important part of planning is capacity planning. Capacity planning concerns how to allocate resources, since having resources available for refining is a cost whether they are in use or not. In the same way it is also a cost in terms of lost sales to not have capacity to produce what the market demands. This means that it is a cost to have capacity but also a cost to not have capacity. For this reason it is of great interest for all companies to have a balance between capacity need and capacity assets.[4]

Within IKEA one planning horizon is called *Mid Term Capacity Planning*, which concerns planning for the nearest 84 weeks. The Mid Term Capacity Planning is carried out within the process *Plan & Secure Capacity,* which is a sub process to *Plan & Secure Supply*. In Figure 1 the core process Plan & Secure Supply is illustrated. Within the scope of these processes is to provide a *Capacity Plan* for this time horizon. The capacity concerns for example planning of transport, central warehouses and goods reception at the stores. For a description of what process orientation means, see Section 4.1.

[2] IKEA webpage (b)
[3] Jonsson, P & Mattsson, S-A. (2003) p. 51-55
[4] Jonsson, P & Mattsson, S-A. (2003) p 299-322

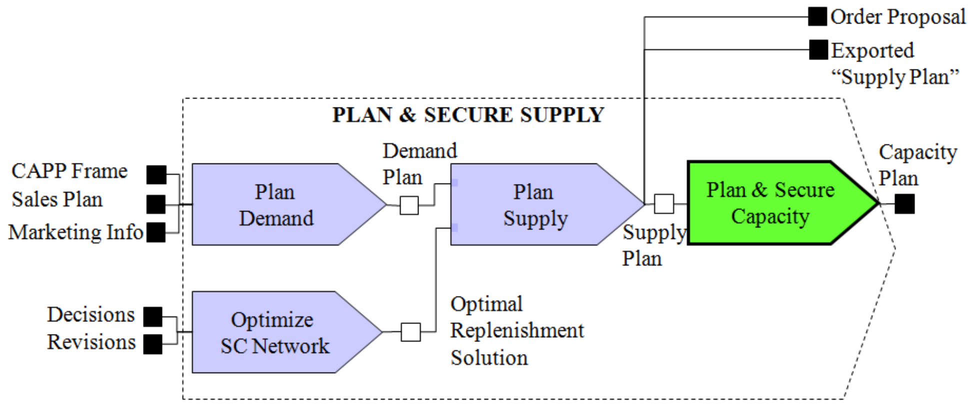

Figure 1. Process map of Plan & Secure Supply

In order to make an as accurate capacity plan as possible high quality in- and outputs are required in the different steps within the processes. One input to Plan & Secure Capacity is the estimated inflow to the selling units. The inflow is measured in volume of products in cubic meter. This input is called *Supply Plan* but has not the agreed quality. To understand the reason why the quality is not high enough it is necessary to understand how this input is estimated. The Supply Plan is, within the sub process *Plan Supply*, calculated from a *Demand Plan*. The Demand Plan is in its turn provided by the sub process *Plan Demand* and is calculated by a "bottom-up" approach. "Bottom-up" means that the future sales in cubic meter for each and every product is forecasted and aggregated up to a total Demand Plan for all products. However, the demand plan for each and every product does not have the desirable high accuracy due to lack of a compiled, high quality forecast including all products.

Therefore, to secure input data, the sub process Plan & Secure Capacity has introduced an activity, called *Secure Input,* which partly complements the two processes Plan Supply and Plan Demand. In this activity, the total Demand Plan is calculated by another approach, which is discussed below. When the Demand Plan in terms of future outflow of products can be estimated with high accuracy, this will contribute to a capacity plan with higher accuracy. An illustration of how the sub processes Plan Demand, Plan Supply and Plan & Secure Capacity are connected to each other within the core process Plan & Secure Supply is shown in Figure 1.[5]

In the activity Secure Input, a “top-down” approach is used to estimate the future sales outflow in cubic meter. In this case, “top-down” basically means that the total sales of all products are converted into the corresponding volume in cubic meter. The starting point of this approach is the sales plan provided by the Group Management. This plan is based on sales plans for all retail countries in local currency, which are compiled, adjusted and converted into euro by using an ex-change rate called GFAR (Group Annual Fixed Rate). By experiences it is known that the Group Management’s sales plan is more reliable than the demand plan. The sales plan then need to be translated into the corresponding volume in cubic meter. This translating procedure requires a conversion factor, which is “average value per cubic meter of all IKEA products” for the forecasted period. However, the average value per cubic meter varies over time, which has to be considered when calculating the conversion factor. Today, no common and agreed way exists of how this conversion from sales forecast into cubic meter should be done. A number of factors that affect the average value per cubic meter are taken into consideration when calculating the conversion factor but there might be other factors to consider instead or as well.[6] For a more profound description of what “top-down” and “bottom-up” means, see Section 4.3.1.1-2.

1.3 Problem discussion

Higher precision when estimating the future sales outflow in cubic meter will contribute to higher precision in the capacity planning, why it is desirable to have an as accurate estimation as possible. Today, in the activity Secure Input, the

[5] Björnsson, Paul (2010-09-30)
[6] Björnsson, Paul (2010-08-10)

estimation of future sales outflow in cubic meter is calculated as illustrated in Formula 1.

Formula 1

$$\frac{Forecasted\ Sales\ Plan\ [Value]}{Conversion\ factor\ \left[\frac{Value}{m^3}\right]} = Forecasted\ outflow\ volume\ [m^3]$$

In order to ensure a high quality estimation of the future sales outflow in cubic meter, high accuracy of the conversion factor needs to be ensured. In this thesis the conversion factor is thoroughly investigated. To ensure high accuracy of the forecasted sales plan is also a prerequisite to ensure a high quality forecast of the future outflow in cubic meter, but that task is outside the scope of this thesis.[7]

For each retail country a specific conversion factor is calculated. This procedure starts by calculating the average value per cubic meter of all IKEA products for the previous 12-months period. This is simply done by dividing the total sales, expressed in local currency, with the corresponding volume in cubic meter for the specific period of time. That average value per cubic meter of an IKEA product then needs to be adjusted with the conditions of next period of time, which in practice means that a forecast of the average value per cubic meter is created, called conversion factor. This procedure is illustrated by equation Formula 2.

Formula 2

$$\left(\frac{Value}{m^3}\right)_y \xrightarrow{Conversion} \left(\frac{Value}{m^3}\right)_{y+1}$$

$$\Longleftrightarrow$$

[7] Björnsson, Paul 2010

$$Conversion\,factor \;=\; \left(\frac{Value}{m^3}\right)_y \; * (Factor_1 * Factor_2 * \ldots * Factor_N)_{y+1}$$

$$= \left(\frac{Value}{m^3}\right)_{y+1}$$

$$N = number\ of\ factors$$

$$y + 1 = Forecasted\ year$$

Today within IKEA, no common and agreed way exists of how the conversion factor should be calculated, which leads to uncertainties of the estimation of the future sales outflow in cubic meter.[8] When estimating the conversion factor a number of factors are taken into consideration but there might be other factors to consider instead or as well.

Among the factors that affect the average value per cubic meter of an IKEA product, the ones that are relevant to consider when calculating the conversion factor have to be distinguished. This leads to the first research question:

1. Which factors should be considered when calculating the conversion factor?

The factors that have been presented in the first deliverable have to be considered in a correct way in order to provide a conversion factor with high accuracy. Therefore, how the factors should be considered is separately investigated. This leads to the second research question:

2. How do the different factors affect the conversion factor?

The effect of the factors must be considered together in a common and agreed way. How this should be done leads to the third research question:

3. How should a model that calculates the conversion factor be designed?

[8] Björnsson, Paul (2010-09-30)

1.4 Purpose

The purpose of this master thesis is to create a model of how the conversion factor could be calculated. The model should contribute to ensure high precision when estimating future sales outflow in cubic meter. The authors of the thesis have no intensions to create a model that gives an exact projection of the reality but that the model should give a good approximation and is easy to grasp and easy to use. The final outcome of the project will be a suggestion of how the conversion factor could be calculated in one common way.

1.4.1 Deliverables

To obtain a systematic research approach that is easy to follow, the purpose is split up into three deliverables, presented below.

The first task is to identify the factors relevant to consider when calculating the conversion factor. A structure of how the factors are related to each other will also be presented. This can be summarised as the first deliverable:

1. A hierarchy of factors that affect the conversion factor.

When the factors have been identified, the impact they have on the conversion factor has to be investigated. How the factors should be taken into consideration when calculating the conversion factor will be presented as the second deliverable:

2. How to consider the effect from the factors.

Which factors and how they should be considered will be presented as well as a common way to consider them in the calculation of the conversion factor. This can straight forward be expressed as the third deliverable:

3. A model of how to calculate the conversion factor.

The model presented can be further investigated and further improvements are possible. Therefore some of the possible improvements will be presented as recommendations of how to improve the accuracy of the conversion factor.

1.5 Delimitations

To narrow down the project to a realistic scope some delimitations have been set.

1.5.1 Part of the Supply chain

The study only considers sales outflow from selling units. A selling unit is a store and its belonging home-shopping through internet or telephone. This means that potential factors that might affect the value per cubic meter earlier in the supply chain, in warehouses or stores are not included. What part of the supply chain that this study considers is illustrated in Figure 2.

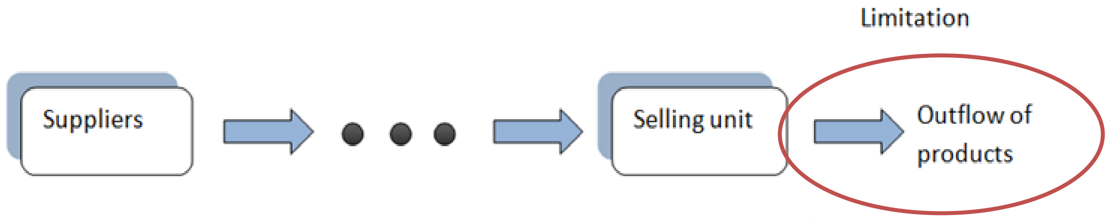

Figure 2. Limitations within the Supply Chain

1.5.2 Volume

This delimitation within the supply chain also brings about a delimitation of what product volume that should be considered through the project. The volume of sales outflow, which is concerned in this thesis, is the volumes of customer packages ready for sale, hence the volume of the product when it leaves a selling unit.

1.5.3 Data

The impact that the identified factors have on the conversion factor would be interesting to investigate with a statistical study, for example a regression analysis. To carry out such a statistical study, measures or estimations have to be available of the different factors included in the conversion factor. It is important that reliable data of the factors are used in the calculation. Within IKEA different data sources exist for some of the measurements and which of the sources are most correct to use when calculating the conversion factor is not entirely clear. Which of the sources to use have to be thoroughly investigated, to guarantee a reliable and high quality statistical analysis. This has, due to lack of time, not been possible to include in this thesis and is therefore excluded from the scope.

1.5.4 Part of IKEA

All 313 IKEA stores are located in 38 countries all over the world.[9] The model of how to calculate the conversion factor presented in this thesis is developed and valid for all the retail countries that are included in the blue group. The countries within the blue group only have stores that are wholly owned by IKEA. The other group, called red group or *ROIG (Retailers Outside the IKEA Group)*, concerns stores that are operated on a franchise basis. To investigate how applicable the model is for the countries within the red group is outside the scope of this thesis.

1.5.5 Accuracy of the model

The authors of the thesis have no intensions to create a model that is an exact projection of the reality but that the model should give a good approximation and increase the precision when estimating the future average value per cubic meter of all IKEA products. A number of factors were considered when calculating the model, but other factors impact as well. An assumption was made that the Pareto rule is valid for the factors, which means that 20 % of the factors corresponds to

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[9] IKEA webpage (c)

80 % of the effect on the average value per cubic meter.[10] The factors that were selected are factors that were interpreted as having the largest impact on the average value per cubic meter. The interpretation of the relationship between reality and the created model is illustrated in Figure 3.

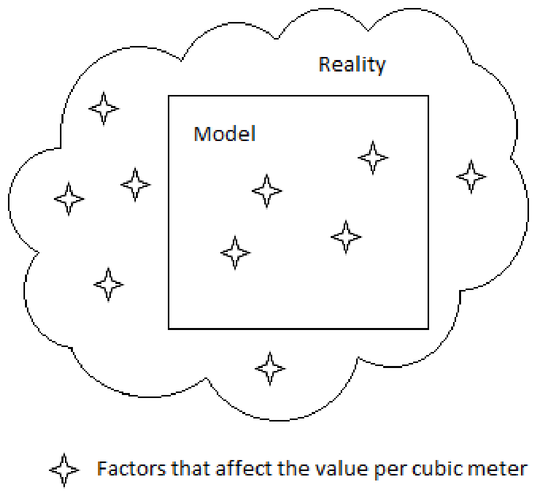

Figure 3. Model vs. reality

1.6 Target groups

First of all, this thesis might be of interest for the people working within and in connection to the sub process Plan & Secure Capacity and might also be of interest for people working within the process Supplying. Second, besides people working for IKEA the thesis can be useful for other persons with an interest of prerequisite steps to capacity planning and for students writing their master thesis.

1.7 Disposition of the thesis

An overview of the disposition is available in this section and the structure of the thesis is presented as well as a short summary of each chapter.

[10] www.businessdictionary.com

Chapter 1 – Introduction

The purpose of this chapter is to provide a background to the problem of this master thesis, an understanding of the problem area and to communicate the purpose of the thesis. The disposition of the thesis and the delimitations are also introduced, as well as a presentation of the target groups and the company.

Chapter 2 – Methodology

This chapter presents the scientific approach for the project and the methods chosen to carry out the different parts of the project. How data was collected, data processing and literature studies will also be discussed. The method of how to evaluate credibility is also presented along with a discussion about the credibility of the study.

Chapter 3 – Empiricism

Initially, this chapter presents the company structure from an overall perspective down to the sub process for which this project concerns. In order to facilitate the understanding of the problem area, there is a focus on capacity planning and the prerequisite for this. This is followed by a description of the factors that were identified to affect the average value per cubic meter of an IKEA product. When no source is specified the information comes from interviews with people working at IKEA.

Chapter 4 – Theoretical framework

To provide a better understanding of the problem area, this chapter presents theory for the study received through literature studies. Initially, overall theory is presented for comparative purposes since the study is of inductive characteristic, and in the latter part of the chapter theory concerning more detailed levels of the project will be presented.

Chapter 5 – Analysis

In the first part of this chapter (5.1), an investigation of whether the factors identified in Section 3.5 should be considered when calculating the conversion factor or not is made. A summary of the chosen factors will be presented as a hierarchical structure and in the second part of the chapter (5.2), how to consider the chosen factors will be discussed. The last part (5.3) presents a model of how the conversion factor could be calculated.

Chapter 6 – Conclusions

The chapter starts with a brief description of the main purpose of this project. This is followed by the conclusions according to the deliverables of the project.

Chapter 7 – Recommendations

In this chapter are, according to the conclusions, the author's recommendations of how to improve the quality of the input to the sub process Plan & Secure Capacity presented.

Chapter 8 – References

Literature, interviewees and electronic sources used to carry out this thesis will be presented in this chapter.

1.8 Terms and definitions

In this Section the expressions and terms that are used in this thesis are explained and definitions will be defined.

1.8.1 Terms

Terms that are used throughout the thesis are summarised below.

HFB	*Home Furnishing Business*. The product range at IKEA is divided into several different HFBs according to the use of the products.
CC or CD	*Cash and Carry* or *Customer Direct*. These two terms concern the way the products are distributed. CC is

products sold in store and CD is products sold through internet or telephone.

GFAR — *Group Fixed Annual Rate*. An average exchange rate used to translate local currencies into the group currency, euro.

Retail country — A country where IKEA has stores.

Selling unit — Either a store or home-shopping unit.

FY — *Fiscal year*. Stretches from the 1st of September to the last of August.

Conversion factor — Forecasted average value per cubic meter of all IKEA products for a specific period of time.

Satellite & Furniture — The furniture group includes all furniture and lager items. The satellite group includes all smaller, cheaper products such as complementary products etcetera.

1.8.2 Definitions

A distinction needs to be pointed out between the *conversion factor* and *average value per cubic meter of an IKEA product*. In this project, the conversion factor is a forecasted average value per cubic meter of all IKEA products that is used when converting the Group Management sales forecast into outflow volume in cubic meter. The unit "average value per cubic meter of an IKEA product" can be calculated for different groups of products and does not necessarily need to include all the IKEA range. When the value per cubic meter occurs in other contexts, not referred to as the conversion factor, the total sales divided by the corresponding volume in cubic meter for a specific time period and a specific group of products is regarded.

2 Methodology

This chapter presents the scientific approach for the thesis and the methods chosen to carry out the different parts of the project. How data was collected, data processing and literature studies will also be discussed. The method of how to evaluate credibility is also presented along with a discussion about the credibility of the study.

2.1 Methodology approach

The methodology is the fundamental working approach for a study. Different approaches concern various analytical depth, such as just to describe a certain situation or to identify relationships between variables within the study. The working approaches are listed below after increasing level of analytical depth. [11]

- Exploratory
- Descriptive
- Explanatory
- Predictive
- Normative

The purpose of an exploratory study is to map the current situation within an area where no or little knowledge exists. The result of an exploratory study should identify what is relevant to further investigate. A descriptive study will more carefully describe the characteristics of a specific area and its surrounding. If the purpose of the study is to answer the question *why* the methodological approach is explanatory and contains deeper descriptions of causes and relationships within the problem area. Predictive research shall, with good knowledge of the problem area, make a prediction about the future in form of, for example, likelihood of certain outcomes. The outcome in a predictive study can depend on conditions or decisions to be made. A normative study aims to develop a solution to a certain

[11] Nilsson, B. (2010-09-02)

problem and can also consist of an action plan for implementation of the solution. [12,13,14]

2.2 Data processing

Data used for a study can be quantitative or qualitative. In quantitative data, events are measured by numbers, while qualitative data consist of words and descriptions. Different analyzing methods are suitable depending on which type of data it concerns. Quantitative data is often received through for example surveys while qualitative data is commonly received through interviews and observations. [15, 16]

Data can also be divided into primary or secondary data. Primary data is information that has been collected directly for the study and secondary data is information that originally has been collected for another purpose. Examples of primary data are surveys while secondary data is literature and other written material. [17]

2.2.1 Interviews

An interview can be prepared differently depending on the purpose of the interview. The interviews can be structured, semi structured or unstructured.

A structured interview has a lot of resemblance with a survey since all the questions already are strictly formulated and a limited number of answering alternative are available. These interviews are often used when a large number of respondents are interviewed with the same set of questions.

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[12] Björklund, M. & Paulsson, U. (2003) p. 58
[13] Höst, B. Regnell, P. & Runesson, P. (2006) p. 29
[14] Nilsson, B. (2010-07-21)
[15] Björklund, M. & Paulsson, U. (2003) p. 63
[16] Denscombe, M. (2009) p.320-321
[17] Björklund, M. & Paulsson, U. (2003) p. 67-68

For semi structured interviews, the topics and questions are also prepared in advance, but are formulated in a flexible way. The interviewee can therefore talk more freely about the subject and elaborate on his or her point of view.

The purpose of unstructured interviews is to an even larger extent to allow the interviewee to develop his or her point of view. A topic is introduced by the interviewers, but the interviewee can then fully communicate his or her reasoning.[18]

2.2.2 Literature studies

Literature is secondary data since the information is written for another purpose. It is also qualitative since the content is communicated through words and descriptions. When using literature studies it is important to keep in mind that the information can be angled or not describing the whole picture.[19]

2.3 Quantitative or qualitative studies

For a quantitative study the main purpose is associated with analysis with a specific focus, based on numerical data. The research design for quantitative studies tends to be predetermined. When doing qualitative studies the research design instead tends to be very flexible and the selection of parts included in the study will be determined during the research. A qualitative study usually describes a specific situation in words which makes it more difficult to do generalizations.[20, 21]

2.4 Induction and deduction

Different approaches exist for the relationship between theory and empiricism in a study, these are *inductive* and *deductive*. An inductive study starts by investigating reality. When the situation is thoroughly described general patterns

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[18] Denscombe, M. (2003) p.231-235

[19] Björklund, M. & Paulsson, U. (2003) p. 67

[20] Denscombe, M. (2009) p. 321-325

[21] Björklund, M. & Paulsson, U. (2003) p. 63

are identified to form new theory. Since the new theory is based on observations a level of uncertainty is introduced. In a deductive study existing theories are first studied and used to make predictions about reality. The conclusion of a deductive study can either reinforce or reject the theory.[22, 23]

2.5 Credibility

Credibility in a study concerns its overall trustworthiness. In order to achieve high credibility it is essential to have high *reliability*, *validity* and *objectivity*. These criteria of evaluation also concern the sources and data used in the study. To ensure high credibility of the sources these are critically reviewed. [24]

2.5.1 Reliability

Reliability concerns the trustworthiness in data collection and analysis made according to stochastic variations. A study has high reliability if the same result is achieved if the study is repeated. The reliability could be increased by for example the use of control questions where the interviewees' opinions get confirmed. A visual interpretation of poor reliability is shown in Figure 4, where high reliability is represented in the center. [25]

Figure 4. Illustration of reliability.

[22] Björklund, M. & Paulsson, U. (2003) p. 62
[23] Bryman, A. (2009) p. 20-24
[24] Björklund, M. & Paulsson, U. (2003) p. 59-61
[25] Björklund, M. & Paulsson, U. (2003) p. 59-61

2.5.2 Validity

The term validity concerns the methods chosen for the study and whether these cover the intended areas and to what extent they represent the reality. In other words to what extent what is intended to be measured actually is measured. To increase the validity the measurement can be investigated through different perspectives.[26] A visual interpretation of poor validity, but high reliability, is shown in Figure 5. Illustration of poor validity but high reliability.

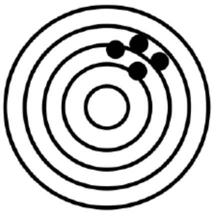

Figure 5. Illustration of poor validity but high reliability.

If both high reliability and high validity is achieved the illustration can be interpreted as in Figure 6. Illustration of high reliability and high validity. [27]

Figure 6. Illustration of high reliability and high validity.

2.5.3 Objectivity

The definition of *objectivity* is to what extent personal values affect the study. High objectivity means that the study with a high probability does not contain any

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[26] Denscombe, M. (2009) p. 425
[27] Björklund, M. & Paulsson, U. (2003) p. 59-61

factual errors or distorted data sample. If the procedure of the study is clearly and detailed described and motivated the objectivity increases.[28]

2.6 Methodology chosen

The methodology chosen for this study is discussed in the following section. The overall purpose of this thesis was to create a model of how to calculate the conversion factor, which will give an approximation of the future average value per cubic meter of an IKEA product. The study contains three research parts defined as three research questions, presented in Section 1.3. In some cases different approaches are used for the different parts of the research, which will be mentioned when discussing the concerned approach or method.

2.6.1 Scientific approach

Different scientific approaches have been chosen for the three different research parts, since the purposes of the parts are different.

The purpose of the first part of the study was to identify relevant factors that affect the conversion factor. This part of the study has an exploratory approach since the purpose was to identify factors and explore what can affect the average value per cubic meter, hence the conversion factor. The result was used as a starting point for further investigation.

The purpose of the second research question was to give a closer description of the factors that were identified in the first step of the study, and how these individually affect the conversion factor. Since the purpose of this part of the study was to describe the characteristics of the identified factors and how they affect the conversion factor, the research approach for this part is descriptive.

The last research question concerns relationship between the identified factors and how these can be considered in a common way when calculating the

[28] Björklund, M. & Paulsson, U. (2003) p. 59-61

conversion factor. Since the purpose of this part was to design a model that considers the identified factors and the relationships between them, this part has an explanatory research approach.

2.6.2 Data processing

The study is based on interviews and literature studies. The main part of collected information was received through interviews with people working at IKEA in order to identify relevant factors and how to consider these factors. Interviews are qualitative data, since they consist of word and descriptions. Since the interviews have been designed for this specific study this data is primary. All interviews have been semi structured, enabling the interviewee to express his or her thoughts and reasoning concerning the area of study.

Literature studies have been carried out to enhance the knowledge of planning within companies, especially prerequisite steps to capacity planning, but also to sort out how to consider some of the different factors in the conversion. These studies are classified as qualitative and secondary data.

2.6.3 Qualitative or quantitative study

For this project the research design was not predetermined, since little knowledge about which factors should be considered were available. The research design and scope of the thesis was instead adjusted along the process. The purpose of the study was also to describe causes and relationships between the identified factors and to do a description of these relationships, which in some cases were described most generically in formulas. Since the design of the study was not predetermined, the purpose of the thesis was to describe the situation in words and no actual calculations were done, the study is qualitative.

2.6.4 Inductive or deductive study

The purpose of this study was to first of all investigate which factors affect the conversion factor. With this starting point, the factors were thoroughly investigated in order to design a model that considers all the relevant factors. In other words, the starting point of the study was to investigate reality in order to detect relationships and patterns of which factors that affect the conversion factor. This resulted in a formula which the authors do not claim gives a perfect projection of the future average value per cubic meter of an IKEA product but a satisfying approximation, defined as conversion factor. Since general patterns are used to identify and form theory, even though this theory is not said to be exhaustive, the study is inductive.

2.6.5 Credibility

The reliability of the study concerns the trustworthiness in data collection and analysis made according to stochastic variations. In other words, the probability that the same result would be achieved if the study was repeated. Since the study mainly is based on interviews, the reliability of these and how they were carried out sets the reliability of the study to a large extent.

Semi structured interviews have been used in this study, so the interviewee was given an opportunity to express their thought concerning the problem area. Control questions were used during the interview to ensure that the answers were correctly interpreted. Directly afterwards a summary was written of the interview and, in cases of uncertainties about the received information, the summary was sent to the interviewee for confirmation. At each interview two interviewers were present to minimise the impact of subjectivity when summarising the interview afterwards. These actions have reduced the risk of misunderstandings and the impact of subjectivity, but the risks are of course not eliminated. This implies that there is a possibility that other results can be achieved if the study was repeated.

Validity concerns to what extent what is intended to be measured actually is measured. The purpose of the thesis was to investigate factors that affect the conversion factor. The authors do not claim to create a model that is a perfect projection of the future reality but an approximation that is easy to grasp and easy to use. Therefore it is included in the scope of the thesis that the model designed to calculate the conversion factor is not exhaustive. There are surely more factors that can be considered and further improvements of the model are possible.

High objectivity means that the study with a high probability does not contain any factual errors or distorted data sample. One risk when doing interviews is the selection of interviewees. When choosing the group of people to interview it is important to choose a selection from the population that all together covers the whole area that is investigated, so that the interviews do not give a twisted result. To ensure that relevant people were interviewed, several interviews were in some cases done concerning the same area.

2.6.6 Criticism of sources

A large part of the basic understanding was received through interviews. 18 persons working for IKEA were interviewed in order to gain knowledge about the organization of IKEA in general and about the conversion from sales forecast to volume of products especially. Since the perception of the social reality is partly subjective this can jeopardise the trustworthiness of the information received through interviews[29]. To increase the trustworthiness, all interviews were held by two interviewers to minimize the risk of misunderstandings. If vagueness occurred after the interviews a description of the interpreted outcome were sent to the interviewee for confirmation.

The literature studies can be seen as sources with high credibility since only literature recommended from the university have been used. Also literature provided by IKEA has been studied, but since this literature already is accepted as reliable from IKEA the authors do not have suspicions against these sources.

[29] Bryman, A. (2009) p. 257-261

3 Empiricism

Initially, this chapter presents the company structure from an overall perspective down to the sub process which this project concerns. To facilitate an understanding of the problem area, there is a focus on capacity planning and the prerequisite for this. This is followed by a description of the factors that were identified to affect the average value per cubic meter of an IKEA product. When no source is specified the information comes from interviews with people working at IKEA.

3.1 Processes within IKEA

To understand where in the organization this project can be of use the overall structure of the organisation will be explained in this section. Earlier IKEA was divided into functions, but in the beginning of the 21st century a transformation towards a more process oriented way of working was initialized. The transformation is ongoing and today IKEA is divided into both functions and processes. Three processes cover the main activities within IKEA and are illustrated in Figure 7.

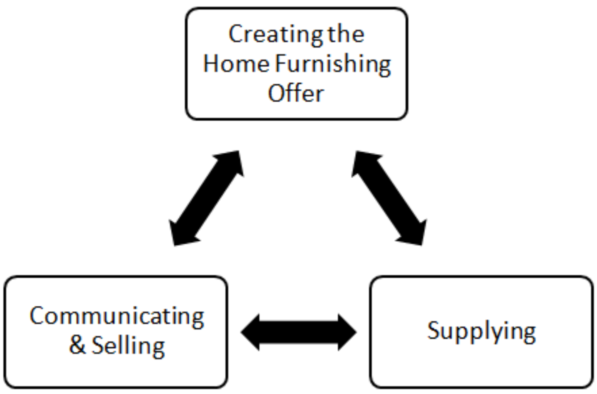

Figure 7. Level 0: Main processes within IKEA.

A short description of the main processes follows below.

- *Creating the home furnishing offer*
  - Responsible for creating and developing the product range.
- *Supplying*
  - Responsible for making the range available for the customers.
- *Communicating & selling*
  - Responsible for communicating the product range to the customers in the store, catalogue or other media.

This project concerns a sub process within the main process Supplying. Supplying is responsible for buying, producing and distributing the IKEA range. This should be done at lowest total cost, with a high customer experienced quality and under good social and environmental conditions.[30] On process included within *Supplying* is Plan & Secure Supply which is further divided into four sub processes, *Optimize Supply Chain Network, Plan Demand, Plan Supply* and *Plan & Secure Capacity.* This project is performed at the request of Plan & Secure Capacity and an illustration of where Plan & Secure Capacity is found within the process Plan & secure Supply is shown in Figure 8.[31]

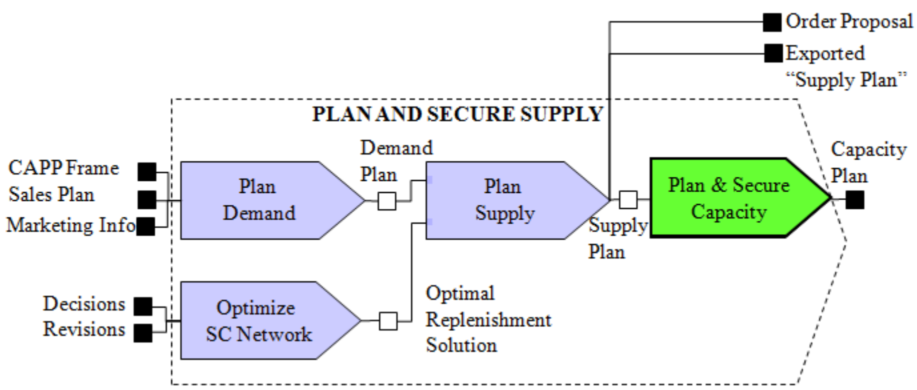

Figure 8. Level 2: Sub-processes within Plan & Secure Supply

[30] Dahlberg Hilldén, A. & Wittrup, A. (2010) p. 26
[31] Björnsson, P. (2010)

3.1.1 The business idea of IKEA

The business idea of IKEA is to offer a wide range of well-designed, functional home furnishing products at prices so low that as many people as possible will be able to afford them.[32] A customer buys a product if he or she finds some kind of value of the product. Key Performance Indicators (KPIs) could measure how capable IKEA is to add value to the products. Within IKEA an important KPI is *Service level* which basically is the same as availability of the products[33]. To achieve high availability it is first of all essential to estimate the demand of the products. The goal is then to meet the demand in an as satisfying way as possible. A prerequisite to meet the demand is to use the recourses in terms of storage areas in an as efficient way as possible. This means that the storage areas like *Distribution centrals* must have the possibility to supply the stores with the demanded quantity within a limit of time. This could be seen as a procedure of adding value to the product which is explained by if, for example, a toilet brush is available for the price of 5 SEK a lot of customers will buy it. If the store on the other hand is out of toilet brushes, none toilet brushes will be sold. Consequently one can say that value could be added to this product by availability. According to Matsson & Jonsson 2003, the extent of how capable a company is to use its recourses to add value is called capacity, which is explained in Section 4.3.

3.1.2 Plan & Secure Capacity

It is the process Plan & Secure Capacity that is responsible for providing a capacity plan for IKEA. In the process there are three levels of planning, Short, Mid, and Long Term Capacity Planning. The Long Term Planning has the longest planning horizon and spans over a period of five years. The issues concerning Long Term Planning are for example decisions about investments in new facilities. The planning of the nearest future is done in the Short Term Planning. The Short Term Planning is basically made for operational decisions. In between the Long and

[32] IKEA webpage (b)
[33] Dahlberg Hilldén, A. & Wittrup, A. (2010) p. 30

Short Term Planning IKEA uses Mid Term Capacity Planning to, for example, plan its capacity of transports, central warehouses and goods receptions at stores for the nearest 84 weeks. [34] This project is focused on the Mid Term Capacity Planning which reminds of Sales and Business Planning which concerns the planning horizon 1-2 year and is described in Section 4.2.2. An illustration of the activities within Mid Term Capacity Planning is provided in Figure 9.

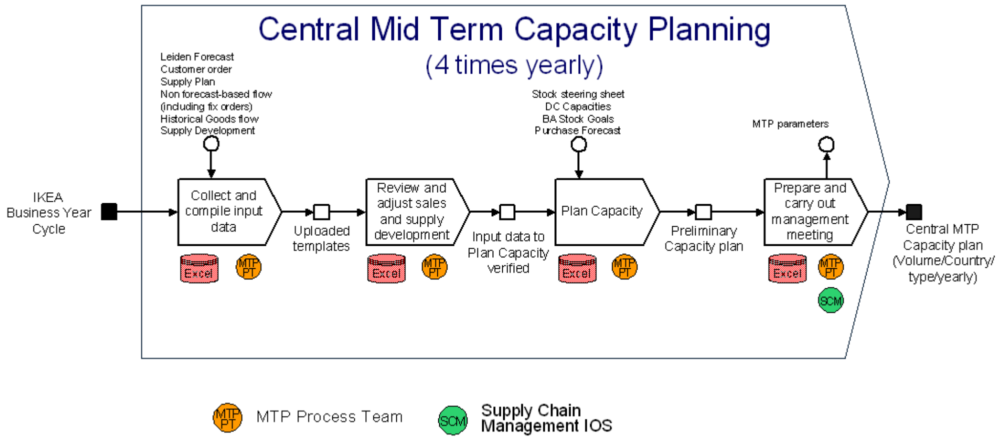

Figure 9. Mid Term Capacity Planning

3.2 Prerequisite to the Capacity planning

The purpose of this project is, as explained in Section 1.4, to create a model of how the conversion factor could be calculated. The conversion factor is an average value per cubic meter of all IKEA products for a future period of time and should be used to estimate the future sales in cubic meters, called sales outflow. The future sales outflow is then, among other, a prerequisite to IKEA's capacity planning.

A large part of capacity planning is to estimate the capacity need. In order to determine the capacity need, the outflow of products has to be estimated. When the outflow has been estimated, the capacity need can be calculated, which

[34] Sunesson, B. (2010-07-21)

makes it possible to start with the capacity planning. The most commonly used method to plan capacity is to use the method "Capacity plan based on production units" which is described in Section 4.3.1.1. That method could be seen as a "bottom-up" approach of calculating the capacity need. IKEA is today also using a bottom-up approach to calculate the future sales outflow in cubic meter which means that the forecasted sales for each and every product is aggregated to a total sales plan. But due to low level of completeness and accuracy of the forecasted sales plan for each and every product this method will not give totally reliable results[35]. Therefore, within IKEA in the process Plan & Secure Capacity, a "top-down" approach is used when calculating the sales outflow in volume, as mentioned in Section 1.1. This means that a total forecasted sales plan from Group Management for all products is converted into the corresponding volume. To do this conversion a conversion factor is needed which is an average value per cubic meter of all IKEA products for a determined period of time. The conversion is illustrated by Formula 1

Formula 1

$$\frac{Forecasted\ Sales\ plan\ [Value]}{Conversion\ factor\ \left[\frac{Value}{m^3}\right]} = Forecasted\ outflow\ volume\ [m^3]$$

The input data needed for this conversion is "Forecasted sales plan" and "Conversion factor". "Forecasted sales plan" is set by Group Management and the "Conversion factor" is calculated in the process Plan & Secure Capacity. This conversion factor is what this project focuses on.

The forecasted sales plan is the net sales in nominal terms, which means that it is the actual sales after discounts and sell-outs.

[35] Björnsson, P. (2010-08-10)

3.3 The Conversion factor

To forecast the average value per cubic meter of an IKEA product, the conversion factor, it is necessary to consider all factors that might affect the value per cubic meter. Further on in this chapter, factors that will affect the average value per cubic meter of an IKEA product are presented. The factors have been identified by interviewing persons with good knowledge about the IKEA organisation.

Since the unit of the conversion factor is *value per cubic meter*, all identified factors must affect either *the value, the volume* or both *the value and volume* of a product. The factors can therefore be sorted into these three different groups.

The available data that concerns the factors are in some cases forecasted goals and in other actual results. Which of the factors that affect the conversion factor is analysed in Section 5.1, how to consider these factors when calculating the conversion factor is analysed in Section 5.2 and a model of how to calculate the conversion factor is presented in Section 5.3. The credibility among other issues about the factors, whether they are a result or a goal, is discussed in Section 5.3.1.

3.4 The conversion factor today

Today when the conversion factor is calculated, the procedure starts by dividing the sales from the previous 12-months period into two groups of products. This grouping is based on the distribution channels, which are products that are bought from store, called *Cash & Carry (CC)*, and products that are bought through home-shopping, called *Customer Direct (CD)*. The grouping is motivated by the difference in product range for the products that pass through the two distribution channels. This is further explained in Section 3.5.1.3.

Then the value per cubic meter for the previous 12-months period is calculated for the two distribution channels. The values per cubic meter are then adjusted by the factors that are assumed to affect the value per cubic meter for the forecasted period of time. These factors are *price investments*, *price adjustment* *changes* and *density improvements*. Price investments are explained in Section 3.5.4.1. Density improvements are improvements that concern volume changes and are further described Section 3.5.2. Price adjustment changes are the difference in price adjustments from the last year and the forecasted year and are described in Section 3.5.4.2. An illustration of this procedure is given by Formula 3 and Formula 4. The Conversion factor is set in net value per cubic meter in nominal terms.

Formula 3

$$Conversion\ factor_{CC} = \frac{CCvalue_{y,GFAR_{y+1}}}{m^3} * (1 + (PI + PAC + DI))_{y+1}$$

Formula 4

$$Conversion\ factor_{CD} = \frac{CDvalue_{y,GFAR_{y+1}}}{m^3} * (1 + (PI + PAC + DI))_{y+1}$$

$$CCvalue_{y,GFAR_{y+1}} = CC\ sales\ for\ year\ y\ expressed\ in\ the\ GFAR\ y+1$$

$$CDvalue_{y,GFAR_{y+1}} = CD\ sales\ for\ year\ y\ expressed\ in\ the\ GFAR\ y+1$$

$$PI = Price\ investments$$

$$PAC = Price\ adjustment\ changes$$

$$DI = Density\ improvement$$

$$GFAR = Group\ Fixed\ Annual\ Rate$$

$$CC = Cash\ \&\ Carry = range\ distributed\ through\ stores$$

$$CD = Customer\ direct = range\ distributed\ through\ home\ shopping$$

$$y + 1 = Forecasted\ year$$

In Table 1 and

Formula 5 follows a fictive example of how the conversion factor is calculated for the products that go through the distribution channel CD.

Table 1. Example of how the conversion factor is calculated for the products that go through the distribution channel CD.

CD	
$Year\ y$	
Actual sales (€)	1 000 000
Actual volume (m^3)	9 000
$Year\ y+1$	
Price adj. Changes	– 1 %
Price investments	– 2%
Density improvements	+2 %

Formula 5.

$$Conversion\ factor_{CD} = \frac{value_{y,GFAR_{y+1}}}{m^3} * (1 + (PI + PAC + DI))_{y+1}$$
$$= \frac{1\ 000\ 000}{9\ 000} * \big(1 + (-0.01 - 0.02 + 0.02)\big) = 109.99\ €/m^3$$

3.5 Factors identified

The factors that affect the average value per cubic meter of a product were identified through interviewing people within IKEA. These factors are first presented in a hierarchical structure in Figure 10 and then further investigated factor by factor.

Since the conversion factor has the unit value per cubic meter, all factors that theoretically affect the conversion factor must affect either the value, volume or both value and volume, as mentioned in Section 3.3. Therefore all factors are sorted within these three different groups: *value, volume* and *value & volume,* depending on how they theoretically affect the average value per cubic meter of a product. All factors are expected to affect the average value per cubic meter but, due to different reasons which are explained in Section 5.1, some factors will not be considered when calculating the conversion factor.

Within these three groups a secondary level was introduced, showing the groups of factors that were identified within IKEA. Factors that were identified to affect the volume of customer packages are found within the group *Density improvements*. Factors that are expected to affect the value of the products are divided into the groups *Macro* and *Micro economic factors*. The group *Product range factors* are factors that are expected to affect both the value and volume.

A description about the actual factors that were identified and sorted into the hierarchy will follow in this chapter. If the effect of the factors should be considered when calculating the conversion factor is discussed in Section 5.1 and, in that case, how this can be done in practice, will be discussed in Section 5.2.

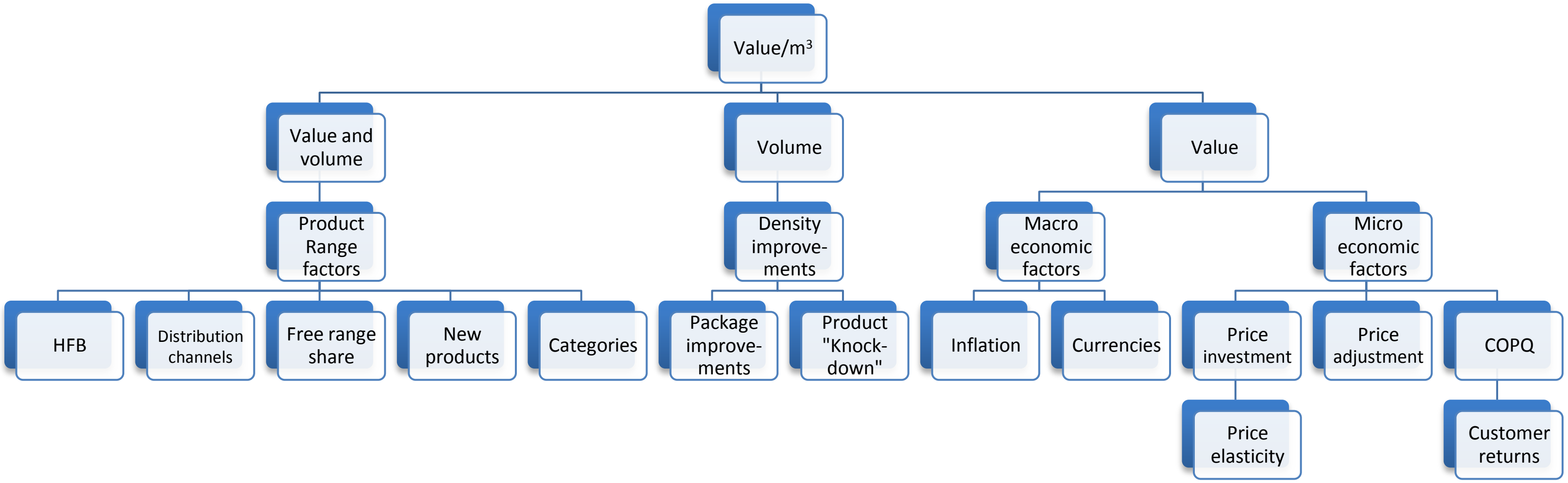

Figure 10. Hierarchical breakdown of identified factors that affect the value per cubic meter for an average IKEA product

3.5.1 Product range factors

The definition of product range factors is changes of IKEA's product range. An example of this is when new products are introduced and some old ones are phased out. It could also be when the revenue of some products or product groups increases or decreases.

All products have a unique value per cubic meter. A change of the product range will therefore obviously contribute to a change of the average value per cubic meter of a product. So, if changes are introduced within the IKEA product range from one period of time to another, the average value per cubic meter of all products will be affected. This can be illustrated by an example: If IKEA decides to include a large amount of silver cutlery in the range, which normally has a high value per cubic meter, this will increase the average value per cubic meter.

Within IKEA a division is made between two types of products, called satellite and furniture. The furniture group includes all furniture and larger items. The satellite group includes all smaller, cheaper products such as complementary products etcetera. Since the average value per cubic meter for the two groups of products often are very different, the mix between furniture and satellite will have a significant impact on the average value per cubic meter of a product group. How this effect will affect the total, average value per cubic meter and how this effect can be considered will be discussed in Section 5.1.1.

3.5.1.1 New products

IKEA has a quite high product renewal rate per year. Many of the new products are however not entirely new, but could be just a change in colour or material from an existing product in order to lengthen the product life cycle. A rule of thumb is that all product changes that make the customer experience a difference of the product require that the product is given a new article number.

3.5.1.2 Home Furnishing Businesses

The product range at IKEA is divided into several different *Home Furnishing Businesses* (HFB), which group the products together according to use.

Depending on what products are included in the HFB, the average value per cubic meter of a product within the HFB will also vary. The range of some HFB includes more furniture while other mainly consist of satellite products. The revenue for the different HFBs also varies, making the proportion in size between the HFBs different. In order to follow the overall development of the different HFBs, the revenue from each country and for each HFB is summarised into total revenue for each HFB.

The changes of revenues are affected by range strategies as well as changes in buying behaviour. IKEA makes forecasts of how much each HFB will increase or decrease its revenue in relation to IKEA´s total revenue. In each HFB a plan is set of how this change of revenue should be achieved. Revenue is affected either by a change of the sales volume, in other words the number of sold products, or by a change in price of the products. Since the business idea of IKEA has a strong focus on being as cheap as possible the price is unlikely to be increased.[36] This implies that to increase the revenue IKEA needs to sell more products. To sell more products the HFBs usually starts an intensive product development or lower the prices, and by that increase the number of sales. The latter, to lower prices to increase revenue, is called price elasticity and is discussed in Section 3.5.4.1.1.

Each HFB also has a specific division of products that are included in the CC and CD range. The CC and CD range is more detailed described in the following section.

[36] IKEA webpage (b)

3.5.1.3 Distribution channels

The IKEA organization has two ways of distributing the products, either through Cash & Carry (CC) or Customer Direct (CD). CC concerns all products that are purchased by customers in stores and CD concerns all products purchased outside the stores, and then delivered directly to the customer. This is called home-shopping and includes sales through internet and telephone ordering.

The average value per cubic meter of a product for the CC and CD range differ since the composition of products in the sales outflow of the two distribution channels are different. The difference in product mix for the CC and CD range depends to a large extent on strategic decisions, such as what products within the total IKEA range that should be available in the CC and CD range.

As mentioned in Section 3.5.1 the IKEA range has been divided into two types of products, called furniture and satellite. The CD range today only offers furniture, but earlier satellite products were also available. The reason why satellite products are excluded today is that the profit for the smaller, cheaper satellite products does sometimes not cover the picking cost or at least gives a too low profit. Almost all of the products within the IKEA range are available in the CC range, with a few exceptions. The exceptions are for example kitchen countertops that have to be cut to the right size after the order has been made, before they are sent to customer.

According to some of the interviewed persons there are deliberate actions, expressed by the company founder Ingvar Kamprad, to increase the revenue of the products provided by CD. This is going to be realized trough marketing initiatives and other activities to promote home-shopping.

3.5.1.4 Categories

All IKEA products are divided into different material areas depending on the raw material of the product. The material areas are then divided into categories which are areas to where a business could be addressed. The categories are in turn divided into segments. An example of this breakdown is *Coloured textile carpets* which is the name of the segment that goes under the category T*extile carpets* which is included in the material area *Textiles*. Each category has a category leader that is responsible for the capacity of the category.

The categories are used in the purchase process and act as link between suppliers and HFBs. This means in practice that the category leaders plan their capacity for each segment with input from the suppliers and then the HFBs can address their needs to the specific category segment. To further describe this, one can say that each HFB could have products from all categories.

The categories were introduced in order to centralize the purchases to get the advantage of economy of scale but also to avoid competition between different business units within IKEA when many HFBs were dealing with the same supplier. Each category has a specific average value per cubic meter which is expressed in Purchase Agreement euro per cubic meter, [PuA €/m^3].

3.5.1.5 Free range

The free range is a part of the IKEA range that aims to satisfy local differences in demand and to support stores with a local range. The range should be complementary to the ordinary range at IKEA stores and provide the stores with products relevant for the local markets. Typical products provided by the free range are chopsticks in China and cheese graders in Sweden. Another part of the free range is *Time restricted offers* (TRO).

The free range as it is today has only existed about two years, but the concept of local range has existed before in a less organized manner. Since these products only consider local range the planning horizon is very short. This part of the range does not have any product development, which means that all products are bought from external suppliers. No forecasting is used today but this is under development and is approximated to be ready for use sometime during the late autumn of 2010. The free range stretches over all HFBs and is also included in the range at each HFB.

3.5.2 Density improvements

The definition of *density improvements* is improvements that concern the volume of the sold product, the customer package. An improvement means that the customer package is decreased in volume. A decrease in volume can be achieved in two ways, either by more effective package solutions or by a “knock-down” of the product. Density improvements concern all products and are measured in the unit value per cubic meter.

3.5.2.1 Package improvements and “knock-downs”

A package improvement is when a product is packed in a smarter and more efficient way so that the customer package is decreased in volume. This could sometimes lead to dramatic changes of how many units that can be stocked on a pallet. For example if a package has the dimension $600 * 210 * 210$ mm $(length * width * height)$ it is possible to stock 6 units on each layer of an EU-pallet $(1200 * 800\ mm)$. If however a smarter package is developed that reduces the width by 10 mm so that the new dimension are $600 * 200 * 210$ it is then possible to stock 8 units on each layer of an EU-pallet. The number of units that can be stocked on the pallet is consequently increased by $33\ \%$. The volume of the package is however only reduced by $5\ \%$. This example is illustrated in Figure 11. In a logistic point of view the improvement of how many units that could be stocked on a pallet is of the biggest interest. But due to the limitations of this master thesis, which is that only the volume of customer packages is investigated, it is only interesting to consider the improvement of the customer package.

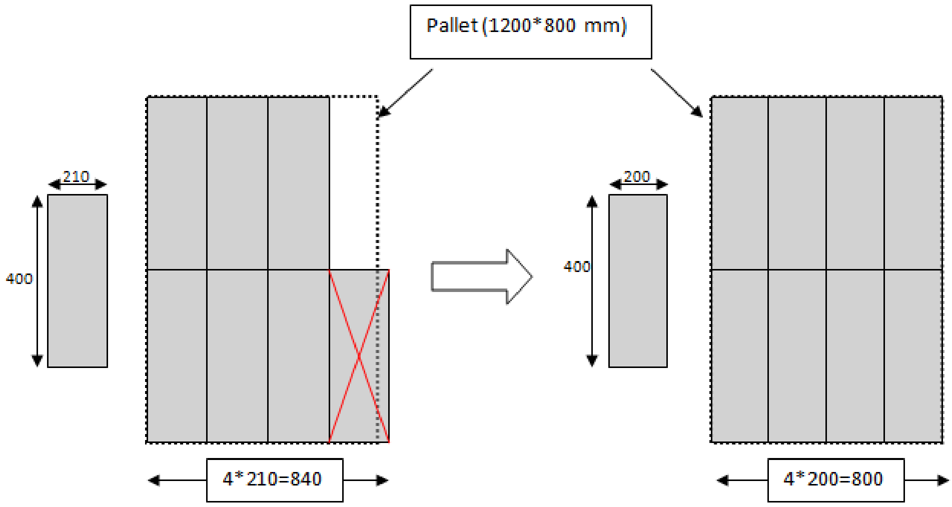

Figure 11. Illustration of a packaging improvement that enables more products per pallet.

Even if package improvements only concern existing products, why is explained in Section 5.1.1.1, the most successful package solution could be achieved in the product development phase, if there is a high level of interaction between the designer, constructor and the package developer. This since consideration of how the product could be packed could be taken already in the design phase.

A “knock-down” is when a product is sold disassembled and the assembly is left to the customer. Both these approaches, more effective package solutions and “knock-downs”, have the purpose to minimize the air inside packages. In 2001 IKEA started a project called “Air hunt” which focuses on, as the name indicates, minimizing the air inside the packages. As a consequence of that project IKEA today, only by volume improvements, strives to increase the average value per cubic meter of all products. After interviewing people at IKEA, relevant for this factor, it seems like there are a high credence to the goal set and most people thinks it is a realistic goal that today is achieved.

3.5.3 Marco economic factors

The macro economic factors that this study investigates are *inflation* and *currencies*.

3.5.3.1 Inflation

All forecasted sales plans are in nominal terms excluding sales tax. Nominal terms mean that a future price of a product is set in the actual price.

3.5.3.2 Currencies

Today, the forecasted sales plan from the Group Management exists in both Euro, which is the agreed Group currency, and the local currency for each country. However, the actual sales in each retail country are in the local currency. To convert money from one currency into euro IKEA uses an ex-change rate called GFAR (Group Fixed Annual Rate) which is a fixed rate over one year. For example is GFAR09 the ex-change rate that was used during the entire FY09. A specific GFAR can also be used when setting forecasts for several years ahead, for example could in 2011 GFAR11 be used to capitalize the sales for 2014. The conversion factor is today expressed in Euro. The author's suggestion about whether the conversion factor should be expressed in Euro or the local currency is analyzed in Section 5.1.3.2.

3.5.4 Micro economic factors

The identified micro economic factors are *price investments*, *price adjustments* and *Cost of Poor Quality.*

3.5.4.1 Price investments

One of the tools that IKEA uses to increase its total revenue is to decrease prices. This, to increase revenue by decrease price, is called price elasticity and is described in Section 4.4.1. A decrease in price is, within IKEA, referred to as an investment in price. Therefore, decreases in prices of different products are called price investments. A price investment of a product means that the catalogue price of a product is lower than what it was the previous year. IKEA calculates the total price investments of all products by comparing the catalogue prices for the forecasted year to the catalogue prices for the previous year. It is the actual price in nominal terms that are compared and price investments are therefore a result of the annual price setting. The procedure of how price investments are calculated is illustrated in Formula 6.

Formula 6

$$Price\ investments = \frac{\sum_{i=1}^{N}((price_i)_{y+1} * q_{i,y+1})}{\sum_{i=1}^{N}((price_i)_{y} * q_{i,y+1})} - 1$$

$$N = Number\ of\ products$$

$$price_i = Catalogue\ price\ for\ product\ i$$

$$y + 1 = Forecasted\ year$$

$$q_i = Quantity\ of\ product\ i$$

This factor is clarified with an example. If the price investments are calculated to $-1.5\ \%$ the prices of IKEA's products will in average be decreased by $1.5\ \%$ in nominal terms. Nominal terms mean that a future price is set in the actual price. Since it is expressed in nominal terms the decrease in price, with a normal inflation around $2\ \%$, is in real terms even bigger ($\approx 3.5\ \%$).

Even if price investments are a result there is one uncertainty around this calculation which is the estimation of the variable q, in Formula 6. Discussion of this uncertainty is provided in Section 5.3.1.2.

3.5.4.1.1 Price elasticity

Price elasticity is not considered when calculating the conversion factor today, as mentioned in Section 3.4, but has been identified as a potential factor to include. A master thesis has been carried out within IKEA concerning price elasticity in order to investigate the potentials for using this as a pricing tool. The thesis concludes that price has a significant impact on sales volumes and that for 34 % of the 240 articles included in the study, a price investment leads to a higher proportional increase in sales volume.[37] In the pricing procedure at IKEA a rule of thumb is that all decreases of price should lead to an increase in sales quantity of 3 times the price decrease. This means that if the price of a product is decreased by 1 % the expected sales quantity should increase by at least 3 %. Since revenue is calculated as $price * quantity$ this means that the revenue is increased by approximately 2 %, see Formula 7.

Formula 7

$$Revenue_{y+1} = 0{,}99 * price_y * 1{,}03 * quantity_y = 1{,}0197 * revenue_y$$

3.5.4.2 Price adjustments

Price adjustments are fluctuations of price during the forecasted year due to for example temporary sales or sell-outs. More precisely, price adjustments are the average difference between the catalogue price and the actual price that the products are sold for. The price adjustments are calculated as in Formula 8.

Formula 8

$$Price\ adjustments = \frac{Actual\ sales}{Sales\ if\ all\ prices\ were\ the\ catalogue\ price} - 1$$

Sell-outs stand for the biggest part of price adjustments. Price adjustments are seen as a cost and have a separate budget. This since the goal is that price adjustments should not affect the gross margin. However the sales price is affected which means that the net sales will also be affected. Price adjustments are a forecasted goal or guideline that is set for each HFB and country.

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[37] Hagström, S. & Salomonsson, L. (2005) p. 87-90

The effect on the conversion factor from price adjustments is called price adjustment changes and is the difference of price adjustments from previous year to the forecasted year. Price adjustment changes are calculated as in Formula 9.

Formula 9

$$Price\ Adjustment\ Changes = \frac{Price\ adjustments_{y+1}}{Price\ adjustments_{y}}$$

3.5.4.3 Cost of poor quality (COPQ)

Cost of Poor Quality (COPQ) is a measure of costs caused by damaged customer returns and damaged goods in store in relation to the sales. The main cost drivers are scrapping and handling.[38] COPQ concerns the costs of all products that, due to some reason, are rejected at the selling unit or by the customer. Since this study only investigates the outflow from selling units, which is the value and volume of customer packages, it will only consider COPQ that occurs after the product has been sold. This means that in the context of this study the part of Cost of Poor Quality that is of interest is the customer returns. A hierarchical breakdown of COPQ is provided in Figure 12. The COPQ is the sales price excluding sales tax plus some handling costs, which is illustrated by Formula 10.

Formula 10

$$COPQ = Sales\ price - Sales\ tax + handling\ costs$$

[38] Dahlberg Hildén, A. & Wittrup, A. (2010) p.35

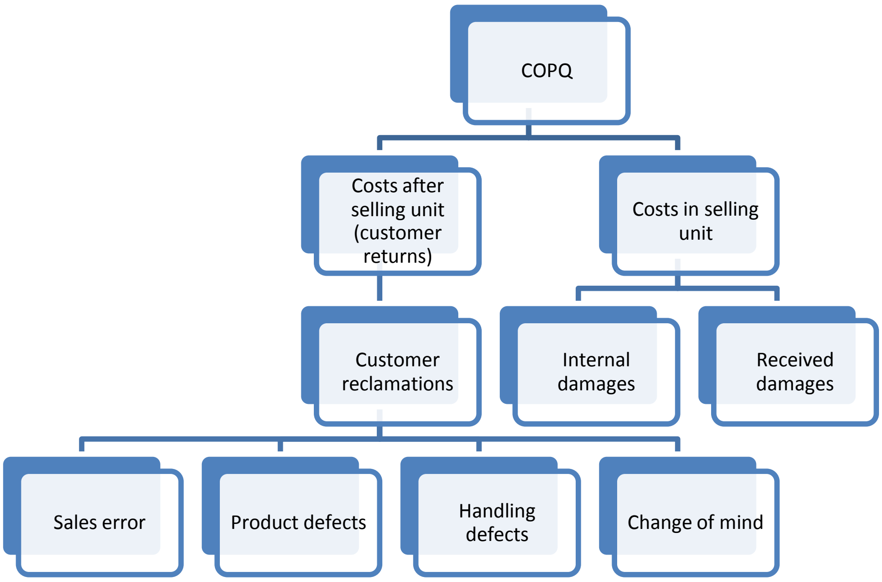


Figure 12. Hierarchical breakdown of COPQ. COPQ codes in parentheses.

When a customer returns a product it can either go back to stock or be seen as a Cost of Poor Quality. Products that go directly back to stock are normally unused products in the original package. On the other hand, if the product is seen as a COPQ it will be sent to the recovery department. At the recovery department the products will either be classified as *AsIs*, *Recycle*, *Spare parts* or *Back to stock*. AsIs products are products that are sold in the bargain corner to a reduced price. Recycle means that the product goes to scrap. If the products are going to scrap, possible spare parts are first collected from the product. Back to stock is exactly what it sounds like but include minor reconstructions of the products as well.

A lot of the money lost on customer returning goods is recovered by the recovery department by repackaging the product so it could go back to stock or preparing it to be sold as an AsIs. Recovery is measured by an index called Recovery Index (RI). The index is the share of the products that go to the recovery department that is recovered. The share is of in-price (Sales price minus gross margin) and since

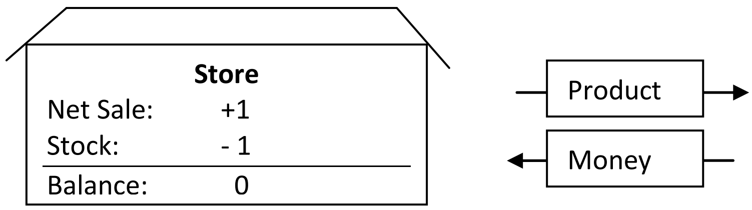
COPQ is expressed in sales price exclusive sales tax the amount of COPQ that is saved by the recovery must be multiplied with (1-gross margin in %). This is explained by Formula 11.

Formula 11

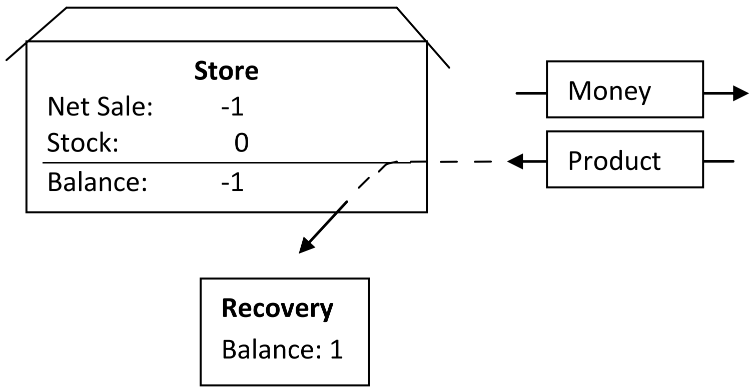
$$Saved\ COPQ = COPQ * RI * (1 - Gross\ margin\ in\ \%)$$

A product that is returned from a customer and seen as COPQ affect the net sale, which means that the sales price for that product is subtracted from the net sale. However, the stock is not affected, which means that IKEA has paid out money to a customer but not received a product in return. This is further illustrated below.

1. A customer buys one product, IKEA increase net sale and reduce stock.



2. The customer returns the product due to some reason, IKEA decrease net sale but stock is unchanged since the product goes to recovery.



3. From the recovery department the product then goes to *AsIs, Recycle*, *Spare parts* or *Back to stock*.

IKEA's goal is to reduce the COPQ with X % per year down to a total COPQ of Y % of IKEA's total revenue in FY13.

4 Theoretical framework

To provide a better understanding of the problem area, this chapter presents theory for the study received through literature studies. Initially, overall theory is presented for comparative purposes since the study is of inductive characteristic. In the latter part of the chapter theory concerning more detailed levels of the project will be presented.

4.1 Process orientation

The traditional way to divide an organization is in *functions* or *divisions,* where each function focuses on a specific task within the company. In a function orientated organisation the overall focus for each function is to improve their part of the organisation. When the functions work on internal improvement the overall picture and customer focus are easily lost. Therefore, to facilitate the understanding for how value is created for the customer, the concept of process orientation can be introduced. A process can be described as a road showing the way from customer need to customer satisfaction. A stricter definition is: [39]

"A process is a repetitively used network of orderly linked activities using information and resources for transforming inputs to outputs, extending from the point of identification to that of the satisfaction of the customer's needs."

Three different types of processes are often used to describe an organization, main-, support- and steering processes. The *main processes* describe the value adding activities within a company, for example how raw material is transformed into a product for an external customer. *Supporting processes* create indirect value by helping the main processes to work as efficient as possible. The purpose

[39] Ljungberg, A. & Larsson, E. (2001) p. 23

of the *steering processes* is to coordinate, manage and develop the main and supporting processes.[40]

The purpose of introducing process orientation within an organisation is to show how the business idea is realized, what market needs that needs to be satisfied and how to do it in practice. Most commonly a combination of functions and processes is used within companies. [41,42]

4.2 Planning

The theoretical framework of this thesis, that concerns planning, is basically focused on planning for manufacturing companies and their material flows. IKEA is first of all a company that designs and sells furniture. Even though the company has its own production to some extent, most of the products are bought from outside suppliers. Nonetheless the planning at IKEA consists to a large extent of planning of material flows. For this reason is theory of planning for manufacturing companies presented below.

4.2.1 Why Planning?

A simplified definition of planning is to take decisions about future activities and events.[43] For all companies, planning of different activities is necessary in order to stay competitive in a global market. To be able to take these decisions about the future some kind of prediction is needed. Two common tools used to predict the future are a forecast and a budget. Both these tools are based on certain assumptions and include guesses about how things will develop.[44]

For material flow and for manufacturing companies the decisions about future activities and events are taken for planning horizons that stretch from the nearest

[40] www.process.nu (a)
[41] www.process.nu (b)
[42] Ljungberg, A. & Larsson, E. (2001) p. 11-22
[43] Jonsson, P. & Mattsson, S-A. (2003) p. 54
[44] Greve, J. (2000) p. 10

hours to several years. The decisions about future activities and events could be about the amount of products to be produced, what equipment to invest in, etcetera. However, uncertainty increases with a longer planning horizon and with that the value of the planning as well. Too long planning horizons can lead to unaware limitations and lower adaptability to the market and new technologies. On the other hand the planning cannot be shorter than the time it takes to adjust the company´s capacity, called reaction time. If the forward planning is shorter than the reaction time, market and technology opportunities cannot be taken advantage of. In the same way, if the demand decreases the capacity cannot be adjusted which leads to low utilization. The planning horizon depends on the level of detail that is of interest and therefore it is common to use different levels of planning. [45]

4.2.2 Levels of planning

Four different levels of planning are commonly used within producing companies, *Sales and Business Planning, Master Planning, Order Planning* and *Operations Planning*. In

Table 2 an overview of the characteristics of each level of planning is provided.[46]

Table 2

Function	Object of planning	Horizon
Sales and Business Planning	Product group/Product	1-2 years
Master Planning	Product	0.5-1 year
Order Planning	Article	1-6 months
Operations planning	Operation	1-4 weeks

[45] Jonsson, P. & Mattsson, S-A. (2003) p. 185
[46] Jonsson, P. & Mattsson, S-A. (2003) p. 54-58

The issues that are faced by Sales and Business Planning concern several functions of the company. Sales and Business Planning can be defined as a process on corporate level which involves elaborating and establishing overall plans for the sales and manufacturing businesses. The next level of planning, Master Planning, has some similarities with Sales and Business Planning, but with the difference that Master Planning is more detailed and covers shorter planning horizons. Order Planning concerns the issues of material flow. The name comes from the fact that the material flow is always initiated by an order. The Operational Planning comprises for example planning of the release of new orders to the production. [47]

4.2.3 The Planning Process

The outcome of this project could be used as a prerequisite to what could be identified as Sales and Business Planning at IKEA. A brief description of the planning process at the level of Sales and Business Planning is that it starts with a forecast of the expected demand over the planning horizon. From this demand plan a delivery and production plan is then developed which is transformed to the corresponding capacity.[48]

4.3 Capacity planning

When it comes to producing companies, the basic idea is to use the company's recourses to refine raw material, components or half fabricates into saleable products. The extent of how capable a company is to use the recourses to add value is called capacity. Capacity is however an issue of money. To have resources available for refining is a cost whether they are in use or not. In the same way it is a cost in terms of lost sales to not have capacity to produce what the market demands. This means that it is a cost to have capacity but also a cost to not have capacity. For this reason it is of great interest for all producing companies to have a balance between capacity need and capacity assets. The function that provides

[47] Jonsson, P. & Mattsson, S-A. (2003)p. 185-298
[48] Jonsson, P. & Mattsson, S-A. (2003), p. 194-199

the activities that calculates this balance is called Capacity Planning. Capacity need has two dimensions, time and volume. The time dimension concerns when the capacity is needed and the volume concerns how much capacity that is needed. There are several methods to plan capacity and the most common ones will be discussed in the following Sections. [49]

4.3.1 Capacity Planning Methods

Capacity planning includes calculating the capacity assets and capacity need. The capacity assets are quite trivial to calculate since it is calculated just by an inventory of the assets that are of interest, for example volume storage space or number of production lines. To calculate the capacity need is a lot more complex. Therefore, when talking about capacity planning, it is actually the capacity need that is calculated. The choice of method depends on what the calculations are based on and what level of planning that it concerns.

It is usually the planned production that is the base for capacity planning. Some of the most common methods for capacity planning are briefly described in this section. Due to the purpose of this thesis, the discussed methods are most appropriate in the capacity planning level sales and business planning.[50]

Important to keep in mind is that the outcome of this project is not a capacity plan but could be used as a prerequisite to the process Plan & Secure Capacity, which is responsible for providing a capacity plan. The prerequisite is to estimate the sales outflow in cubic meter and is today calculated by using either a “bottom-up” or a “top-down” approach. Two methods of planning capacity, which could be identified as a “bottom-up” and a “top-down” approach, are therefore described in the two following sections.

[49] Jonsson, P. & Mattsson, S-A. (2003), p. 299-322
[50] Jonsson, P. & Mattsson, S-A. (2003) p. 487-492

4.3.1.1 Capacity plan based on production units

The easiest way to calculate the capacity need from a production plan is to use the same unit of capacity as used when measuring the production volumes. The production plan for a specific article is then equal to the capacity needed for that article. The total capacity is then established by summarising all articles. This method is used for finished products and commonly used units are pieces, area or volume. A prerequisite for this method is that the same unit is used for all articles; otherwise they cannot be summarised into a total capacity need. An illustration of the information flow of this planning method is shown in Figure 13.[51]

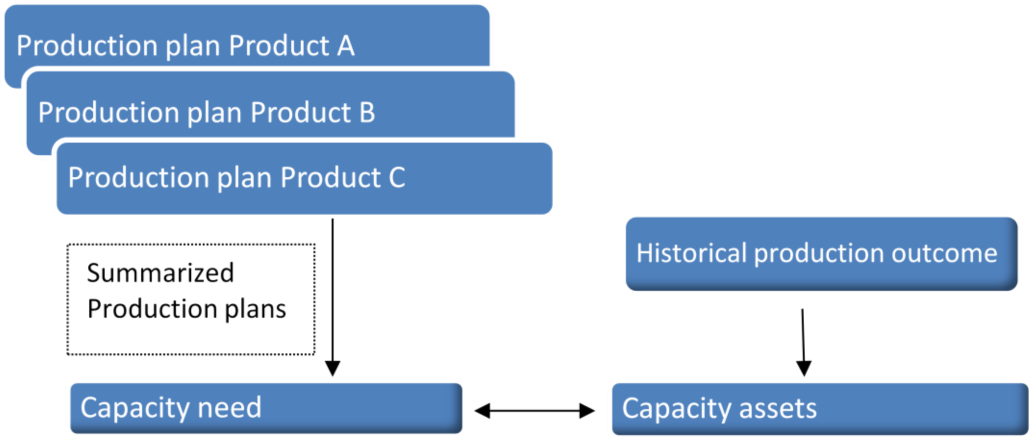


Figure 13. Information flow in the method "Capacity based on units"

This method, "Capacity plan based on production units", could be seen as capacity calculation from a "bottom-up" perspective. In this project a different method to calculate the capacity need is investigated which could be described as a "top-down" approach. This means that instead of aggregating the capacity need for each and every article to a total capacity need as in the "bottom-up" approach, the capacity need is calculated from a forecasted sales plan. The method is

[51] Jonsson, P. & Mattsson, S-A. (2003) p. 492-496

consequently that forecasted Sales plan in Euro is converted to the corresponding volume in cubic meter.

4.3.1.2 Capacity need with capacity planning factors

The “top-down” approach of calculating sales outflow in cubic meter that is used in this project is similar to the method “Capacity need with capacity planning factors” which is described in Jonsson & Mattsson (2003). The authors there discuss how the total production plan is allocated to different departments. This is done by first setting the production plans, which then are transformed to a total capacity need. The total capacity need is after that allocated to different departments using factors that are specific for each department. [52] The similarities between the methods, “top-down” approach and “Capacity need with capacity planning factor”, are that they both use a “top-down” approach when the capacity is calculated. The information flow of “Capacity need with capacity planning factors” is illustrated in Figure 14.

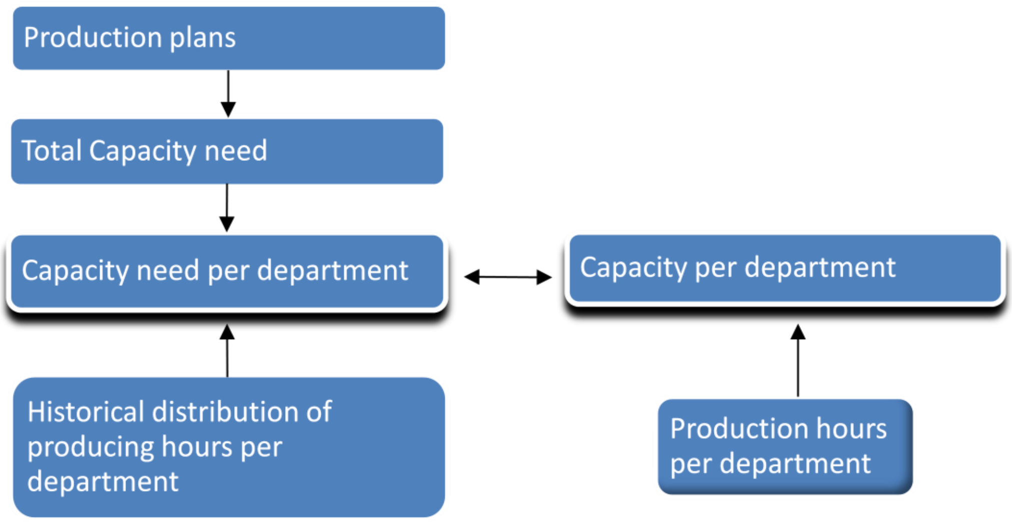


Figure 14. Information flow in the method “Capacity need with capacity planning factors”.

[52] Jonsson, P. & Mattsson, S-A. (2003) p. 496-502

4.3.2 Similarities to the budgeting process

The “top-down” approach has, within the budgeting area similarities to a method called “The decomposition method”. The resemblance is that the decomposition method is also based on an overall objective that then is broken down to smaller budgets.[53]

4.4 Theory concerning the factors

For the majority of the factors identified to affect the average value per cubic meter, the interviews have given sufficient information on how they affect the average value per cubic meter. But for one of the identified factors, price elasticity, literature studies were necessary to evaluate how it affects the average value per cubic meter.

4.4.1 Price elasticity

Price elasticity concerns the relationship between demanded quantity of a product and its price. A price alteration can contribute to either an increase or a decrease of the demanded quantity of the product. If the price alteration is measured as a percentage change and the change in demand that follows also is measured in a percentage change, the ratio between them is called price elasticity. The definition can also be expressed as in Formula 12.[54]

Formula 12

$$Price\ elasticity\ for\ a\ product\ \epsilon = \frac{\Delta Q/Q}{\Delta P/P}$$

$$\Delta Q = Change\ in\ demand\ quantity$$

$$Q = Demand\ quantity$$

$$\Delta P = Change\ in\ sales\ price$$

[53] Greve, J. (2000) p. 165-168

[54] Black, J. (2002) p.365

$$P = Sales\ price$$

Since an increase in price most often causes a decrease in demanded quantity, the price elasticity is normally a negative value.

If the ratio equals -1, the demand for the product is said to be *Unit elastic* which means that if the price decreases by for example $3\ \%$, a change in demand of $3\ \%$ can be expected. On the other hand, if the ratio is somewhere between -1 and 0, the percentage change in price is larger than the expected change in demand. This is called *Inelastic demand*, which insinuates that price alterations will only imply small changes in the demanded quantity of the product. An example of inelastic demand for a product would be if the price would be decreased by $10\ \%$, but only cause a $1\ \%$ change in demanded quantity of the product. The last option is that the ration is below -1, implying that the demand is sensitive to price changes, called *elastic demand*. A small percentage change in price would result in a larger percentage change in demanded quantity.

When very small price alterations are considered, the ratio can be interpreted as in Formula 13.

Formula 13

$$\epsilon = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q}{\Delta P}\frac{P}{Q} \rightarrow \frac{dQ}{dP}\frac{P}{Q}\ when\ P \rightarrow 0$$

A geometric interpretation of price elasticity is show in Figure 15.

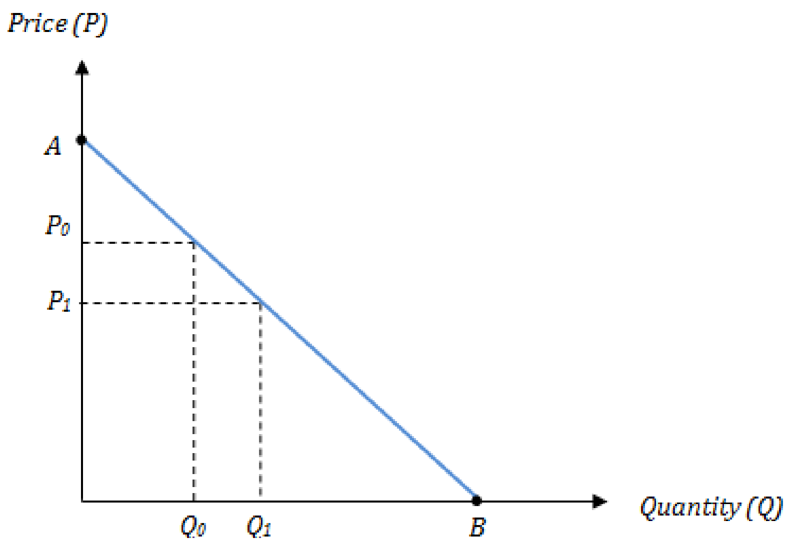


Figure 15. Price-Quantity graph

The actual price of the product is not the only thing that determines the price elasticity of the demand of a certain product. Other factors also influences such as *substitution possibilities*, *budget share*, *direction of income effect* as well as *time*.[55] However, this is not necessary to consider in order to evaluate the effect of price elasticity on the conversion factor.

[55] *Microeconomics and behaviour* McGraw-Hill, eight edition, 2010. p.119

5 Analysis

In the first part of this chapter (5.1), an investigation of whether the factors identified to affect the average value per cubic meter should be considered when calculating the conversion factor or not is made. A summary of the chosen factors will be presented as a hierarchical structure and in the second part of the chapter (5.2), how to consider the chosen factors will be discussed. The last part (5.3) presents a model of how the conversion factor could be calculated.

5.1 Factors that affect the value per cubic meter

In this section, an investigation of whether the factors, identified in Section 3.5, should be considered when calculating the conversion factor or not is made. The investigations are based on the empirical data from Chapter 3 and each factor is discussed in separate sub sections. The sub section will end with a conclusion about whether the factor should be considered when calculating the conversion factor or not. Finally, a hierarchical structure of all factors that should be considered is presented.

5.1.1 Product range factors

Since the IKEA product range is constantly changing the average value per cubic meter of a product also changes. This means that changes of the IKEA range have an impact on the average value per cubic meter, hence the conversion factor. To investigate which of the different ways to consider product range changes that is most appropriate, of the ones presented in Section 3.5.1 ,a deeper description of this part of the problem is necessary and will be presented below.

A desirable approach to calculate the average value per cubic meter for all products would be to first calculate the value per cubic meter for each article. If these values per cubic meter would be summarised directly, the average value per cubic meter would not consider the share the different products corresponds to of the total revenue. Therefore a weighted mean has to be calculated that considers the share of total revenue for all articles. The weight factors can be value or volume based, and value based weight factors is used further on in this thesis. The weighted mean will be called *base value per cubic meter* and can, for example, be calculated as shown in Formula 14.

Formula 14

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{N} share_{i,y+1} * \left(\frac{value}{m^3}\right)_{i,y}$$

$$N = Number\ of\ articles\ in\ the\ IKEA\ range$$

$$\left(\frac{value}{m^3}\right)_{i} = average\ value\ per\ cubic\ meter\ for\ article\ i$$

$$share_i = \frac{Revenue\ of\ article\ i}{Total\ revenue\ of\ IKEA}$$

$$y + 1 = forecasted\ year$$

This approach to calculate the average value per cubic meter is called a "bottom-up" approach and is not reliable to use today due to low quality forecasts of the revenue for many of the articles. Still, the impact of product range changes will affect the average value per cubic meter of a product and is desirable to consider when calculating the conversion factor. Is it then possible to consider product range changes with a "top-down" approach without regarding each and every article?

As mentioned in Section 1.1, the problem with the "bottom-up" approach is that IKEA do not have a reliable sales plan at an article level. What IKEA does have is a total sales plan and even sales plans for the two distribution channels CC and CD. It is also possible to calculate the average value per cubic meter for sales outflow through the two distribution channels. With these parameters it is possible to calculate a weighted mean value, a base value per cubic meter, which considers product range changes in the outflow of the two distribution channels. This approach is also the one that IKEA uses today, which is further explained in Section 3.4. However, it would be desirable to have sales plans and corresponding average value per cubic meter for a larger number of product groups than just CC and CD, when calculating the weighted mean. The product groups can for example be HFBs or categories, which are described in Section 3.5.1 . The approach when calculating the weighted mean with consideration to product groups is the same as when calculating the weighted mean at an article level, which is illustrated by Formula 15.

Formula 15

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{N} share_{i,y+1} * \left(\frac{value}{m^3}\right)_{i,y}$$

$$N = Number\ of\ product\ groups\ in\ the\ IKEA\ range$$

$$\left(\frac{value}{m^3}\right)_{i} = average\ value\ per\ cubic\ meter\ for\ product\ group\ i$$

$$share_i = \frac{Revenue\ of\ product\ group\ i}{Total\ revenue\ of\ IKEA}$$

$$y + 1 = forecasted\ year$$

In this section the different groupings that are possible of the IKEA range will be discussed. The groupings that will be investigated are *distribution channels*, *HFBs*, *categories* and *free range*. The impact of new products in the range will affect all of the different product groups and will therefore be discussed separately.

5.1.1.1 New products

The factors that affect the value per cubic meter can be different improvements, for example price investments and density improvements, discussed in Section

3.5.4.1 and 3.5.2. However, when measuring an improvement of a product, there has to be two different states that are compared, one “before the improvement” state and one “after the improvement” state. When a new product is introduced there is no existing state, which means that no “before the improvement” state can be used for a comparison. Consequently, an improvement can only consider existing products. How should then the effect from new products on the conversion factor be considered?

IKEA has a renewal rate of $Z\ \%$ of the product range, as mentioned in 3.5.1.1. When considering the effect from new products there are basically three different points of view.

The first point of view is that the new products will have similar properties as the phased out products. This means that improvements like price investments or volume improvements will not be valid for these products and to get an average improvement for all products, the improvements could for example be multiplied with the share of existing products as in Formula 16.

Formula 16

$$Average\ improvement\ for\ all\ products = Improvement * (1 - renewal\ rate)$$

The second point of view is that new products behave like the existing products which mean that all changes or improvements that concern the existing products also are valid for the new products. This point of view would, in Formula 16, theoretically be equal to a renewal rate of zero.

The last way of considering the effects from new products is that the new products neither act like the phased out products nor the existing products, but in completely different way. For example, if the new products in average have a value per cubic meter that is far from the average value per cubic meter of both the existing and phased out products.

How the effect from new products is taken into consideration for the factors it concerns is explained and motivated in the specific section where each factor is analysed.

5.1.1.2 Home Furnishing Business

Each HFB has a unique range of products and consequently also a unique average value per cubic meter, as mentioned in Section 3.5.1.2. If the revenue of the different HFBs will change, the weighting between the different values per cubic meter will also change, which is further explained by an example. A HFB with a higher value per cubic meter than the rest of the HFBs is expected to increase its revenue at the same time as the revenues for all the other HBFs are expected to stay the same. Consequently, the weighting between the values per cubic meter for the HFBs will change and the HFB with the higher value per cubic meter will increase its share of the total revenue. This means that the total average value per cubic meter of an IKEA product will be expected to increase.

As mentioned above, product range changes are advantageously considered on as detailed level as possible. Therefore, to get a more detailed level than is achieved today, the grouping of products on a HFB level can be used. Then the product range changes will be considered through several different groups instead of only two, CC and CD, as today.

This factor should be considered when calculating the conversion factor: ☑ YES

5.1.1.3 Distribution channels

The product range of the outflow though the two distribution channels CC and CD varies, as described in Section 3.5.1.3. If the product range is changed within these two groups, the average value per cubic meter for the outflow through CC or CD will change. This will in turn contribute to a change of the total average value per cubic meter. Besides, if the revenue for the different outflows also changes, the weighting factors will change and imply a change when calculating the weighted mean. Also described in that section is that the revenue for the two distribution channels are expected to change significantly in the future which makes this factor important to consider. The outflow through the distribution channels are therefore expected to have a significant impact on the conversion factor.

An example illustrates that changes in outflow through the two distribution channels affect the average value per cubic meter and thereby also the conversion factor. Assume that the average value per cubic meter for the products distributed through CC is lower than the value per cubic meter for the products distributed. An increase in revenue for the CC share will decrease the conversion factor since a larger part of the revenue will be products with lower value per cubic meter. Contrary, a decrease in CC share will increase the average value per cubic meter of all products. Changes in revenue for the distribution channels are expected to affect the conversion factor in the same manner as changes in revenues for the HFBs.

To consider product range changes on an even more detailed level than only the HFB level, the division of each HFB into CC and CD shares are preferable, making it possible to consider product range changes with XX different product groups.

This factor should be considered when calculating the conversion factor: ☑ YES

5.1.1.4 Categories

Another way to consider the effect on the value per cubic meter from product range changes could be to use the categories as a grouping of products. The categories have, like every HFB and the two distribution channels, a unique value per cubic meter. If IKEA decides to increase the revenue of one category in relation to IKEA's total revenue the average value per cubic meter of an IKEA product will be affected. This effect is similar to the one from HFBs with the difference that categories and HFBs are different types of grouping, for example can all categories exist within a HFB. A discussion of which of these dimensions that is the most representative is however redundant since the category dimension only works with Purchase Agreement value per cubic meter which first would have to be converted into corresponding value per cubic meter for outflow sales since the conversion factor is presented in sales value per cubic meter. This conversion would be beyond the scope of this project and would create unnecessary uncertainties. This leads to the conclusion that the category dimension is not relevant to consider when calculating the conversion factors, but can be of interest when analyzing the value per cubic meter in other parts of the supply chain.

This factor should be considered when calculating the conversion factor: ☒NO

5.1.1.5 Free range

The free range covers all kind of products and is included in all the different HFBs. In other words, all the products within the free range are also included in the HFBs. Since all kind of products can be a part of the free range, the product range of the free range can be expected to be more or less the same as the rest of the product range within IKEA. This assumption leads to the insight that a change in the free range share would not significantly contribute to a change in the average value per cubic meter of a product. Besides this assumption, the total free range share compared to the total range is no more than x %. A limitation is also set so the free range share will not increase to more than y % of the total range. This means that if the average value per cubic meter of the products within the free range is changed by 5 %, which could be seen as a large change, this would not significantly impact on the total average value per cubic meter.

Due to that the average value per cubic meter is assumed to be similar for the free range and the overall product range, and that the free range is no more than w % of the product range, the free range will not be taken into consideration when calculating the conversion factor.

This factor should be considered when calculating the conversion factor: ☒NO

5.1.2 Density improvements

IKEA has an overall goal to, through density improvements, increase the average value per cubic meter by z %, as mentioned in Section 3.5.2. If this goal is achieved the average value per cubic meter of a product will certainly be affected. The goal is unfortunately today not measurable so a follow-up is not possible which introduce uncertainties related to this factor.

The empirical investigation of this factor shows however that people within IKEA believes this is a realistic goal that today is achieved in one way or another. Desirable would be to do some kind of regression analysis to establish if there is a correlation between the value per cubic meter of an average IKEA product and the density improvements of z % per year. This would, however, require an investigation of reliable data sources which is outside the scope of this thesis.

5.1.2.1 The impact on density improvements from new products

As with all improvements, when investigating density improvements, the impact of new products needs to be considered.

Density improvements could be achieved by package improvements or a "knock-down", both manners are discussed in Section 3.5.2.1. These approaches and ways of thinking are advantageously implemented in an as early stage as possible of the product development process. This means that all new products are given good opportunities to minimize the air inside the packages. Therefore it is assumable that the new products will have less air inside the packages than the phased out products. This means that new products should not be treated differently than existing product, meaning that the renewal rate should theoretically be seen as zero. Consequently it is a realistic to believe that the goal of, by density improvements, increasing the value per cubic meter by z % is valid for IKEA's total range.

This factor should be considered when calculating the conversion factor: ☑ YES

5.1.3 Macro economic factors

The macro economic factors that are analysed are *inflation* and *currencies*.

5.1.3.1 Inflation

When converting the average value per cubic meter of an IKEA product from one year to another, the effects of inflation must be considered. The reason for this is that the sales plan from the Group Management is set in nominal terms, which means that the conversion factor also needs to be in nominal terms. To set the conversion factor in nominal terms one has to consider what the prices will be in the future, that is the actual future price setting of IKEA's products.

This factor should be considered when calculating the conversion factor: ☑ YES

5.1.3.2 Currencies

When converting the sales plan for each country to the corresponding volume in cubic meter, every country needs a specific conversion factor. The sales plan from Group Management, which the conversion factor should convert into the corresponding volume, is set in both euro and the local currency. Therefore, the conversion factor could be expressed in either euro or local currency. Today, the conversion factor is expressed in euro. This requires however a redundant conversion from the local currency into euro. Therefore the authors of this project recommend that the conversion factor for each retail country is expressed in the local currency.

If it for some other reason is necessary to keep the conversion factor expressed in euro, it is important that the converting from local currency into euro is performed in the right manner. In section 5.2.6 follows a description of how this procedure in that case should be performed.

This factor should be considered when calculating the conversion factor: ☒NO

5.1.4 Micro economic factors

In this section, micro economic factors that affect the average value per cubic meter are analysed. The factors are *price investments*, *price adjustments* and *Cost of Poor Quality* (COPQ).

5.1.4.1 Price investments

If the price of a product is changed the value per cubic meter of that product will be changed. Since price investments is a result of the price changes of each and every product, which is described in Section 3.5.4.1, it will affect the value per cubic meter of an average IKEA product.

5.1.4.1.1 The impact on price investments from new products

The price investments only concern existing products, due to the reason described in Section 5.1.1.1. However, since the conversion factor concerns all products it is desirable to calculate the average price investment factor for all products. To get an average factor for all products the effects from new products must be handled. There are, as mentioned is Section 5.1.1.1, three ways to consider the effects from new products.

The first one is to assume that the price investments only concern existing product. This means that, to get an average price investment factor for all products, the price investments must be multiplied with the share of existing products.

The second way of dealing with the effects on price investments from new products is to assume that the new products follow the same pattern as the existing products. This means that if the price of the existing products in average is decreased by r % the new products also have a r % lower price than if they were introduced the last year; consequently the total price investment is $-r$ %.

The third way is that the price investments are completely different for the new products.

After profound discussions with the interviewees for this project it has been decided that the effect from new products should be handled in the way that new products follow the same pattern as existing products which theoretically could be seen as a renewal rate of zero. One motivation for this is that when introducing new products IKEA gets good use of accumulated experiences with similar products which for example minimize the risk for childhood diseases. This gives IKEA good opportunities to set low prices on the products from the beginning.

This factor should be considered when calculating the conversion factor ☑ YES

5.1.4.2 Price elasticity

A price investment of a product is not taken into action if it does not lead to an increase of sales quantity of at least three times the price investment; hence a price investment leads to an increase of revenue, as explained in chapter 3.5.4.1.1. If the revenue of a product is increased the value per cubic meter of that product will have a higher impact on the conversion factor. Therefore it is intuitive that the price elasticity should be a relevant factor to consider when calculating the conversion factor. The effect of this factor must be considered, but where and how it can be considered will be discussed below. If the effect of price elasticity is considered when calculating the conversion factor, the effect will be considered twice. This is explained below.

Table 3. An example of what a decrease in price will lead to.

Product X: Price investments = $-2\ \%$					
Price	Sales quantity	Revenue	Volume (m^3)	Value/m^3	Impact on Conversion factor
↓	↑	↑	→	↓	↑

↓= Decrease ↑ = Increase → = Stable

In Table 3, an example is shown of what consequences a decrease in price will lead to. These consequences are considered differently. The decrease in price will lead to a decrease of the value per cubic meter, which will affect the conversion factor. This is taken into consideration by the factor price investments. The effect from the increase of revenue, which the increase of sales quantity will lead to, is considered in the product range factors. The explanation to how the effect is considered by the product range factors is that the expected increase of revenue is taken into consideration when each HFB sets their revenue forecasts. This since, if the revenue of a product is expected to increase, this is considered when forecasting the revenue for the entire HFB. In the same way, if the revenue of a HFB is expected to increase, this is considered when the Group Management sets the sales plan. So, as mentioned in Section 3.5.4.1, price investments are a tool that is used to increase the revenue of a HFB. If the exact price elasticity relationship between price and sales quantity was known this would help to forecast the revenue. But since this relationship not is known and is hard to estimate, IKEA could only guess what revenue the proposed price investments would imply. This estimating is however a task for the sales forecasting procedure, where the sales plan is set. This means that the future sales outflow that is going to be converted to the corresponding volume already includes the effects from price elasticity. Therefore, price elasticity must not be considered when calculating the conversion factor.

An example will further explain this; the revenue of a HFB is estimated to increase by $10\ \%$. This increase is achieved by, among other tools, an average decrease of the HFB's prices by 3 %. The decrease of price by 3 % will decrease the value per cubic meter with 3 %. The increase of revenue by 10 % caused partly by the price decrease will increase the HFB's impact on IKEA's total value per cubic meter. If the price elasticity would be considered by further increasing the HFB's impact when calculating the conversion factor, the effect of price elasticity will be considered twice; the first time when estimating the revenue for each HFB and the second time when calculating the conversion factor. This would give an incorrect conversion factor.

This factor should be considered when calculating the conversion factor: ☒NO

5.1.4.3 Price adjustments

If the price of a product is changed the value per cubic meter of that product will also be changed, as mentioned in Section 3.5.4.2. Price adjustments are fluctuations of prices for the forecasted year. In contrast to price investments, price adjustments are a forecasted goal or a guideline. However, when setting the average price adjustments, the effect of new products does not have to be taken into consideration. This since price adjustments is a relative difference of the annual price fluctuations and the actual catalogue price, which is set for all products including the new ones.

Since price adjustments directly affect the price of a product, hence the value, it is a factor that should be considered when calculating the conversion factor.

This factor should be considered when calculating the conversion factor ☑ YES

5.1.4.4 Cost of poor quality (COPQ)

In the frame of this project the issues around COPQ that are of interest are costs for sold products that are returned from customers. As mentioned in Section 3.5.4.3 when a product is returned from a customer the net sale is adjusted, which means that the sales price is subtracted from the net sale. However the stock is not effected which means that one product has gone out of the selling unit but IKEA has not received any income for it. This is further explained by an example: A customer buys one product, returns the product due to some defect (reclamation), the product is rejected to scrap and the customer gets a new product. Then two products have passed the selling unit outflow but IKEA has only gotten paid for one. Consequently the value per cubic meter for those products has been decreased by 50 %. In fact, the value of the first product is the original selling price and the second one is zero. If in the same case the customer reclamation is due to some sales error and there are no errors concerning the quality of the product, the customer gets a new product and the returned product simply goes back to storage ready for sale again. Then one product has passed the selling unit and IKEA has got paid for one as well. Consequently no change of value per cubic meter has been made for that product. The type of COPQ that is of interest for this project is marked in Figure 16.

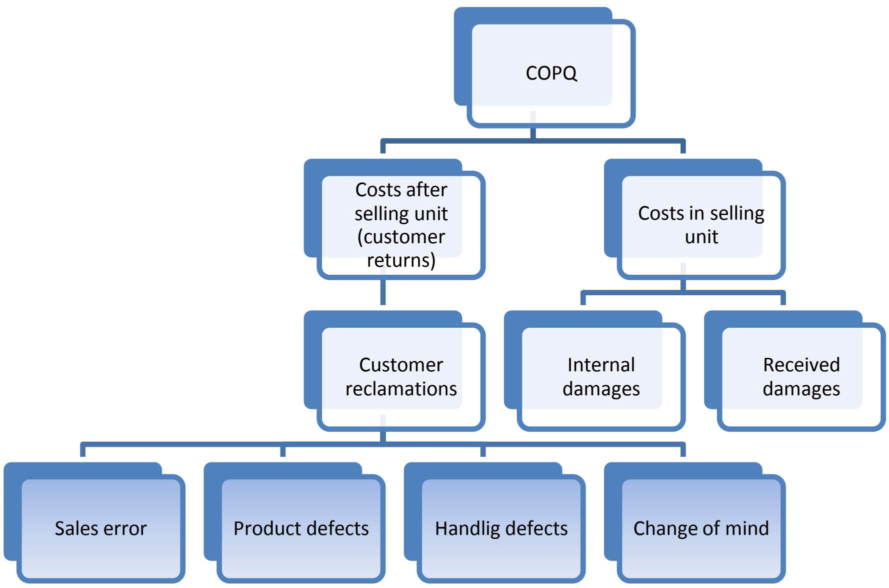


Figure 16. Hierarchical breakdown of COPQ. COPQ that is of interest for this project are marked blue. COPQ codes in parentheses.

5.1.4.4.1 Impact on the average value per cubic meter from COPQ

As mentioned in the previous section, the impact that COPQ has on the average value per cubic meter of an IKEA product depends on what happens with the product after the customer has returned it. It is in this part the Recovery department is important. At the Recovery department the products will either be classified as *AsIs*, *Recycle, Spare parts* or *Back to stock*. The products classified as AsIs will be sold to a reduced price in the Bargain corner. The Recovery Index (RI) measures how much of the cost of the products that are recovered. Since this study investigates factors that affect the value per cubic meter of sold products the RI must be converted to share of the sales price that is recovered. This is done by multiplying the RI with one minus gross margin. The COPQ that affects the value per cubic meter of an average IKEA product is then calculated as in Formula 17:

Formula 17

$$COPQ_{vm3} = COPQ^{*} * (1 - RI * (1 - gross\ margin))$$

$$COPQ_{vm3} = COPQ\ that\ affects\ the\ average\ value\ per\ cubic\ meter$$

$$^{*}Concerns\ the\ COPQ\ markes\ with\ a\ darker\ color\ in\ figure\ 17$$

Above, in Formula 17 , the amount of money that IKEA loses on customer returns is calculated. Notable is that it is the loss of sales and not just costs. However when the actual effects on the conversion factor should be calculated it is the COPQ in relation to total revenue that is needed. Actually it is just the forecasted change of COPQ from previous year that is of interest. The reason to this is clarified with an example: If the COPQ (that is of interest for this project) was 2 % for the previous year this means that the value per cubic meter could be 2 % higher if there were no COPQ. So if IKEA, for the next year, aims to reduce the COPQ with 20 %, which means that COPQ will be 1.6 % for the next year, IKEA has by that increased the value per cubic meter with 0.4 %. On the other hand, if the COPQ remains 2 % for the next FY the value per cubic meter will also remain constant (if nothing else affects the value per cubic meter).

The COPQ that affects the average value per cubic meter is calculated as in Formula 18.

Formula 18

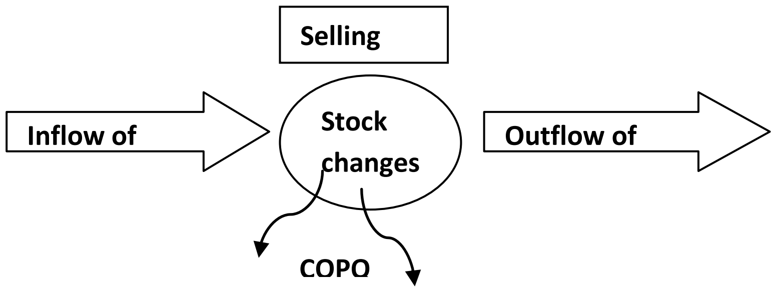
$$COPQ\ (\%)_{vm3} = \frac{COPQ_{vm3}}{Total\ revenue} * Change\ of\ COPQ$$

$$COPQ\ (\%)_{vm3} = Actual\ effect\ on\ the\ average\ value\ per\ cubic\ meter\ from\ COPQ$$

The *Change of COPQ* is a forecasted goal of how much IKEA will decrease COPQ for the next FY. IKEA's goal is today to reduce COPQ with x % per year down to a COPQ of y % of IKEA's total revenue in FY13. If this goal is reliable it means that the effects on the average value per cubic meter from COPQ will not be of interest after FY13.

5.1.4.4.2 Discussion about COPQ

As explained in Section 5.1.4.4.1 COPQ will affect the average value per cubic meter of an IKEA product of the outflow from selling unit. Therefore, it is intuitively that COPQ should be a factor to consider when calculating the conversion factor. This might however lead to misleading results. To understand the reason to this the basic idea of the conversion factor must be understood. This is that the purpose of the conversion factor is that it should convert the net sales into the corresponding volume. Net sales means, as explained in Section 3.3 that it is the actual, total sales. Since COPQ is no sale but a cost of lost sales it might twist the result of the volume that corresponds to the sales if COPQ is considered when calculating the conversion factor. Another problem that would occur if COPQ were considered when calculating the conversion factor is that it is, as explained in Section 3.5.4.3, only a part of COPQ that should be taken into consideration when calculating the conversion factor. Instead the authors of this thesis believes that it is a better approach to consider the total COPQ when calculating the inflow to selling units instead of when calculating the outflow from selling unit, which is the purpose of this thesis. The procedure of calculating the inflow to selling unit would then look like this.



Formula 19

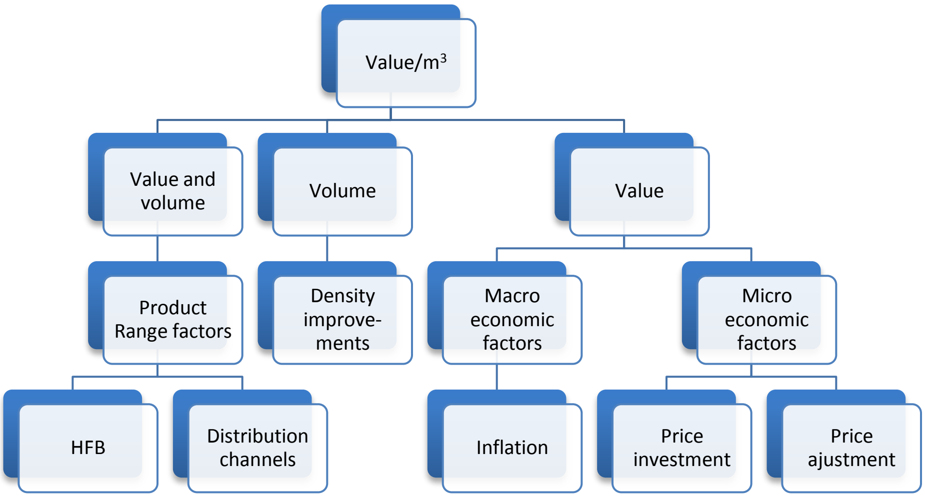
$$Inflow = Outflow + Stock\ changes + COPQ + \varepsilon$$

$$\varepsilon = Wastage$$

This factor should be considered when calculating the conversion factor: ☒NO

5.1.5 Factors that affect the conversion factor

A hierarchical breakdown of all factors that should be considered when calculating the conversion factor is provided below.



5.2 How to consider the factors that affect the conversion factor

The factors that have been selected in Section 5.1 and that will be considered when calculating the conversion factor have to be further investigated to ensure that they are taken into consideration in an appropriate manner. How each factor should be considered when calculating the conversion factor is discussed in this section. The section starts however with a brief description of the author's basic idea of how to calculate the conversion factor.

5.2.1 Basic idea of how to calculate the conversion factor

The main purpose of this thesis is to create a model of how to calculate the conversion factor. A prerequisite for this is to investigate which factors that will affect the average value per cubic meter of an IKEA product. To create a model of the conversion factor means in practice that the average value per cubic meter of an IKEA product should be converted from one year to the next. This is illustrated by Formula 20.

Formula 20

$$\left(\frac{value\ (local\ currency)}{m^3}\right)_y \xrightarrow{Conversion} \left(\frac{value\ (local\ currency)}{m^3}\right)_{y+1}$$

$$y + 1 = Forcasted\ year$$

The conversion means that factors that will affect the average value per cubic meter of an IKEA product, for the next year, will be considered. How this can be done in practice is shown in Formula 21 and Formula 22.

Formula 21

$$Conversion\ factor = \left(\frac{Value}{m^3}\right)_y * (Factor_1 * Factor_2 * \ldots * Factor_N)_{y+1}$$
$$= \left(\frac{Value}{m^3}\right)_{y+1}$$

$$N = number\ of\ factors$$

Formula 22

$$Conversion\ factor = \left(\frac{Value}{m^3}\right)_y * \prod_{k=1}^{N}(factor_k)_{y+1} = \left(\frac{Value}{m^3}\right)_{y+1}$$

5.2.2 Product Range factors

Important to take into consideration, when analysing how the product range factors should be included when calculating the conversion factor, is that the effect of different changes must only be considered once. This is especially important if many different dimensions and product groups are included in the calculations of the conversion factor.

5.2.2.1 Home Furnishing Businesses

The most detailed approach to calculate the effect of product range changes would be on an article level, but as mentioned in the first part of Section 5.1.1, this is not possible. Instead, the effects from product range changes on the average value per cubic meter can be considered on a HFB level, when the conversion factor is calculated from a "top-down" perspective. The approach for this calculation is the same as in the generic example when calculating the base value per cubic meter with optional product groups, see Section 5.1.1. This calculation can be done as in Formula 23.

Formula 23

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{M} (share)_{i,y+1} * \left(\frac{value}{m^3}\right)_{i,y}$$

$$i = HFB\ number\ i$$

$$M = Number\ of\ HFBs$$

$$\left(\frac{value}{m^3}\right)_{i} = Average\ value\ per\ cubic\ meter\ for\ HFB\ i$$

$$share_i = \frac{Revenue\ of\ product\ group\ i}{Total\ revenue\ for\ IKEA}$$

This approach requires that a forecast of the revenue for each HFB is available. Today, IKEA makes projections of how each HFB will expand or decrease in terms of revenue changes, which can be used when calculating this dimension of the conversion factor. It is also necessary to have the average value per cubic meter for each HFB for the previous 12-months period.

5.2.2.2 Distribution channels

A change in revenue of the outflows through CC or CD will have an impact on the conversion factor, as explained in Section 5.1.1.3. All together, a change in revenue for either one of the outflows through CC or CD or for the HFBs will imply a change of the conversion factor. However, both the CC and CD outflow and the HFB dimension separately include all the products within the IKEA range. To make sure that product range changes are only taken into consideration once when calculating the conversion factor, these two factors must be considered together, as will be explained in the section below.

A division can be made within each HFB between the products that are distributed through CC and CD. Forecasts of the revenues for the CC and CD shares within each HFB are used to calculate the weighting factors. Equally, a value per cubic meter can be calculated for the products within a HFB that pass through the CC channel and another value per cubic meter for the products within the HFB that pass through the CD channel. These average values per cubic meter are multiplied with corresponding weight factor and summarised to a weighted mean. The calculations for one distribution channel, for example CD, are shown in Formula 24.

Formula 24

$$share_{CD_i} = \frac{Revenue\ for\ the\ CD\ share\ within\ HFB\ i}{Total\ revenue\ for\ IKEA}$$

$$\left(\frac{value}{m^3}\right)_{CD_i} = Average\ value\ per\ cubic\ meter\ for\ the\ CD\ share\ of\ HFB\ i$$

The average value per cubic meter of a product distributed trough CC can be calculated in the same manner. A formula describing how the base value per cubic meter then can be calculated, considering both the HFB dimension and the distribution channel dimension, is shown in Formula 25.

Formula 25

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{N}\left(share_{CD_i,y+1} * \left(\frac{value}{m^3}\right)_{CD_i,y} + share_{CC_i,y+1} * \left(\frac{value}{m^3}\right)_{CC_i,y}\right)$$

$$i = HFB\ i$$

$$N = Total\ number\ of\ HFBs$$

$$y + 1 = forecasted\ year$$

If the number of distribution channels is not to be limited, a more generic way to calculate the base value per cubic meter is shown in Formula 26.

Formula 26

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{N} \sum_{j=1}^{M} share_{i,j,y+1} * \left(\frac{value}{m^3}\right)_{i,j,y}$$

$$j = Distribution\ channel\ j$$

$$M = Total\ number\ of\ distribution\ channels$$

$$share_{i,j} = \frac{Revenue\ for\ sales\ through\ distribution\ channel\ j\ within\ HFB\ i}{Total\ revenue\ for\ IKEA}$$

$$\left(\frac{value}{m^3}\right)_{i,j} = Average\ value\ per\ cubic\ meter\ for\ sales\ through$$

$$distribution\ channel\ j\ within\ HFB\ i$$

Formula 26 gives the base value per cubic meter of a product when considering both the HFB dimension and distribution channels and will be used in the model of calculating the conversion factor.

5.2.3 Density improvements

Since IKEA today do not have any measurements of the density improvements, the authors believe that the goal, that density improvements should increase the average value per cubic meter by 2 % per year, should be used when calculating the conversion factor.

5.2.3.1 Discussion around density improvements

Density improvements concern the volume improvements that are achieved through “knock-downs” and more efficient package solutions. This means that density improvements only consider improvements concerning volume, and should therefore be called volume improvements.

“What gets measured gets done”[56] is a quote that accentuate that it is of great importance to measure the right things. With this in mind it is intuitively that volume improvements should be measured in volume or more explicitly a percentage of volume decrease. Today density improvements are measured in value per cubic meter but since there are several other factors that affect the value per cubic meter, for example price investments, this might lead the focus away from the improvements that only concern the volume of the products or more precisely the volume of the customer packages of the product.

As mentioned above, no follow-up of the density improvements exists and would be difficult to create as long as it is measured in the way as it is done today. Therefore the authors of this thesis suggest that the improvements that concern volume should be measured in volume and that volume improvements should be calculated in the same manner as price investments, which would be as in Formula 27.

Formula 27

$$Volume\ improvements = \frac{\sum_{i=1}^{N}((volume_i)_{y+1} * q_{i,y+1})}{\sum_{i=1}^{N}((volume_i)_{y} * q_{i,y+1})} - 1$$

$$i = Product\ i$$

$$N = Number\ of\ products$$

[56] Ljungberg, A. & Larsson, E (2001) p.215

$$q_i = Quantity\ of\ product\ i$$

$$y + 1 = Forecasted\ year$$

This manner is however not possible to use today since there is no reliable volume follow-up for each and every product. However, a new data base that will contain reliable volume follow-up is under construction so hopefully the manner discussed above will be possible to use in a near future. Until such time, volume improvements will be considered as the density improvements that are used today.

5.2.4 Macro economic factors

The macro economic factor that should be considered when calculating the conversion factor is inflation. Below follows a description of how this is considered when calculating the conversion factor.

5.2.4.1 Inflation

The effect from inflation is actually considered in the factor price investments. Price investments are the difference of the catalogue price from one year to another and since the catalogue prices are set in nominal terms the effect from inflation is considered.

5.2.5 Micro economic factors

The micro economic factors that should be considered when calculating the conversion factor are price investments and price adjustments.

5.2.5.1 Price investments

This factor is a result of the price changes from one year to the next and the author’s believe that it should be calculated in the same way in the future. This is shown Formula 6.

Formula 6

$$Price\ investments = \frac{\sum_{i=1}^{N}((price_i)_{y+1} * q_{i,y+1})}{\sum_{i=1}^{N}((price_i)_y * q_{i,y+1})} - 1$$

$$price_i = Catalogue\ price\ for\ product\ i$$

$$N = Number\ of\ products$$

$$y + 1 = Forecasted\ year$$

$$q_i = Quantity\ for\ product\ i$$

5.2.5.2 Price adjustments

The conversion factor is based on the actual sales for the last year. The actual sales are net sales and include all price adjustments made for that year. This means that price adjustments will only affect the value per cubic meter if the price adjustments are forecasted to be different from last year. The effect on the conversion factor from price adjustments should be calculated as in Formula 28.

Formula 28

$$Price\ adjustment\ changes = \frac{Price\ adjustments_{y+1}}{Price\ adjustments_y}$$

5.2.6 Conversion factor expressed in euro

If IKEA for some reason would like to express the conversion factor in euro, a description of how this should be performed is explained in this section.

The conversion factor for each country is, as mentioned in Section 5.2.1 based on the actual sales in local currency for the last year or the current year up to date. This base is then multiplied with the factors that will affect the value per cubic meter for the forecasted period of time and a conversion factor in local currency per cubic meter is calculated. This conversion factor then needs to be converted to euro per cubic meter. This is done by multiplying the conversion factor in local currency with the GFAR for the forecasted period. This procedure is illustrated with Formula 29-Formula 31.

Formula 29

$$\left(\frac{kr}{m^3}\right)_y * \prod_{k=1}^{N} Factor_{k,y+1} = \left(\frac{kr}{m^3}\right)_{y+1}$$

Formula 30

$$\left(\frac{kr}{m^3}\right)_{y+1} \rightarrow \left(\frac{euro}{m^3}\right)_{y+1}$$

Formula 31

$$\left(\frac{kr}{m^3}\right)_{y+1} * \left(\frac{euro}{kr}\right)_{GFAR\ y+1} = \left(\frac{euro}{m^3}\right)_{y+1}$$

It is of importance that the calculation of each country's specific conversion factor follows this procedure, explained above. An example of how the same forecast in euro can give different corresponding volume if this procedure not is followed is given below.

5.2.6.1 Currency example (all numbers are fictive)

This is an example were different GFARs (ex-change rates) can give different estimations of future sales volume (outflow) if "euro per cubic meter" or the "local currency per cubic meter" is used as conversion factor. In this example the local currency is Swedish kronor (SEK).

In Table 4 one can see that the actual sales for 2009 were 10 000 SEK which with GFAR09 corresponds to 1 000 euro. The volume that this sale corresponds to is 10 m^3 which gives an average value per cubic meter of 100 euro per cubic meter. Since it in this example is assumed that the product of all factors is 1 the conversion factor is the same as the average value per cubic meter.

Table 4. This table shows how the conversion factor for 2010, both in [€/m3] and in [kr/m3], is calculated with the sales from 2009 as base.

2009			2010	
GFAR09	$10\ SEK/€$		**Conversion factor**	
Net sales (SEK)	$10\ 000\ kr$	∏Factors=1* →	**In euro**	$100\ €/m^3$
Net sales (€)	$1\ 000\ €$		**In kronor**	$1000\ SEK/m^3$
Net volume	$10\ m^3$			

*(When assuming that the product of all factors that affect the value per cubic meter is 1 that is equal to assume that all conditions from 2009 also are valid during 2010.)

In Table 5 the forecasted sales for 2010 are estimated to 1000 euro which with GFAR10 corresponds to 9000 SEK. With the conversion factors (in euro and in kronor) are then the corresponding volumes calculated.

Table 5

2010		Conv. Factor		Volume
GFAR10	$9\ SEK/€$			
Forecasted sales (€)	$1\ 000\ €$	$100\ €/m^3$	→	$10\ m^3$
Forecasted sales (SEK)	$9\ 000\ SEK$	$1000\ SEK/m^3$		$9\ m^3$

Notable from Table 5 is that the calculated volume differs when using euro or kronor per cubic meter as conversion factor. When the conversion factor is in euro the corresponding volume is calculated to be 10 m^3 and when the conversion factor is in kronor the volume is calculated to 9 m^3. Which of these volumes is then the right estimation? To determine this some things need to be clarified. First of all, the forecasted sales plan in euro is the expected sales. But since the sales will be in kronor the corresponding sales in kronor must be calculated which in this case are 9 000 SEK. Since the value per cubic meter is 1 000 SEK/m^3

regardless to what the GFAR is, the correct answer of the volume to be sold is 9 m^3.

If in the same example the recommended procedure, described above, instead was used the result would be correct. This is illustrated below in Formula 32 - Formula 34.Formula 31

Formula 32

$$\left(\frac{kr}{m^3}\right)_y * \prod_{k=1}^{N} Factor_{k,y+1} = \left(\frac{kr}{m^3}\right)_{y+1} \leftrightarrow 1000 * 1 = 1000\, SEK/m^3$$

Formula 33

$$\left(\frac{kr}{m^3}\right)_{y+1} * \left(\frac{euro}{kr}\right)_{GFAR\ y+1} = \left(\frac{euro}{m^3}\right)_{y+1} \leftrightarrow 1000 * \frac{1}{9} = 111.11\, euro/m^3$$

Formula 34

$$\frac{Forecasted\ Sales\ Plan\ [€]}{Value\ per\ cubic\ meter\ \left[\frac{€}{m^3}\right]} = Forcasted\ outflow\ volume\ [m^3] \leftrightarrow \frac{1000}{111.11} = 9m^3$$

5.3 The model of the conversion factor

In this section, all factors that should be considered when calculating the conversion factor are summarised into a model of how to calculate the conversion factor. The model could be divided into two parts. The first part is a base value per cubic meter that is calculated from the value per cubic meter from previous 12-months period and the forecasted revenue. This part considers the product range factors. The second part is factors that affect only the value or the volume and should represent conditions of the forecasted period of time. This is expressed in Formula 35.

Formula 35

$$Conversion\ factor = \left(\frac{Value}{m^3}\right)_{base} * \prod_{k=1}^{M} (factor_{\mathrm{k}})_{y+1}$$

$$M = number\ of\ factors$$

$$y + 1 = Forecasted\ year$$

The first part that is called base value per cubic meter is where the effects from the product range factors are considered. This is calculated as in Formula 36.

Formula 36

$$\left(\frac{Value}{m^3}\right)_{base} = \sum_{i=1}^{N} \left(share_{CD_i,y+1} * \left(\frac{value}{m^3}\right)_{CD_i,y} + share_{CC_i,y+1} * \left(\frac{value}{m^3}\right)_{CC_i,y} \right)$$

$$i = HFB\ i$$

$$N = Number\ of\ HFBs$$

$$share_{CD_i} = \frac{Revenue\ for\ the\ CD\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$share_{CC_i} = \frac{Revenue\ for\ the\ CC\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$CC = Cash\ \&\ Carry = range\ distributed\ through\ store$$

$$CD = Customer\ direct = range\ distributed\ through\ home\ shopping$$

In the second part are the other factors that affect only the value or only the volume. This part is calculated as in Formula 37.

Formula 37

$$k = 1M(factor_k)_{y+1} = ((1 + PI) * (1 + DI) * (1 + PAC))_{y+1}$$

$$PI = Price\ investments$$

$$DI = Density\ improvements$$

$$PAC = Price\ adjustment\ changes$$

5.3.1 Discussion about uncertainties of the model

The purpose of the model is, as mentioned earlier, to give a projection of the future average value per cubic meter of an IKEA product. There are however some uncertainties about the model. To estimate the uncertainties of each factor, a regression analysis could be used. A regression analysis requires reliable data for several years back in time which is outside the scope of this project to evaluate. In this section are the uncertainties around each factor discussed.

5.3.1.1 Product range factors

This factor is considered in the part where the base value per cubic meter is calculated. The calculation is based on the assumption that each HFB has an unchanged average value per cubic meter from one period of time to the next. This means that product range changes within a HFB is not considered, it is only the revenue changes of each HFB that are regarded. This is however not the whole truth since, when the conversion factor is calculated, the base value per cubic meter is multiplied with the factors of next year. Since the revenue change of a HFB is a forecast this implies uncertainties. To estimate these uncertainties is however outside the scope of this project.

5.3.1.2 Price investments

Price investments are calculated as in Formula 6.

Formula 6

$$Price\ investments = \frac{\sum_{i=1}^{N}((price_i)_{y+1} * q_{i,y+1})}{\sum_{i=1}^{N}((price_i)_y * q_{i,y+1})} - 1$$

$price_i = Catalogue\ price\ for\ product\ i$ $\qquad$ $q_i = Quantity\ of\ product\ i$

$N = Number\ of\ products$ $\qquad$ $y + 1 = Forecasted\ year$

As with product range factors, this factor is based on some kind of forecasting, which implies uncertainties. The forecasting concerns the forecast of each products quantity, q_i. There are even products in IKEA's range that there are no forecasts for. These products are for example new products and products in the free range. This means that price investments are calculated for the main part of the range and is then expected to be representative for the rest of the range as well.

5.3.1.3 Price adjustment changes

Price adjustment changes are the ratio between next year's forecasted price adjustments and previous year's actual price adjustments. The forecast of the next year's price adjustments implies uncertainties but since the forecasted price adjustments has a budget that should cover the actual adjustments, one could assume that actual adjustments correspond well to the forecast.

5.3.1.4 Density improvements

This factor is a forecasted goal and today no follow-up exist which makes this factor uncertain by its nature. But as mentioned in Section 5.2.3.1, the authors recommend that density improvements should be called volume improvements and be calculated in the same manner as price investments. This would however require a reliable volume follow-up of each and every product, which does not exist today.

6 Conclusions

This chapter starts with o brief description of the main purpose of this project. This is followed by the conclusions according the deliverables of the project.

The main purpose of this master thesis is to recommend one common way of how to calculate the conversion factor, which is a future, average value per cubic meter of all IKEA products. This is presented as a model that calculates the conversion factor, which considers different factors that have been identified to impact on the average value per cubic meter. The authors of the thesis have no intensions to provide a perfect model that is an exact projection of the reality but the model should give a good approximation of the future average value per cubic meter of an IKEA product. The model should also be easy to grasp and easy to use.

The authors' basic idea of how the conversion factor should be calculated is described in Formula 35.

Formula 35

$$Conversion\ factor = \left(\frac{Value}{m^3}\right)_y * \prod_{k=1}^{N}(Factor_k)_{y+1} = \left(\frac{Value}{m^3}\right)_{y+1}$$

$$N = number\ of\ factors$$

$$y + 1 = Forecasted\ year$$

In words this means that the average value per cubic meter from the previous 12-month period of time should be converted into an estimation of the average value per cubic meter for the forecasted period of time. To obtain a systematic research approach that is easy to follow, the purpose was split up into three deliverables, also discussed in Section1.4.

1. A hierarchy of factors that affect the conversion factor.

2. How to consider the effect from the factors.
3. A model of how to calculate the conversion factor.

6.1 Deliverable 1 – A Hierarchy of factors that affect the conversion factor

In Figure 17 a complete hierarchical breakdown structure of the factors that the authors believe is relevant to consider when calculating the conversion factor is illustrated. As explained in Section 3.3 all factors that affect the conversion could be sorted within the groups of factors that affect the value, the volume or both the value and volume.

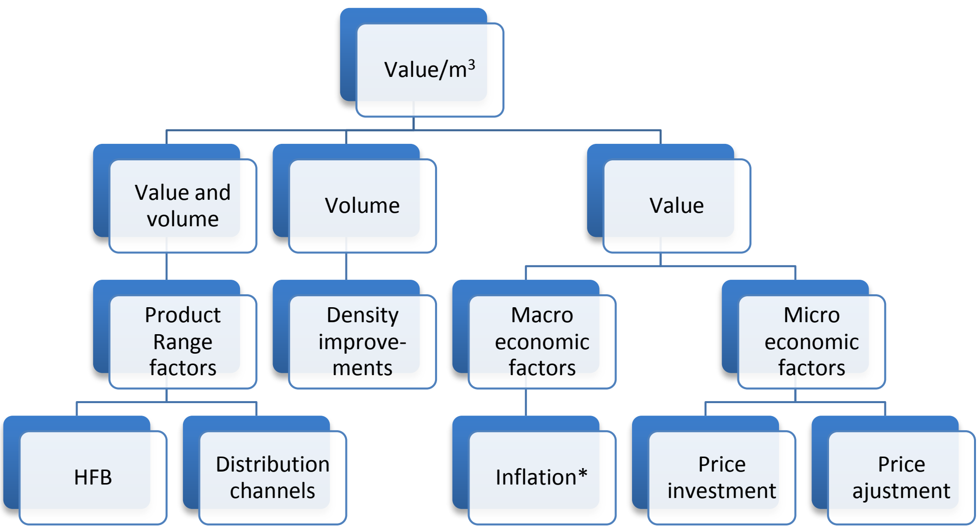


Figure 17. Factors that affect the conversion factor. *The effect from inflation is considered in price investments.

6.2 Deliverable 2 - How to consider the effect from the factors

The factors that are chosen to affect the conversion factor should be considered differently, how is summarised in this section.

6.2.1 Product range factors

Product range factors are briefly defined as changes of IKEA's product range. A change could be that new products are introduced and some old ones are phased out. It could also be that IKEA increase or decrease the revenue of some products or product groups.

Product range changes are advantageously considered on an as detailed level as possible. The best case would be to consider product range changes on article level. This is however not reliable, which is explained in Section 5.1.1. Which is then the most detailed level that can be used when considering product range changes?

The conclusion from the analysis in Section 5.1.1.2 is that product range changes are best considered on Home Furnishing Business (HFB) level. This, since forecasted revenues are available on a HFB level, and that it is possible to calculate an average value per cubic meter for each HFB. If the revenue for a HFB is expected to increase, the value per cubic meter for this HFB will have a bigger impact when calculating the total average value per cubic meter, hence the conversion factor.

On the other hand, if the same HFB is forecasted to decrease its revenue the value per cubic meter of the HFB will have less impact on the total average value per cubic meter. With regards to product range changes on HFB level a base value per cubic meter of the conversion factor is calculated which is illustrated in Formula 22.

Formula 23

$$\left(\frac{value}{m^3}\right)_{base} = \sum_{i=1}^{N} (share_i)_{y+1} * \left(\frac{value}{m^3}\right)_{i,y}$$

$$i = HFB$$

$$N = Number\ of\ HFBs$$

$$share_i = \frac{Revenue\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$y + 1 = forecasted\ year$$

It is actually even possible to split each HFB in two groups depending on distribution channels. With regards to this breakdown the base value per cubic meter is calculated as in Formula 23.

Formula 25

$$\left(\frac{Value}{m^3}\right)_{base} = \sum_{i=1}^{N} \left(share_{CD_i,y+1} * \left(\frac{value}{m^3}\right)_{CD_i,y} + share_{CC_i,y+1} * \left(\frac{value}{m^3}\right)_{CC_i,y} \right)$$

$$share_{CD_i} = \frac{Revenue\ for\ the\ CD\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$share_{CC_i} = \frac{Revenue\ for\ the\ CC\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$CC = Cash\ \&\ carry = range\ distributed\ through\ store$$

$$CD = Customer\ direct = Home\ shopping$$

This base value per cubic meter is a combination of the actual value per cubic meter of the previous 12-months period and forecasted revenue of the CC and CD share within each HFB. In other words, it is a combination between the result from last year and the forecast of next year.

In the base value per cubic meter effects from product range changes are taken into consideration. To get the final version of the conversion factor this base then needs to be adjusted with the other factors that were identified to impact on the conversion factor.

It should also be noted that the effects from new products is assumed to be negligible, the reason to this is explained in Section 5.1.

6.2.2 Density improvements

Density improvements should be considered as a factor that increases the base value per cubic meter with 2 % per year.

6.2.3 Inflation

The effect from inflation is considered in the factor price investments.

6.2.4 Price investments

Price investments could either increase or decrease the base value per cubic meter depending on if IKEA in general increases or decreases the prices. It is a result of the annual catalogue prices in relation to last year's.

6.2.5 Price adjustments

Price adjustments should be considered in the following way:

$$Price\ Adjustment\ Changes = \frac{Price\ adjustments_{y+1}}{Price\ adjustments_{y}}$$

6.3 Deliverable 3 - A model of how to calculate the conversion factor

The model of how to calculate the conversion factor could be divided into two parts. The first part is a base value that is calculated from the average value per cubic meter of the previous 12-months period and the forecasted revenue. The second part is factors that should represent the conditions of next year for the factors that affect only the value or the volume of a product. This is expressed in Formula 31-Formula 33.

Formula 35

$$Conversion\ factor = \left(\frac{Value}{m^3}\right)_{base} * \prod_{k=1}^{M} (factor_k)_{y+1} = \left(\frac{Value}{m^3}\right)_{y+1}$$

Formula 36

$$\left(\frac{Value}{m^3}\right)_{base} = \sum_{i=1}^{N} \left(share_{CD_i,y+1} * \left(\frac{value}{m^3}\right)_{CD_i,y} + share_{CC_i,y+1} * \left(\frac{value}{m^3}\right)_{CC_i,y}\right)$$

Formula 37

$$\prod_{k=1}^{M} (factor_k)_{y+1} = ((1 + PI) * (1 + DI) * (1 + PAC))_{y+1}$$

$PI = Price\ investments$ $\qquad$ $i = HFB\ i$

$DI = Density\ improvements$ $\qquad$ $M = Number\ of\ factors$

$PAC = Price\ adjustment\ changes$ $\qquad$ $N = Number\ of\ HFBs$

$$y + 1 = Forecasted\ year$$

$$share_{CD_i} = \frac{Revenue\ for\ the\ CD\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$share_{CC_i} = \frac{Revenue\ for\ the\ CC\ share\ of\ HFB\ i}{Total\ revenue\ of\ IKEA}$$

$$CC = Cash\ \&\ Carry = range\ distributed\ through\ store$$

$$CD = Customer\ direct = range\ distributed\ through\ home\ shopping$$

7 Recommendations

In this chapter are, according to the conclusions, the author's recommendations of how to improve the quality of the input to the sub process Plan & Secure Capacity presented.

7.1 One common and agreed model

Throughout the study it became clear that no common and agreed way exists of how to calculate the conversion factor and of which factors to include in the model. Therefore the first recommendation is to decide upon one generic model of how to calculate the conversion factor and which factors to consider in this model. The model presented in Section 5.3 can be used for calculating the conversion factor. The model considers more factors than are considered today, but there are still room for further improvements. Some potential improvement areas concerning the conversion factor are presented below.

7.2 Density improvements

When considering the factors included in the model, more or less uncertainty are brought about depending on the characteristics of the factors. For example, density improvements bring about more uncertainty than price investments for the reasons mentioned in Section 5.3.1, and therefore it would be preferable to increase the quality of density improvements. Today a goal of the density improvements is used when calculating the conversion factor and no actual measurements of how well this goal is achieved are carried out. Even if the goal is considered to be realistic, how the actual outcome of the density improvements correspond to this goal would be preferable to investigate. A system of how to measure the volume of each and every product is however under development. When this system is ready to use the authors of this project recommend that density improvements are called volume improvements and are calculated in the same manner as price investments, which is shown below in Formula 27.

Formula 27

$$Volume\ improvements = \frac{\sum_{i=1}^{N}((volume_i)_{y+1} * q_{i,y+1})}{\sum_{i=1}^{N}((volume_i)_{y} * q_{i,y+1})} - 1$$

$$i = Product\ i$$

$$N = Number\ of\ products$$

$$q_i = \text{Quantity}\ of\ product\ i$$

$$y + 1 = Forecasted\ year$$

7.3 Data sources

Another aspect that needs to be revised is which data sources to use for the different factors when calculating the conversion factor. During this study it has become clear that for some factors different data exist of the same measurement and which data to use for the factors included in the conversion factor is not clearly defined. The investigation of which data sources that are relevant to use is excluded of the scope of this study, but is important to define in order to improve the quality of the conversion factor.

8 References

Literature, interviewees and electronic sources used to carry out this thesis is presented in this chapter.

8.1 Literature

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8.2 Electronic sources

IKEA webpage (a) – Our business Idea
http://www.ikea.com/ms/en_US/about_ikea/the_ikea_way/our_business_idea/index.html (2010-10-24)

IKEA webpage (b) – About the IKEA concern
http://www.ikea.com/ms/sv_SE/about_ikea/facts_and_figures/about_ikea_group/index.html (2010-10-20)

IKEA webpage (c) –Facts and figures
http://www.ikea.com/ms/sv_SE/about_ikea/facts_and_figures/ikea_group_stores/index.html
(2010-10-27)

www.process.nu (a) - http://www.process.nu/default.aspx?ID=10 (2010-07-21)

www.process.nu (b) - http://www.process.nu/default.aspx?ID=11 (2010-07-21)

www.businessdictionary.com -
http://www.businessdictionary.com/definition/Pareto-principle.html (2010-10.27)

8.3 Interviews

Eighteen persons within IKEA and three outside IKEA were interviewed in order to collect information about the research questions.

8.3.1 Persons within IKEA

Alingfeldt, Lars-Henrik	(2010-08-16)
Askenberger, Per	(2010-08-16)

Bergstrand, Henrik	(2010-06-15, 2010-08-27)
Björnsson, Paul	(Continuously during 2010-06-07 to 2010-10-29)
Dickner, Allan	(2010-08-10)
Ellesson, Torbjörn	(2010-08-07)
Ericsson, Bo	(2010-06-15)
Gieselsson, Monica	(2010-09-16)
Gustavsson, Per-Olof	(2010-08-10)
Jensen, Lucie	(2010-08-10)
Johansson, Cecilia	(2010-08-26)
Johansson, Helena	(2010-08-11)
Mackie, Iain	(2010-08-26)
Paul Saar	(By e-mail during the period 2010-06-07 to 2010-10-04)
Schwartz, Tomas	(2010-06-08)
Skarstam, Niklas	(2010-09-14)
Stjernfeldt, Tommy	(2010-06-15)
Sunesson, Björn	(2010-07-21)

8.3.2 Persons at the University

Marklund, Johan	(2010-06-09)
Nilsson, Bertil	(2010-07-21, 2010-09-02)

Olsson, Fredrik (Continuously during 2010-06-07 to 2010-10-29)