Eindhoven University of Technology

MASTER

Space management in the fashion retail industry

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Award date:
2012

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Space management in the fashion retail industry

by
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in partial fulfilment of the requirements for the degree of

Master of Science
in Operations Management and Logistics

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Series Master Theses Operations Management and Logistics

Subject headings: fashion retail, space management, sales forecasting
Abstract

Space management in the fashion retail industry receives more and more attention as a way to enhance the store’s sales. In this study, space management is investigated by determining the departments that a store should contain, and subsequently, the size of these departments. Regression analyses show that the sales of a store can be predicted with a forecast accuracy of 88.3%. In addition, it shows that the numbers of visitors and equivalents (i.e. the size of a store) greatly influence the sales. Subsequently, the stores are grouped and quantitative, as well as qualitative, research provides insights into the other variables that influence the store’s performance. Finally, recommendations are provided about which departments each store should contain, and how the division of these departments within the store should be, to maximize sales. In general, a Men’s-Boys’ store is preferable for generating the highest sales.
Acknowledgements

This report is the result of my Master Thesis Project, which has been executed to obtain the degree of Master of Science in Operations Management and Logistics at Eindhoven University of Technology. I have performed this project between March 2012 and August 2012 on behalf of WE Fashion. During this project, I learned much about fashion retailing and space management. I found out that it is very difficult to allocate space for a fashion retailer, based on historic sales results. I hope that my research will contribute to this.

From WE Fashion, I would like to thank my colleagues from the Retail Operations team. It has been a pleasure to be a part of your team and to learn more from you about retail operations and its possibilities and threats. My special thanks go to Jan Kamp and Hieke Bakker, whose enthusiasm about my research and valuable feedback has brought my thesis to a higher level. Moreover, thank you for given me the opportunity to execute my Master Thesis Project at WE Fashion.

From Eindhoven University of Technology, my special thanks go to Karel van Donselaar, my first supervisor from the OPAC group. I enjoyed the discussions I had with you about my research. Besides, I appreciate that you have put me back on track if that was necessary. Your enthusiasm about investigating fashion retailing, which was also a relatively new part of retailing for you, has been a source of inspiration and I am very grateful for your support. In addition, I would like to thank my second supervisor, Jeroen Schepers from the ITEM group. I have really appreciated your valuable suggestions and feedback, your new insights and ideas have improved the quality of my work.

Finally, I would like to thank my boyfriend, parents and friends for their continuous support during this final phase of my studies. Thanks to you I got the chance to experience very enjoyable and valuable years as a student, at which I will look back with good feelings.

Esther van den Aarssen
Utrecht, August 2012
Executive summary

WE Fashion (WE) is a fashion retailer that sells their products via their own stores. WE initiated this master thesis project with the objective of obtaining more insight into which departments (Men’s, Women’s, Boy’s, or Girl’s) a store should contain, and subsequently, what the size of each department should be. Each store contains one or more departments. A combination of departments in a store is called a format. This research includes only the formats MB (Men’s-Boy’s store), MBG, MWB, MWBG, and W. Besides the selected formats, the research is focused on stores in The Netherlands and Belgium, and on the stores that were open during whole 2011.

In the stores the apparel is displayed on furniture, e.g. a wall unit or a table. Depending on the size of the particular furniture, the furniture can be translated into equivalents. For instance, a standard wall unit of 1.20 meter can be used for 60-80 products and is counted as one equivalent (EQ). Therefore, the size of the departments is expressed in terms of equivalents.

Problem definition and research design

The research question is defined as: How can the turnover of each store be optimized by adjusting the format and sizes of the departments? Moreover, the other variables that have a significant influence on the store’s sales are identified. These are called the control variables.

The research involves three steps that result in an answer for the research question. Step 1 contains the regression analyses. The regression models are used to predict the sales of the stores. Moreover, the regression models are used to identify and rank the control variables. The control variables included in the regression analyses were proposed by experts within WE or were obtained from the literature. Subsequently, Step 2 groups the stores, based on the current format of the stores and the control variable with the greatest influence, i.e. the number of visitors per year. Additional best practice analyses are executed for each class in this grouping. Finally, Step 3 optimizes the total sales of each class in the grouping by providing recommendations regarding the best division of the departments.

Results

Step 1 Regression model

Step 1 contains the development of a linear regression model. The regression analyses show that the store’s sales can be predicted with a forecast accuracy of 88.3 %. The regression model uses the sizes of the departments as fixed predictor variables. Using the forecasted number of visitors instead of the actual number of visitors (which is not known in advance), does not result in a significantly lower forecast accuracy. The formula of the best regression model is:

\[
\begin{align*}
\text{Log total sales } 2011_i &= 5.759 + 0.249 \times \text{Perc. Men}_i - 0.007 \times \text{Perc. Boys}_i + 0.232 \times \text{Perc. Girls}_i \\
&+ 0.0000000887 \times \text{Visitors } 2011_i - 0.074 \times \text{Banding } 2011_i + 0.002 \times \text{Total EQ}_i \\
&+ 0.030 \times \text{Presence The Sting}_i + \varepsilon_i
\end{align*}
\]

The best regression models are obtained by using the ‘LogSales’ and the ‘Sales per Visitor’ as dependent variables. The LogSales is a logarithmic transformation of the sales, such that the assumptions of linear regression are met. The sales estimation is recalculated from the predicted LogSales.
Table A provides the standardized coefficients Beta of these two regression models. This is a relative measure which can be used to compare the influence of variables with each other. For example, the size of the Men’s department has a greater influence on the sales per visitor than the size of the Boy’s department. Moreover, for instance, the presence of a C&A in the same area as the WE store has a stronger negative influence on the sales per visitor than the presence of a Zara. However, the findings have to be applied with caution, due to the limitations in the data.

Furthermore, Table A shows that the variables ‘number of visitors per year’ and ‘total number of equivalents’ are the most influential control variables on the store’s sales.

<table>
<thead>
<tr>
<th>Standardized Coefficients Beta</th>
<th>LogSales</th>
<th>Sales/Visitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perc. Men</td>
<td>0.258</td>
<td>0.410</td>
</tr>
<tr>
<td>Perc. Boys</td>
<td>-0.003</td>
<td>0.342</td>
</tr>
<tr>
<td>Perc. Girls</td>
<td>0.045</td>
<td>0.096</td>
</tr>
<tr>
<td># Visitors</td>
<td>0.467</td>
<td></td>
</tr>
<tr>
<td>Total # equivalents</td>
<td>0.304</td>
<td>0.194</td>
</tr>
<tr>
<td>Banding (assortment depth and width)</td>
<td>-0.292</td>
<td>-0.363</td>
</tr>
<tr>
<td>The Sting*</td>
<td>0.065</td>
<td></td>
</tr>
<tr>
<td># residents 0-17 years</td>
<td></td>
<td>-0.253</td>
</tr>
<tr>
<td>% Visitors of # residents in city</td>
<td></td>
<td>-0.245</td>
</tr>
<tr>
<td>Shopping centre vs Dummy city centre**</td>
<td>0.214</td>
<td></td>
</tr>
<tr>
<td>C&amp;A*</td>
<td>-0.171</td>
<td></td>
</tr>
<tr>
<td>Avg. Income per resident</td>
<td>0.153</td>
<td>-0.123</td>
</tr>
<tr>
<td>Zara*</td>
<td></td>
<td>-0.098</td>
</tr>
<tr>
<td>BVO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Presence of the competitor in the same area as the WE store: Yes (‘1’) or No (‘0’)
** WE store located in a city centre (‘1’) or in a shopping centre (‘0’)

Table A Standardized coefficients Beta

**Step 2 Grouping stores**

Step 2 groups stores, such that recommendations can be provided for each group of stores (class) regarding the best format and division of departments. The stores within a certain class are comparable with each other, therefore, they should have the same preferable format and division of departments. The stores are grouped based on their current format and the number of visitors per year. These criteria are used because the grouping based on the format of the stores compensates the problem of the big collection differences between the departments. Moreover, the number of visitors turned out to be the variable with the greatest influence on the store’s sales, see Step 1.

Subsequently, best practice analyses are performed for each class to obtain more insight into the other variables that result in higher or lower sales for a store. The analyses show that differences in performance are mostly caused by specific circumstances in a particular store or city. However, t-tests show that these differences are not statistically significant.

Additionally, best practice analyses are executed for each format separately. These more detailed analyses show that the variable ‘economical environment city’ has a significant influence on the sales of the stores with a Women format. Moreover, the performance of the stores with the format Men-Women-Boys(-Girls) differs significantly depending on internal variables, namely ‘attractiveness store’, ‘division departments’, and ‘accessibility store internal’. Unfortunately, not all variables could be included into the regression analyses because not all of the data are available.
Table B provides the results of the best practice analyses. Each variable is measured with a Likert scale from 1 (strong positive effect on the store’s sales) to 5 (strong negative effect) (Blumberg, Cooper, & Schindler, 2005).

<table>
<thead>
<tr>
<th>Lowest/ highest performing stores</th>
<th>Format (class)</th>
<th>W (1a, 3a)</th>
<th>MB(G) (1b, 3b)</th>
<th>MWB(G) (1c, 3c)</th>
<th>Avg.</th>
<th>W (1a, 3a)</th>
<th>MB(G) (1b, 3b)</th>
<th>MWB(G) (1c, 3c)</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response rate</td>
<td></td>
<td>83%</td>
<td>88%</td>
<td>100%</td>
<td>90%</td>
<td>50%</td>
<td>50%</td>
<td>67%</td>
<td>55%</td>
</tr>
<tr>
<td><strong>Internal variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Format store</td>
<td></td>
<td>2,4</td>
<td>2,9</td>
<td>2,8</td>
<td>2,7</td>
<td>3,3</td>
<td>3,5</td>
<td>3,3</td>
<td>3,1</td>
</tr>
<tr>
<td>Quality store manager and team</td>
<td></td>
<td>2,6</td>
<td>2,4</td>
<td>2,0</td>
<td>2,3</td>
<td>3,7</td>
<td>3,5</td>
<td>3,3</td>
<td>2,9</td>
</tr>
<tr>
<td>Attractiveness store</td>
<td></td>
<td>2,2</td>
<td>1,7</td>
<td>3,0</td>
<td>2,3</td>
<td>2,7</td>
<td>3,8</td>
<td>3,8</td>
<td>3,0</td>
</tr>
<tr>
<td>Division departments</td>
<td></td>
<td>3</td>
<td>2,7</td>
<td>2,7</td>
<td>2,8</td>
<td>3,0</td>
<td>2,5</td>
<td>3,0</td>
<td>2,9</td>
</tr>
<tr>
<td>Surface store</td>
<td></td>
<td>2,6</td>
<td>2,6</td>
<td>3,0</td>
<td>2,7</td>
<td>3,0</td>
<td>2,3</td>
<td>3,5</td>
<td>3,1</td>
</tr>
<tr>
<td>Accessibility store</td>
<td></td>
<td>2,8</td>
<td>2,9</td>
<td>2,7</td>
<td>2,8</td>
<td>3,3</td>
<td>3,5</td>
<td>3,0</td>
<td>2,9</td>
</tr>
<tr>
<td><strong>External variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractiveness centre</td>
<td></td>
<td>3,4</td>
<td>2,1</td>
<td>2,0</td>
<td>2,4</td>
<td>3,0</td>
<td>4,3</td>
<td>5,0</td>
<td>3,4</td>
</tr>
<tr>
<td>Economical environment city</td>
<td></td>
<td>3,4</td>
<td>2,3</td>
<td>2,7</td>
<td>2,7</td>
<td>4,0</td>
<td>3,5</td>
<td>3,8</td>
<td>3,3</td>
</tr>
<tr>
<td>Competitors</td>
<td></td>
<td>2,4</td>
<td>2,4</td>
<td>3,2</td>
<td>2,7</td>
<td>2,7</td>
<td>3,3</td>
<td>4,0</td>
<td>3,2</td>
</tr>
<tr>
<td>Accessibility store</td>
<td></td>
<td>2,6</td>
<td>3,0</td>
<td>2,5</td>
<td>2,7</td>
<td>3,0</td>
<td>3,8</td>
<td>2,5</td>
<td>2,7</td>
</tr>
</tbody>
</table>

Table B Best practice analyses

**Step 3 Store optimization**

Step 3 optimizes each class by adjusting the division of the departments. The research shows that the performances of the Men’s and the Boy’s departments are higher than the performance of the Women’s and the Girl’s departments, based on the sales per equivalent. Especially for the Women’s department, this lower performance is caused by a lower performance of the collection. However, due to strategic reasons and investments that have already been made, WE stated that stores should also contain Women’s and Girl’s departments. Therefore, it was decided to maintain the current format of the stores.

The recommendations regarding the best division of the departments in the stores are obtained by using a Linear Programming (LP) model. This LP model maximizes the total sales of the stores in each class by taking into account the restrictions of WE regarding the minimum and maximum sizes of the departments. Table C provides the best division for each class. Reallocation of the equivalents among the departments will generate approximately 1% extra sales in comparison with the current division of the departments.
Subsequently, proposals are provided on how the format of the stores might be improved. This information can also be used for new stores. Firstly, the stores are grouped based on the number of visitors per year (which can be predicted with the regression model) and the number of equivalents (which is the second variable with the greatest influence on the store’s sales). Secondly, the format with the highest sales per equivalent is determined for each class in this grouping. Table D shows this preferred format for each class in the grouping. Finally, when the preferred format of a store is known, Table C can be used to determine the best division of the equivalents within this format.

<table>
<thead>
<tr>
<th>Grouping Equivalents</th>
<th>Total EQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>&lt; 80*</td>
</tr>
<tr>
<td>&lt;150,000</td>
<td>MB</td>
</tr>
<tr>
<td>150,001-250,000</td>
<td>MB</td>
</tr>
<tr>
<td>&gt;250,000</td>
<td>(W)***</td>
</tr>
</tbody>
</table>

* Stores with < 80 EQ should contain a Men or Women department.
** Stores with > 160 EQ should contain a Men and Women department.
*** This class contains only stores with a W format. Therefore, stores could not be compared.

General Applicability

The general applicability of the findings is investigated for other countries, formats, and years. The forecast accuracy remains in all cases above 80%. In addition, in other countries, formats, and years, the Men’s and Boy’s departments are also performing better than the Women’s and Girls’ departments. Hence, the procedure to determine the best format and size of the departments, as described in Step 3, can be generalized as well to these situations. However, further investigation is required to determine the preferred formats and division of the departments in these stores.

Conclusions

In conclusion, the research question can be answered by generally stating that a Men-Boys format is preferred above other formats. The Men’s and Boy’s departments are generating the highest sales per equivalent, therefore, these departments should receive the highest number of equivalents. In all cases, the restrictions provided regarding the minimum and maximum number of equivalents for each department should be taken into account. It should be noted that the recommendations should be applied to the stores with caution, because specific circumstances in a particular store or city can have a contradicting effect on the store’s sales.

Recommendations future research

It is recommended to investigate the influence of the size of the departments more extensively, for example: the relation of the size of the department to the sales per equivalent; the minimum and maximum size of the departments; and a variable division of equivalents within a year. Furthermore, extra research is required regarding the implementation of the exchange of equivalents among departments, namely, which styles (e.g. Business, Smart or Casual) within a department should be expanded or reduced. In addition, to improve the regression models, extra data should be gathered regarding for example the quality of the store managers, the presence of competitors, and demographic variables. Finally, more research is also required to determine the influence of the internal and external variables.
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IX
1. Introduction

WE Fashion is a fashion retailer that sells their products via their own stores. WE Fashion initiated this master thesis project with the objective of obtaining more insights into which departments (Men’s, Women’s, Boys’, or Girls’) a store should contain, and subsequently, what the size of each department should be.

This chapter presents background information regarding this research project. Paragraph 1.1 describes the structure of the report. Paragraph 1.2 introduces WE Fashion by providing a general description of the company. The problem environment is described in paragraph 1.3. Subsequently, paragraph 1.4 introduces the problem that is investigated in this research.

1.1 Structure of report

This report is divided into five parts. The structure is based on the regulative cycle of van Strien (1997), which is shown in Figure 1.

Figure 1 shows that the regulative cycle consists of five elements. The first element is the ‘problem definition’. This element discusses the motivation for this research and the needs of WE Fashion. Based on this problem definition, a literature review is carried out in chapter 2.

The second element is the ‘research design’. This element translates the company needs into a research design and contains the methodology to investigate the problem. Chapter 3 analyzes the problem in detail: the research questions and the scope of the project are defined.

The third element discusses the ‘model results’. Chapters 4 and 5 elaborate this element and describe respectively the regression analyses and the best practice analyses. Subsequently, the chapters highlight the results of these analyses.

The results of the regression analyses and the best practice analyses are used to optimize stores. Moreover, the results are adapted such that they are applicable in practice. This is described in the fourth element of the regulative cycle, namely the ‘model adaption’. Chapter 6 describes this element.
Furthermore, chapters 6 and 7 discuss the last element, the ‘implementation & conclusions’. These chapters show how this research can be used, in order to solve the problem which is identified in the first part. Subsequently, chapters 8 and 9 provide a final discussion and conclusion.

1.2 Company description

This research performs a case study within WE Fashion, further named as WE. This paragraph provides a brief description of the company.

WE is an originally Dutch, slightly upmarket, fashion retailer selling clothing, shoes, bags, and accessories of its own WE clothing brand. Initially, WE only operated in the Netherlands, however, there are currently over 240 stores with 3,000 employees across 7 European countries. Besides the Netherlands, WE has stores in Belgium, Luxembourg, Germany, France, Austria, and Switzerland. Since 2009, WE has a webshop as well. Moreover, WE has a partnership with Uniquepai in China since 2010. The organization’s international distribution centre and head office are located in Utrecht, The Netherlands. WE Fashion is part of the European fashion group LOGO International, which also owns O’Neill, the Swiss lingerie chain Beldona, wholesaler Waalwear and the Setpoint chain.

The mission of WE is to inspire people to express their personal style (WE Fashion the company, 2009). Moreover, WE focuses on good designs with a North European feel instead of the latest fashion trends. The target group of WE are men and women aged between 25 and 35 and kids aged between 2 and 12. The collections and stores of WE are trying to inspire the customers to find their own style. The Men’s and Women’s collections are within the casual, smart and business segments. WE intends to bring fashion and lifestyle together into a New Store Concept (NSC), i.e. a new design of a store with new furniture that gives the brand more personality. The NSC is focusing on inspiring people and creating a feeling of a ‘third place’: a place where people are happy to spend their time alongside home and work. Since the introduction of the NSC in 2010, 22 stores are launched with this new concept.

WE is established in 1917 as a wholesaler specialized in men’s fashion articles. The history of WE starts in 1962 when the first retail business is opened with the name ‘HII’ (Dutch for ‘He’). This store solely sells men’s fashion. In 1986 followed a separate chain offering women’s wear called ‘ZII’ (Dutch for ‘She’). Those names were changed to WE Men, WE Women and WE Stores (i.e. a Men’s and Women’s department in one store) when the company decided to open branches internationally in 1999 (WE Fashion the company, 2009).

WE is a vertical organization which means that the whole process is executed ‘in house’, including designing collections, buying the assortments, and sales via its own stores.

1.3 Problem environment

This paragraph describes the environment in which the research is executed. Firstly, the terms are described that are commonly used throughout this report. Secondly, the development of the turnover of the departments is globally investigated with respect to different years and to the total market. Finally, this paragraph describes the distribution of the stores over the different countries and the distribution of the formats.

Terminology

Each store contains one or more of the following departments: Men’s, Women’s, Boys’, and Girls’. A combination of departments in a store is called a format.
Naturally, in the stores the apparel is displayed on furniture, e.g. a wall unit or a table. Depending on the size of the particular furniture, the furniture can be counted as comparable equivalents. A standard wall unit of 1.20 meter can be used for 60-80 products and is counted as one equivalent (EQ). For example, a round table is counted as four EQ because it can display approximately 250-300 products (WE Fashion, 2011). Therefore, the size of a department can be expressed in terms of equivalents.

**Turnover departments**

The objective of this master thesis project is to optimize the turnover of the stores by adjusting the format and the size of the departments within that store. Therefore, a global investigation is performed to obtain insights into the development of each department among the years. In addition, the market share of each department is examined.

The systems of WE provide access to data from 2002 until 2012 (budget). Figure 2 shows the indexed turnover for Europe per year from 2002 until 2012. The total turnover in Europe in 2011 is used as a basis (index 100). The total turnover and the turnover per department are shown. The stores in The Netherlands encounter the same trend. Figure 2 shows that 2005 and 2007 had the highest growth in turnover, while WE encountered a decline in turnover in 2008 and 2010. The highest turnover is achieved in 2009.

![Figure 2 Indexed turnover per year (WE MicroStrategy Web, 2012)](image)

Table 1 shows an overview of the total fashion market in The Netherlands from February 2010 until January 2011. The kids market is defined as the fashion for kids aged below 12. The adults market is for people aged above 12. Table 1 shows that the total women’s market is more than 1.5 times bigger than the men’s market, while the market share of WE in the men’s market is more than 1.5 times bigger than the women’s market. This remarkable fact is due to the history of WE, i.e. WE is settled for a longer time in the men’s market than in the women’s market, according to paragraph 1.2.

<table>
<thead>
<tr>
<th>Department</th>
<th>Total market</th>
<th>WE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>34%</td>
<td>4%</td>
</tr>
<tr>
<td>Women</td>
<td>57%</td>
<td>1%</td>
</tr>
<tr>
<td>Boys</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td>Girls</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>3%</strong></td>
</tr>
</tbody>
</table>

*Table 1 Total fashion market in The Netherlands in millions (Source: GFK Panelservice, CBS, WE MicroStrategy Web, 2011)*
Paragraph 1.2 described that WE owns stores in seven European countries. The exact number of stores is changing continuously: stores are closed, new stores are opened, and stores are renovated. Figure 3 provides an overview of the distribution of the stores in Europe that were open during whole 2011.

Stores can have different formats. A format can be defined as a certain combination of departments, i.e. a combination of Men’s (M), Women’s (W), Boys’ (B), and Girls’ (G) departments. WE uses ten different formats. More formats are possible, however, not all formats are used. For example, the format MG (Men and Girls) is not used as a format, because it logically does not make sense to sell only Men’s and Girls’ wear together. Figure 4 shows an overview of the distributions of formats through the open stores in The Netherlands and Belgium in 2011. Only the stores in The Netherlands and Belgium that were open during complete 2011 are taken into account in this research, see chapter 3. The MB format is mostly used in stores because of historical reasons, namely, WE started as a menswear specialist, see paragraph 1.2.

1.4 Problem introduction

This section contains the first element of the regulative cycle by Van Strien (1997), see Figure 5. Namely, this paragraph introduces the problem.

Currently, it is hardly possible to compare stores, due to the fact that stores differ in format, the number of visitors, turnover, surface, implemented store concept, store manager, etcetera. If, for instance, a MB store can be expanded, analyses have to be made for the destination of this new surface, i.e. if the highest turnover can be generated by expanding the Men’s department or by adding a Women’s department. However, it is hardly possible to make well underpinned recommendations, because fully comparable stores are not available.

A second problem within WE regarding the allocation of departments, is that WE lacks a standard method for determining the required size of a department. Currently, the Sales department firstly
defines the format of a store. Secondly, a project group, which consists of the departments Sales and Store design and a Visual Merchandiser, determines the size of each department. In this decision making process, the architecture of the building (e.g. the shape of the building, columns in the store, and the number of floors) is of major importance. Moreover, the decision regarding the required sizes of the departments is based on experience and ‘gut feeling’ of the project group. Therefore, it is preferable to have an objective model on which decisions can be based.

Problem definition

From the context above, the problem definition is phrased below. The format of a store is defined as the combination of Men’s, Women’s, Boys’, and Girls’ departments in the store.

| WE Fashion does not have an objective, standardized method to determine for each store the optimal format and size of each department. |

As described above, WE is lacking an objective, standardized method, such that stores can hardly be compared with each other and general recommendations can hardly be provided.

Research objectives

The purpose of this research is twofold. At the academic level, the research aims to contribute to the scientific literature on fashion retail and space management. The literature gap is identified in paragraph 2.4. The practical goal of this research is to develop a method that can be used to optimize the turnover of a store by adjusting the format and the division of the departments within a store.
2. Review of relevant literature

This chapter discusses existing literature that is relevant for this research. Paragraph 2.1 describes the general characteristics of the fashion retail industry. Paragraph 2.2 contains an overview of the literature about quantitative space management models. The environmental factors that influence the buying behavior of customers, i.e. the atmospherics, are described in paragraph 2.3. Finally, paragraph 2.4 identifies the gap in the literature and describes the opportunities of this research to fulfill a part of this gap.

2.1 Fashion retail industry

This paragraph describes the general characteristics of the fashion retail industry.

The fashion industry is often considered as the apparel sector, which is indeed the main component (Priest, 2005). According to the fashion theory of Blumer (1969), the word ‘fashion’ is used to describe trends that evolve in a spontaneous way in accordance to the spirit of the time. Therefore, ‘fashion’ is not only applicable to the apparel sector, but can also be used for companies operating in related sectors, for instance, accessories and shoes (Brun, Caniato, Caridi, & Castelli, 2008).

Literature identifies the general characteristics of the fashion industry: short lifecycles, low predictability, high volatility, high importance of service, high importance of presentation, and high-impulse purchasing (Bruce & Daly, 2006, Brun et al., 2008, Christopher, Lowson, & Peck, 2004, Turley & Milliman, 2000).

Retailers are at the end of the supply chain, and are responsible for the sale of physical goods from a fixed location, i.e. shops or stores, in small or individual lots for direct consumption by the purchaser (Ploos van Amstel & van Goor, 2006). Retail connects the products of the supply chain with the customers, and is therefore highly important for a company. Much research regarding supply chain management and the fashion retail industry is focusing on decreasing the lead time within the supply chain. Models are developed that tries to decrease the response time, such that the retailer and the supply chain can react faster on the varying demand (Christopher et al., 2004, Fisher, Hammond, Obermeyer, & Raman, 1997). Commercial success or failure is largely determined by the organization’s flexibility and responsiveness, therefore, the attention of research in the area of supply chain management in the fashion industry is increased during the last years (Bruce, Daly, & Towers, 2004, Christopher et al., 2004).

2.2 Space management

This paragraph provides an overview of the available literature about quantitative space management models. Literature about shelf space allocation in the fashion retail industry is unfortunately hardly available, nevertheless, much literature can be found about this topic in the food retail industry. The differences and similarities between these two sectors are described in Appendix A.

In this paragraph, the most influential model in the food sector is described. Subsequently, recommendations are provided to use and adopt models about space management from the food sector to the fashion industry.
Space management models

The allocation of shelf space is an important aspect of a retailer’s sales and operational costs. The central strategic problem for the retailer is to anticipate and adapt to new tastes and changing product life cycles. Corstjens & Doyle (1983) are the first, and most influential, researchers that have developed a dynamic optimization model, instead of a static model. The dynamic model takes into account the market dynamics that retailers encounter. With the dynamic model it is for instance possible to allocate more space to new products and to divest earlier from declining products.

The key variables in the dynamic model of Corstjens & Doyle (1983) are: relative profit margins, sales, elasticities and cross elasticities (i.e. assigning more space to product A affects the available space for product B, and hence, the sales of product B), product growth rates, relative growth rates, and the discount rate. The objective of the dynamic model for space allocation is to maximize the profit of the retailer. The model determines the preferred ratio in space between two products.

Appendix A describes that the food and the fashion retail industry have a few main differences, however, the key ideas of the models from the food sector can be adjusted and used for the fashion sector as well. For instance, the space management model of Corstjens & Doyle (1983) determines the ratio of space between two products in the food retail industry. This model can be adjusted such that it is applicable for the fashion retail industry as well. An application of this model can be to determine the ratio of space between two departments in a fashion store, e.g. the percentage of the Men’s and Women’s departments in a store.

However, by implementing models from the food sector into the fashion sector, the differences between the sectors cannot be ignored. Therefore, the adjusted model for the fashion retail industry needs to take into account the fact that the predictability of the products in the fashion sector is lower than the predictability of the products in the food sector. The predictability of the products in the fashion sector is lower, because the fashion sector is more liable to life-cycles, the economy, the quality of service, impulse purchasing, and price and quality of the assortment.

Hence, the model of Corstjens & Doyle (1983) is not used in this research, because the profit and costs, and the stock of the departments are not taken into account.

Capacity management

Besides the product allocation and size of the departments, another aspect of space management is capacity management. Capacity management is defined as the management of the limits of an organization’s resources, such as its labor force, manufacturing and office space, technology and equipment, raw materials, and inventory (Chiang, Chen, & Xu, 2007). Most literature about capacity management in the retail industry is focusing on services (Wilson, Zeithaml, Bitner, & Gremler, 2008).

In the context of this project, capacity management is related with the best use of the available furniture in a store. The demand can exceed the available capacity (i.e. furniture), because the demand per department varies during a year, i.e. peaks in demand require more furniture to store more products. Moreover, the capacity can exceed the demand as well. Generally, two strategies can be applied for matching supply and demand: shifting demand to match capacity, and flexing capacity to meet demand (Klassen & Rohleder, 2002). Shifting demand in a retail environment is for instance done with promotions. Flexing capacity is for instance done by hiring part-time employees and to exchange furniture between departments (Wilson et al., 2008).
2.3 Atmospherics

This paragraph describes the environmental factors that influence the buying behavior of customers, i.e. the atmospherics. The atmospherics are investigated for this research, because quantitative models about space allocation are not fully able to predict the customer demand in a fashion retail environment, see paragraph 2.2. This paragraph describes a framework that shows the influence of the atmospheric variables on the buying behavior of customers. Moreover, this paragraph describes the different kinds of atmospheric variables.

Retailers spend yearly a huge amount of money on designing, building, and refurbishing stores. In addition, a lot of money is spent on hiring and training employees that interact with the customers. However, retailers do not always have the knowledge, or lack a systematic approach, to determine the appropriate mix of environmental factors that influence the shopping behavior (Baker, Grewal, & Levy, 1992). Therefore, besides the aspect of space management, there is another important variable which has a significant influence on the buying behavior of customers, namely the atmospheric effects (i.e. the environmental effects). ‘Atmospherics’ are defined as ‘the effort to design buying environments to produce specific emotional effects in the buyer that enhance his purchase probability’ (Kotler, 1973).

Most research about atmospherics is based on the influence of one particular variable on the turnover of a store, e.g. the influence of music (Areni & Kim, 1993, Milliman, 1982) or the influence of queuing (Wilson et al., 2008). These types of researches are executed with the use of an experiment, e.g. the music is varied in genre and volume by holding the other variables constant (Areni & Kim, 1993, Milliman, 1982). Research can be performed in a real store or in a fake, laboratory environment (Brüggen, Foubert, & Gremler, 2011). However, for most of the atmospheric variables no research is already executed. The next section provides a framework that categorizes the atmospherics and shows the influence that these atmospherics have on the buying behavior of customers.

Framework

The framework of Bitner (1992) is used as a basis for the literature review on the topic of atmospherics. This framework includes the five categories of store atmosphere, and is later modified by Turley & Milliman (2000) and Barry & Evans (1998). The framework visualizes the effect of the retail atmospherics on shopping behavior, and is shown in Figure 6. Appendix B provides a specification and examples of the five categories of store atmosphere. This master thesis project focuses on the division of the equivalents among the different departments, which is perceived as a variable in the category ‘Store layout’ (Bitner, 1992). The framework of Bitner (1992) is used to describe the different atmospherics and to describe the final effect on the performance of the store. However, the model will not be used in the rest of this master thesis project, because this framework ignores the direct effects of the atmospherics.

The concept of atmospherics is strongly related with the concept of servicescape (Bitner, 1992). The difference between these concepts is that atmospherics are factors that evoke pleasant feelings of a store while the servicescape is especially related to the physical surroundings, e.g. a new design of a store (van Heerden, Botha, & Durieux, 2009). Bitner (1992) included many of the aspects of servicescape into the framework of the atmospherics.
Figure 6 shows the effect of the store’s atmosphere on the shopping behavior. First, the physical environment is related with the individual customers’ characteristics and the individual employee’s characteristics to determine their response at a certain point in time. Second, the influence of the atmosphere in the store on both the customers and the store’s employees is modeled, i.e. the responses of the customers and the employees are modeled. Subsequently, the responses of the employees and the customers are influencing each other (Turley & Milliman, 2000).

Managers can use this framework to investigate and control the atmospheric elements in their shops such that the required responses can be achieved. By adjusting the atmospherics, managers can for instance communicate a desired environment (image) to a particular target market, and hence, a desired shopping behavior can be achieved (Turley & Milliman, 2000).
The literature review shows that there is enough evidence to state that the atmosphere has an effect on the shopping behavior of consumers. Hence, the store performance can be enhanced by managing these atmospherics (Turley & Milliman, 2000). However, retailers have to keep in mind that the responses to the shop environment are not universal. Different categories of consumers appear to behave differently when presented with the same atmospheric variables. These categories of consumers can for instance be divided by gender and age (Turley & Milliman, 2000). Research shows that consumers may not always be aware of the particular aspects of the retail atmosphere, even when it is influencing their behavior (Milliman, 1982).

2.4 Literature gap

This paragraph identifies the gap in the literature. The research aims to fulfill a part of this literature gap.

The most important gap in the literature is that the combination of space management and fashion retail is not made yet. Literature about space management is available, however, this literature is mostly applied to the food retail industry. Paragraph 2.2 provided focus points for adjusting these models to make them applicable for the fashion retail industry as well.

Furthermore, the available literature about fashion retail is mostly related to: the management of specific atmospherics, visual merchandising aspects, or to servicescape as a way of renewing stores. The impact of many of the atmospheric variables are not yet, or not fully, investigated. Moreover, no literature is known that ranks these variables on influence on the performance of stores. Furthermore, the available literature is mostly focusing on one specific atmospheric variable instead of a combination of variables. In addition, the current available literature about atmospherics is mostly using experiments to investigate the influence of the variables. Finally, there is no literature found that provides recommendations regarding the best format and sizes of the departments within a fashion retail environment.
3. Research design

Paragraph 1.4 introduced the problem and defined the problem definition. This chapter translates the problem definition into a research question. Subsequently, the research question is divided into sub questions. Paragraph 3.1 presents the research questions. The scope of the research is defined in paragraph 3.2. Paragraph 3.3 describes the data collection. Subsequently, paragraph 3.4 describes how these data are prepared for the analyses.

This chapter contains the ‘research design’, which is the second element of the regulative cycle (van Strien, 1997), see Figure 7.

3.1 Research questions

Paragraph 1.4 described the problem definition, namely: WE Fashion does not have an objective, standardized method to determine for each store the optimal format and size of each department. Not selecting the best format and the best division of the departments, can lead to a loss of sales. Therefore, an objective model is required that provides the best solution, based on best practice of other stores. The objective of this research is to develop such a model.

This paragraph translates the problem definition into a research question. Subsequently, the research question is divided into sub questions.

Research question

The objective of this research results into the following research question:

**How can the turnover of each store be optimized by adjusting the format and sizes of the departments?**

Besides the format and size of the departments, other variables affect the store’s sales. These influential variables are called the ‘control variables’. This research investigates these variables as well. Furthermore, the control variables are ranked, based on the degree of influence on the turnover of a store.

Sub questions

The research involves three steps that result in an answer for the research question. Step 1 contains the regression analyses. The regression models are used to predict the sales of the stores. Moreover, the regression models are used to identify and rank the control variables. Step 2 groups the stores with comparable stores into classes, such that recommendations for each class can be provided in Step 3. Additional best practice analyses are performed for each class in this grouping. Finally, Step 3 optimizes the total sales of each class in the grouping by providing recommendations regarding the best format and division of the departments. Each step is broken down into sub questions.
Step 1 Regression model

A regression model is developed to obtain insight into the influence of the format and the size of the departments on the turnover of a store. In addition, the regression model is used to identify the control variables. The regression model takes the following form (1):

\[
Sales_i = b_0 + b_1 \times Perc.\ Men_i + b_2 \times Perc.\ Boys_i + b_3 \times Perc.\ Girls_i + b_4 \times Format\ BG_i + \ldots + b_{12} \times Format\ MWBG_i + b_{13} \times X_i + b_{14} \times Y_i + b_{15} \times Z_i + \varepsilon_i\quad (1)
\]

The turnover of a particular store \(i\) is explained by the format of the store and the percentage of the equivalents for the Men’s, Women’s, Boys’ and Girls’ departments. WE distinguishes ten different formats, which are modeled as dummy variables. The control variables \(X, Y,\text{ and } Z\) are included in the regression model as well. Paragraph 3.4 describes the data analysis and the maximum number of control variables that can be included into the regression model. The constant \(b_0\) includes the factors that have an influence on the sales but that are equal for all stores, for example, the weather and the image of the WE brand. Finally, the regression model contains the error term \(\varepsilon\).

Regression analyses show the influence of the control variables. Hence, the regression describes which control variables should be included and excluded into the regression model.

1. Which potential control variables can be identified out of interviews with experts?
2. Which potential control variables are already investigated in the literature and have these variables a significant influence on the turnover of a store?
3. Which potential control variables have the greatest influence on the store’s sales, based on the available data?

Step 2 Comparable stores

Once the regression model is completed, the stores are divided into classes, based on these control variables. The stores are grouped, such that recommendations can be provided for each group of stores (class) regarding the best format and division of departments that each class should have. The stores within a certain class are comparable with each other, therefore, they should have the same preferable format and division of departments. However, within a class, turnover can still differ a lot between stores. Therefore, a best practice research (Blumberg et al., 2005) is executed, i.e. the stores with the highest and the lowest turnover are investigated to determine the other factors that have an influence on the turnover. These findings are compared with the results of the regression analyses.

4. Based on which criteria can the stores be divided into classes, such that the stores within a certain class are comparable with each other?
5. What are the reasons that stores within a class perform better or worse than the other stores in that class?

Step 3 Recommendations stores

Step 2 divided stores into classes with comparable stores. Step 3 optimizes each class by adjusting the format and division of the departments. The recommendations are found by using a Linear Programming (LP) model. The restrictions set by WE are included in the LP model. Furthermore, Step 3 provides insights into the performance of the different departments and formats.
6. Which restrictions have to be taken into account in optimizing the stores and classes, and how does the final Linear Programming model look like?

7. How and which recommendations can be made for each class regarding the best format and size of the departments?

8. What is the expected increase in turnover per class by applying the recommendations?

9. How can the model be generalized to other countries, formats, years, and to new stores?

3.2 Scope

Due to the restrictions in time and available data, the scope is determined.

Only the stores that were open in entire 2011 are taken into account. In addition, only the open stores in The Netherlands and Belgium are included. Moreover, five of the ten formats are not investigated, because from these formats, not enough data points are available. These three restrictions are set to be able to use sufficient, reliable, recent, and comparable data. Additional explanation of these restrictions can be found in paragraph 3.4.

Furthermore, the research is focusing on current stores with their current number of equivalents as fixed. The research does not include new stores. In addition, the sales via e-commerce are excluded, because this channel is not limited with respect to available space for a certain group.

The control variables included in the model, i.e. the variables that have an influence on the turnover of a store, are restricted due to time restrictions and restrictions in the availability of data. Therefore, only the control variables are taken into account that are proposed in the interviews or in the literature. Basically, all resources are used to collect the data of these control variables. However, it is still possible that some data are unavailable or too confidential. The data collection is explained in depth in paragraph 3.3.

The research question, as given by WE, is focusing on increasing the turnover per store by adjusting the format and the size of each group. Therefore, the costs and the gross and net margin are not taken into account. Moreover, the research is based on the turnover of a store and not on the unit sales, the number of transactions, the stock and turnover rate, etcetera. The focus of the project is on space management and its opportunities to increase the sales of a store.

The size of a department is defined by the number of equivalents used, instead of the number of square meters. This method is used because the number of furniture (and therefore the number of products) based on the number of square meters can vary a lot between stores, for instance due to a non-regular form of a store or because of variations in the width of an aisle, which is not the case with equivalents. Moreover, store managers can easily count the furniture used for a certain department, which is easily calculated into the number of equivalents, while the number of square meters is not easy to measure. Nevertheless, the density of the equivalents (number of square meters per equivalent) is included as a control variable. In November 2011 a furniture count is accomplished. Unfortunately, it appears that mistakes are made, because the stores had to count the equivalents instead of the furniture. Therefore, for this master thesis project, a new furniture count is completed in March 2012. In this count, the stores had to count the furniture types, which are transformed into equivalents by a
computer system. This method decreases the number of mistakes that can be made about the number of equivalents. However, these data about the number equivalents in March 2012, being the most reliable data, are applied to the sales data of 2011. Moreover, experts within WE, i.e. the visual merchandisers and the space management department, explained that it is unusual that departments exchange many furniture regularly.

3.3 Data collection

This paragraph describes the data gathering.

In this research, the main unit of analysis (the dependent variable) is the turnover of a store (Blumberg et al., 2005). This information is available within the systems of WE. It is chosen to use the most recent data of a complete year as a starting point, which is 2011, to be able to provide general recommendations that can be used during the entire year.

In addition, data about the independent variables are collected. The data about the formats used in the stores are available within WE. The percentage space of each department within a store is measured with the number of equivalents that each group occupies. A frequent counting method for counting the equivalents is set up in spring 2011. However, problems have arisen with this counting method, such that this data are not reliable. Therefore, as a part of this project, a new count is performed. Paragraph 3.2 explained this problem with the previous counts.

Data about the control variables are partly available, and are partly investigated during this project. Data of control variables that are available in the systems of WE are mainly data about internal aspects, for instance, the number of visitors, and if the old or new store concept is used in the store. Data that are not directly available are mainly data about external aspects, for instance, information about the competitors in each store area, and demographical information. The missing information is collected via other departments and companies, e.g. via CBS (the central office of statistics) is data gathered about the demographical variables. The worst case scenario about the data collection is that data about a specific variable cannot be obtained, entailing that this variable should be excluded from the analyses.

Interviews with the experts within WE are hold with employees from the following departments: Space Management, Retail Operations, Planning, Store Design, Real Estate, Visual Merchandising, Visual Merchandising Concept Managers, Finance, Buying, Area Managers, Human Resources, and Sales.

3.4 Data analysis

After collecting the data, the data are selected and prepared for the analyses. This paragraph explains this process.

Minimum sample size

For an optimal analysis, sufficient data points should be collected. There are many rules of thumb for calculating the optimal sample size, for instance ten times the number of predictors (Park & Dudycha, 1974), or the more conservative formula of Green (1991): \( n = 50 + 8k \), where \( k \) is the number of predictors and \( n \) the required number of data points. There are also power based formulas, like the one proposed by Dupont & Plummer (1998), which calculates the required sample size based on a sample of the data. Others have suggested a minimum sample size, e.g. (Pedzahur, 1997), however, this minimum varies across papers. The main guideline for predictive analysis is: the more is better.
By applying the rules of thumb of Park & Dudycha (1974), the countries with less than ten stores are not taken into account. Therefore, Luxembourg, France, and Austria are not included. The remaining stores are in The Netherlands, Belgium, Germany, and Switzerland.

As described in paragraph 1.3, WE uses ten formats. However, of these ten formats, only five formats are used in more than ten stores. According to Park & Dudycha (1974), only the five formats that have more than ten observations (stores) will be included, i.e. the formats MB, MBG, MWB, MWBG, and W.

Outliers

Before starting with the analysis, the outliers in the data are identified. No data are missing in the dataset. The values of the depended variable (i.e. the total sales in 2011) are translated into z-scores such that outliers can be identified. The cases with a z-score above 3.29 are identified as potential outliers, and no more than 5% of the cases may have a z-score above 1.96 (Field, 2009). In addition, a boxplot is created which also provides an indication of the potential outliers (Field, 2009).

In this dataset, two outliers are identified by looking at the z-score of the stores, i.e. both stores have a z-score above 3.29 and by excluding these two stores, the total number of outliers is below the 5%. In addition, both stores are excluded after further investigation of the boxplots.

Store selection

For this research, it is preferable to use only the stores in The Netherlands and Belgium. WE is founded in The Netherlands and is, therefore, well established in this country. Moreover, WE has a long experience in Belgium as well. According to the experts within WE, the stores and market in Belgium are comparable with The Netherlands. The experts explain that the other European countries are relatively new markets for WE and are not directly comparable to The Netherlands, due to for instance other regulations, economies, years of experience, and tastes. For example, WE does not have a Girls’ department in France, and the Girls’ collection in Germany has already been stopped, due to unprofitability.

In addition, the pooling test, i.e. t-test, shows that The Netherlands and Belgium have the same group means, with respect to the total sales of the stores, while the other countries have different group means (Field, 2009). The outcomes of the t-test are provided in Appendix C. Hence, only the stores in The Netherlands and Belgium are included in this research.

Regression model

After the selection criteria, 128 stores are selected in The Netherlands and Belgium with the formats MB (i.e. Men-Boys), MBG, MWB, MWBG, or W. These stores are included in the regression analyses. The regression model contains seven independent variables, i.e. three for the size of the departments and four for the formats used, plus the control variables. Using the guideline of Green (1991), this implies that with the data of 128 stores, a maximum of three control variables can be included. Hence, formula (2) shows the adjusted regression model:

\[
Sales_i = b_0 + b_1 \cdot Perc.\ Men_i + b_2 \cdot Perc.\ Boys_i + b_3 \cdot Perc.\ Girls_i + b_4 \cdot Format\ MB_i + b_5 \cdot Format\ MBG_i + b_6 \cdot Format\ MWB_i + b_7 \cdot Format\ MWBG_i + b_8 \cdot X_i + b_9 \cdot Y_i + b_{10} \cdot Z_i + \varepsilon_i \tag{2}
\]

The construction and analyses of the final regression model are described in chapter 4.
4. Step 1 Regression model

This chapter contains the description and the results of the regression model, which is the third part of the regulative cycle of Van Strien (1997), see Figure 8. The regression model provides insights into the variables that influence the store’s sales.

Paragraph 4.1 identifies the variables that are included in this model. The assumptions of multiple regression analyses are explained in paragraph 4.2. Paragraph 4.3 describes the required transformations of the data and the dummy coding. Paragraph 4.4 provides the measurement tools for assessing the regression model. Paragraph 4.5 describes the different methods of regression. Paragraph 4.6 provides the results of the regression analyses. Lastly, the validity of the model is tested in paragraph 4.7.

The basic process as described by Field (2009) is used for the linear regression analyses. These are executed using SPSS-software.

4.1 Control variables

The variables ‘format used in the store’ and ‘size of the departments’ are the fixed variables in the regression analyses, see chapter 3. Nevertheless, many more variables influence the turnover of a store. This research focuses on the most influential ones, called the ‘control variables’. These, and the method to select them, are described in this section. Moreover, it provides an initial ranking of the control variables.

The list of control variables that are taken into account in this research is based on interviews and literature research. The control variables are identified by interviewing experts of WE from the following departments:

- Space Management
- Planning
- Real Estate
- Visual Merchandising Concept Managers
- Buying
- Human Resources
- Retail Operations
- Store Design
- Visual Merchandising
- Finance
- Area Managers
- Sales

In addition, literature research is performed to investigate what is already known in the literature about the influence of the different variables.

Initial ranking

Based on the findings from the interviews and the literature review, an initial ranking of the control variables is defined, with respect to the degree of influence that the variable has on the turnover of a store, see the list on the next page. This initial ranking is further tested in the regression analyses.
1. Number of visitors per year - greatest influence
2. Banding, i.e. the width of the assortment
3. Average income per resident
4. Number of residents in the city
5. Location of the store, i.e. a city or shopping centre
6. Presence of competitors
7. Store concept, i.e. an old or new store concept
8. Surface of the store, i.e. BVO, VVO, and number of equivalents
9. Number of shop floors
10. Furniture density, i.e. the number of square meters per equivalent
11. Age distribution in the city - smallest influence

Appendix D contains an overview of the control variables, including the description of each variable and a summary of the findings from the interviews and the literature review. Unfortunately, there is no data available about the quality of the store managers and the size of the façades of the stores. Please refer to paragraph 8.3 for the recommended follow-up research to the control variables.

4.2 Assumptions multiple linear regression

To be able to generalize the results and the conclusions of the sample to the population, several assumptions need to be verified when using linear regression analysis (Hair, Black & Anderson, 2010). This paragraph describes which assumptions have to be met by the regression models.

This report is limited to the strictest assumptions. For an overview of all assumptions, see Berry (1993). These most important assumptions are: normally distributed errors, no perfect multicollinearity, independent errors, homoscedasticity, and linearity (Field, 2009, Hair, Black, & Anderson, 2010).

Appendix E provides a description of these assumptions. One regression model is used to show how the assumptions are checked. Paragraph 4.5 and Table 2 describe for each regression model if the assumptions are met.

4.3 Transformations and dummy coding

The regression models have to meet some assumptions, see paragraph 4.2. This paragraph describes how variables can be transformed to meet these assumptions. Subsequently, dummy coding is described which is used to include categorical variables in the linear regression models.

Variable transformation

Paragraph 4.5 shows that the original form of the dependent variable, i.e. the total sales, violates several assumptions in the regression model. Therefore, the dependent variable is transformed (Field, 2009). Several transformations are tested and a trial and error method shows that the logarithmic transformation provides the best results for the regression models, i.e. the log10 of the total sales is used as dependent variable. Fewer assumptions are violated by using this log of the total sales. The sales estimation is recalculated from the predicted LogSales.

Dummy coding

Categorical variables are included in the linear regression model by the means of dummy coding. It uses a binary system (i.e. only ones and zeros) to convey all information about the variable. Hence, dummy variables are no scale variables and do not imply if higher variables are better or worse.
In order to use dummy coding, a baseline group is chosen (Field, 2009). In this research, dummy coding is applied to the following variables:
- Format used, i.e. MB, MBG, MWB, MWBG, or W, with MB as the baseline group
- Store concept, i.e. new or old store concept, with the old store concept as the baseline group
- Location, i.e. city or shopping centre, with the shopping centre as the baseline group

4.4 Measurement tools

The performance of the regression models is assessed by measurement tools. This paragraph describes the applied measurement tools, which are ‘adjusted $R^2$ value’ and ‘Mean Absolute Performance Error’.

The dataset for the regression analyses contains $n$ observations, where $n$ is the number of stores. Each store $i$ in the dataset has a particular turnover for 2011, i.e. the value $y_i$.

**Adjusted $R^2$ value**

The first measurement tool is the ‘adjusted $R^2$ value’. This is provided by SPSS. The regression model estimates the sales of each particular store in the dataset, which is often not exactly the same as the actual sales of the store. The adjusted $R^2$ value shows how much of the variance in the dependent variable, i.e. the sales of a store, is explained if the model has been derived from the population from which the sample was taken. Therefore, the adjusted $R^2$ is an indication of the loss of predictive power for using the sample instead of the population. A higher value for the adjusted $R^2$ indicates a better model (Field, 2009). The adjusted $R^2$ can be calculated by using formula (3) and (4).

\[
R^2 = \frac{SS_{Regression}}{SS_{Total}} = \frac{\sum_{i=1}^{n}(\text{forecasted sales} - \text{average actual sales})^2}{\sum_{i=1}^{n}(\text{actual sales}_i - \text{average actual sales})^2} \tag{3}
\]

\[
Adjusted \ R^2 = \frac{(1-R^2)(\text{nr.of cases } n-1)}{\text{nr.of cases } n-\text{nr.of predictors}-1} \tag{4}
\]

**Mean Absolute Performance Error**

Secondly, the Mean Absolute Performance Error (MAPE) value assesses the fit between the estimated sales of the store with the regression model and the actual sales. The MAPE value provides information about the error in the regression model, i.e. the part of the actual sales that was not estimated with the regression model. Therefore, the MAPE value has to be as low as possible. This performance indicator is calculated by using formula (5) (Montgomery & Runger, 2010).

\[
MAPE = \frac{1}{n} \sum_{i=1}^{n} \left| \frac{\text{actual sales}_i - \text{forecasted sales}_i}{\text{Actual sales}_i} \right| * 100\% \tag{5}
\]

Subsequently, the MAPE value is used to calculate the forecast accuracy. The higher the value of the forecast accuracy, the better the fit is between the regression model and the actual sales. The relationship between the MAPE and the forecast accuracy is shown in formula (6) (Montgomery & Runger, 2010).

\[
\text{Forecast accuracy} = 1 - MAPE \tag{6}
\]
4.5 Methods of regression

The regression analyses contain many independent variables, as described in paragraph 4.1. Because of the limited dataset, i.e. 128 stores, a maximum of ten predictors can be included in the regression model, see paragraph 3.4. Therefore, it has to be decided which variables are included into the model and how these variables are included. This paragraph describes the regression method that is used for the regression analyses.

Forced entry method

According to Field (2009) various types of regression analyses can be performed; a forced entry or a stepwise method. A forced entry method is used when it is known in advance which variables should be included into the regression model. For this reason, the fixed predictors, i.e. the format and the size of the departments, are included using this forced entry method.

Stepwise method

Since this research contains many control variables, and preliminary research is not available of all variables, it is not exactly known which variables should be included into the regression models and which variables should be excluded. Therefore, a stepwise regression method is used for obtaining the best regression model, since this type of method determines which variable should be added or deleted from the regression model step by step.

However, even with a stepwise method, it is not recommendable to include all variables at the same time (Field, 2009, Hair et al., 2010). Therefore, to obtain the best combination of control variables, the selected independent variables are altered many times. The initial ranking of the interviews and the literature review, see paragraph 4.1, is used as a basis for this method. The included control variables are, for instance, varied by using the top or bottom five variables of the initial ranking.

This report presents only the significant variables. As described in paragraph 4.1, Appendix D provides the total list of variables that are tested.

4.6 Results regression analyses

This paragraph discusses the performance of the various regression models. Table 2 contains a summary of the regression analyses. Only the basic and the best performing regression models are shown. For each regression model, the Standardized Coefficients Beta for the variables is provided, the performance of the model is tested, and the assumptions are checked.

As described in paragraph 4.3, Appendix E contains the description of the assumptions that are verified. Regression model 3 is used to show how the assumptions are checked.

Five types of regression analyses are executed, see the first rows in Table 2. The starting point is Sales as dependent variable. However, these regression models are violating assumptions. Consequently, the data are transformed, as described in paragraph 4.3, and the Log Sales is used as the dependent variable. Furthermore, the Sales per Equivalent and the Sales per Visitor are used as dependent variables such that the performance of stores can be better compared with each other. Finally, the Number of Visitors is used as dependent variable, such that this estimated number can be the input value for the other regression models, since the number of visitors of a store cannot be known in advance. Each kind of regression analysis, and their associated regression models, is described in this paragraph.
Table 2 shows mostly regression models that are based on the size of the departments. The size of the department, measured as a percentage of equivalents for each department, determines the format of a store as well. Therefore, the format of a store can be excluded from the regression analyses, although this has the disadvantage that the insights into the attractiveness of a format are lost as well. In contrast, the size of the departments cannot be determined from the format used in a store. Therefore, the size of the departments needs to be included in the regression model. Appendix F contains a more extensive overview of the results of the regression analyses. It shows, for instance, a regression model which specifically investigates the influence of the competitors on the performance of a store.
Regression model 1 and 2: Total sales

The regression analysis starts with the Total Sales of a store as dependent variable. The purpose of this research is to enhance these total sales. Therefore, the predictor variables of these total sales are investigated. Regression models 1 and 2 predict the total sales. Unfortunately, these regression models are violating many assumptions. Therefore, the findings cannot be generalised outside the sample of stores. Hence, the next section describes the use of the Log Sales as dependent variable.

Regression model 1 uses both the format and the size of the departments as predictor variables. However, these two variables are highly correlated. The VIF of these regression models and the Pearson correlation are too high, and therefore, the assumption of multicollinearity is violated. As described in the previous section, the format of a store can eventually be excluded from the regression models. Furthermore, model 2 does not includes the variables ‘number of visitors’ and ‘total number of equivalents’, because these variables are correlated highly with the dependent variable, i.e. the Pearson correlations are above 0.80 (Field, 2009).

Regression model 3 and 4: Log total sales

Regression models 3 and 4 predict the Log total sales. The transformation of the Sales as dependent variable was required, because otherwise assumptions are violated, see paragraph 4.3 and the previous section. The use of the log total sales as dependent variable has some advantages and disadvantages. On the one hand, the regression models provide insights into the influence of the control variables on the turnover of a store. However, on the other hand, the value of the log total sales is hardly applicable if the regression model is used for forecasting the total sales of a store. Therefore, the log total sales needs to be transformed back into the total sales, which increases the forecasting error.

Regression model 3 takes into account the variables ‘number of visitors’, and ‘total number of equivalents’. These variables are included, because the maximum VIF value is below 10, despite the fact that the Pearson correlation of these variables are above 0.80 (Field, 2009). Regression model 4 excludes both variables.

Regression model 3 is preferred above model 4, because the forecast accuracy of regression model 3 is higher than that of model 4. The forecast accuracy of regression model 3 is 99.2 % for the Log Sales and 88.3 % for the Sales, while the forecast accuracy of model 4 is 98.8 % for the Log Sales and 83.2 % for the Sales. Consequently, regression models 3 and 4 are preferred above regression models 1 and 2, which are directly predicting the Sales, because the forecast accuracy of models 3 and 4 are higher and less assumptions are violated.

Regression model 5 and 6: Relative sales

The previous regression analyses show that the variables ‘number of visitors’ and ‘number of equivalents’ are highly important variables for the total sales of a store. However, these variables correlate with each other and with the dependent variables (i.e. the Sales and Log sales). Therefore, the relative sales are used as dependent variables to avoid this problem of multicollinearity. The relative sales are measured with the dependent variables ‘Sales per Equivalent’ (regression model 5) and ‘Sales per Visitor’ (regression model 6). Moreover, these relative sales can be used to compare stores, e.g. the sales of a store with much more visitors will naturally be higher than the sales of a store with fewer visitors. This effect is compensated by introducing the dependent variable ‘sales per visitor’. Hence, stores can be better compared with each other.
Regression models 5 and 6 have a forecast accuracy of respectively 87.8 % and 88.8 %, and both models violate only partly the assumption of linearity. Furthermore these models provide insight into the other variables that have an influence on the sales of a store, which can be seen in Table 2. The most important other variable is the banding of a store, which is also a highly influential variable in regression models 3 and 4.

The variable ‘sales per visitor’ has the preference above the variable ‘sales per equivalent’, because of two reasons. Firstly, the variable ‘number of visitors’ has a higher influence on the sales of a store than the variable ‘number of equivalents’ (see section: ‘ranking control variables’). Secondly, the dependent variable ‘sales per visitor’ has the preference above the dependent variable ‘sales per equivalent’ because of measurement reasons. The number of equivalents varies during a year, therefore, the average total number of equivalents of a store for 2011 is not exactly known. Moreover, the data of the equivalents count from March 2012 are used, which is applied to the sales of 2011. The number of equivalents in March 2012 can deviate from the average of 2011. In addition, the furniture is counted by the store employees themselves, which can cause measurement errors.

**Regression model 7: Number of visitors**

The relative sales have to be calculated back to the sales of a store as well. The sales per equivalent can be multiplied by the number of equivalents, and the sales per visitor can be multiplied by the actual number of visitors. In these cases, the forecast accuracy remains equal. However, in contrast to the number of equivalents, the number of visitors cannot be known in advance, and this value is especially difficult to predict for new stores. Therefore, this number of visitors is forecasted with regression model 7, which is described in detail later in this paragraph.

Regression model 6 has a forecast accuracy of 88.8 % and regression model 7 has a forecast accuracy of 78.5 %. However, multiplying the sales per visitor (regression model 6) with this forecasted number of visitors (regression model 7) results in a forecast accuracy of 79.7 %.

**Conclusion results**

This section provides the conclusion and main results of the regression analyses. Moreover, this section discusses which regression model is the most suitable for this research.

Table 2 shows that the sales of the stores can be predicted very well. Especially, the forecast accuracy of the transformed sales (the Log Sales) is very high, using regression models 3 and 4. The regression models identify the most important variables that have an influence on the performance of the stores, namely ‘number of visitors’ and ‘number of equivalents’. These results are used for grouping the stores, which is described in chapter 5. Regression model 3 is the best regression model that includes these two variables.

The regression analyses use different dependent variables. The dependent variable ‘Log sales’ is preferred above ‘Sales’, because less assumptions are violated with this transformed variable, while the forecast accuracy of the regression models is still higher than when directly predicting the sales. Therefore the influence of the control variables can be tested better, using the regression models with ‘Log sales’ as dependent variable.
In addition, the relative sales (i.e. the variables ‘sales per equivalent’ and ‘sales per visitor’) are used to obtain insight into the other variables that influence the sales of a store and to compare stores more easily. Besides the variables ‘number of visitors’ and ‘number of equivalents’, the variable ‘banding of a store’ (i.e. the assortment width) is also highly important for the sales of a store, as became clear from regression models 5 and 6.

**Ranking control variables**

Besides predicting the sales of a store, the purpose of the regression analyses is to investigate the ranking of the control variables, i.e. which variables have the greatest influence on the turnover of a store. This ranking is used for grouping the stores in step 2, see chapter 5. This paragraph shows and compares the ranking of the control variables from regression models 3 (Log sales) and 6 (Sales per visitor). In addition, this section compares the ranking derived from the regression analyses with the initial ranking from the literature and the interviews (see paragraph 4.1).

**Standardized Coefficients Beta**

Table 3 provides information about the ranking of the control variables, namely the Standardized Coefficients Beta of these control variables are shown. These standardized coefficients indicate the relative importance of each variable, such that their influences can be compared. For example, the variable ‘number of visitors’ has the highest Standardized Coefficient Beta, therefore, this value has the greatest influence on the turnover of a store. In the previous section is described that regression models 3 and 6 are preferred to be used for determining the ranking of the control variables.

<table>
<thead>
<tr>
<th>Standardized Coefficients Beta</th>
<th>Regr.3 LogSales</th>
<th>Regr.6 Sales/Visitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perc. Men</td>
<td>0,253</td>
<td>0,440</td>
</tr>
<tr>
<td>Perc. Boys</td>
<td>-0.003</td>
<td>0,342</td>
</tr>
<tr>
<td>Perc. Girls</td>
<td>0,045</td>
<td>0,096</td>
</tr>
<tr>
<td># Visitors</td>
<td>0,467</td>
<td>0,194</td>
</tr>
<tr>
<td>Total # equivalents</td>
<td>0,304</td>
<td>0,194</td>
</tr>
<tr>
<td>Banding (assortment depth and width)</td>
<td>-0,292</td>
<td>-0,363</td>
</tr>
<tr>
<td>The Sting</td>
<td>0,063</td>
<td></td>
</tr>
<tr>
<td># residents 0-17 years</td>
<td></td>
<td>-0,253</td>
</tr>
<tr>
<td>% Visitors of # residents in city</td>
<td>-0,245</td>
<td></td>
</tr>
<tr>
<td>Shopping centre vs Dummy city centre</td>
<td>0,234</td>
<td></td>
</tr>
<tr>
<td>C&amp;A</td>
<td>-0,171</td>
<td></td>
</tr>
<tr>
<td>Avg. income/ resident</td>
<td>0,153</td>
<td></td>
</tr>
<tr>
<td>Zara</td>
<td>-0,123</td>
<td></td>
</tr>
<tr>
<td>BVO</td>
<td>-0,088</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Standardized coefficients Beta

Table 3 shows that the variables ‘number of visitors’, ‘total number of equivalents’, and ‘banding of a store’ have the greatest influence on the turnover of a store. The influence of the variables is discussed in the rest of this section.

**Department size**

The sizes of the departments are used as fixed predictor variables in both regression models. The sizes of the Men’s and Girls’ departments have a positive influence on the sales of a store. The influence
of the size of the Men’s department is very high in comparison with the other variables, because the sales of this department are much higher than the sales of the other departments, see chapter 5.

The influence of the Boys’ and the Girls’ departments are limited in regression model 3, because these departments contain a restricted number of equivalents. Moreover, the stores do not differ highly in the percentage of equivalents for the Boys’ and Girls’ departments. This is described in chapters 5 and 6 as well. In contrast, the size of the Boys’ department has a great influence on the sales per visitor.

In the regression models, the percentage of equivalents for the Women’s department is not taken into account, because this percentage can be calculated from the percentages of the Men’s, Boys’, and Girls’ departments. If the percentage of Women’s equivalents was included in the model, instead of the percentage of Men’s equivalents, then the standardized coefficient Beta became -0.345. This implies that the Women’s department has a negative influence on the sales of a store, and that the influence of a Women’s department is higher than that of the Men’s, Boys’, or Girls’ department.

Number of visitors

Naturally, the number of visitors has a strong positive influence on the sales of a store, because without visitors, no sales can be generated.

Banding

The variable ‘banding’ is negatively related to the sales and the sales per visitor, which implies that the higher the number of banding, the lower the sales is. A higher number of banding, e.g. band 4, indicates a smaller width and depth of the assortment in the store. Similarly, a lower banding, e.g. band 1, indicates a bigger assortment, and hence, a lower banding is beneficial for a store. Therefore, the negative sign for banding is expected in advance.

Competition

The influence of the presence of competitors in the same city on the sales per visitor is contradictory. The influence of The Sting has a slightly positive influence, while C&A and Zara have a negative influence. It can be the case that C&A and Zara have the same target group as WE, and hence, that customers in this target group buy in these stores instead of buying at WE, while The Sting, which also has the same target group as WE, does attract more customers for WE.

Location

Moreover, regression model 6 shows that the sales per visitor are higher for stores in a city centre than for stores in a shopping centre, while this has no significant effect on the sales of a store (regression model 3). As mentioned in the literature (Andreu, Bigné, Chumpitaz, & Swaen, 2006), the internal environment in a shopping centre has a stronger negative effect on the emotions and on the willingness to spend money than in a city centre. Hence, the sales per visitor are lower in a shopping centre than in a city centre.

Resident composition

The variables ‘number of residents aged between 0-17 years’ and ‘the percentage of visitors with respect to the total number of residents in the city’ have a negative influence on the sales per visitor. These variables are not significant in regression model 3. These two variables can imply that if a city has more residents, the sales per visitor decrease. However, these variables do not have a significant influence on the number of visitors (regression model 7). Therefore, cities with more residents have the same number of visitors, and hence, the sales per resident decreases. The average income per resident...
has a positive influence on the sales of a store, because residents with a higher income have more
purchasing power and will spend more money on apparel.

Comparison findings regression analyses and literature review and interviews

The ranking of the control variables out of the regression analyses confirm the findings from the
literature review and the interviews with experts of WE, see paragraph 4.1. The only difference is the
influence of the total number of equivalents. For this variable, no literature was available, such that the
importance was only predicted by the interviews. Out of the regression analysis, it came clear that its
importance is higher than expected.

The experts stated that a small store can provide high sales with a high turnover rate, e.g. a small
store in the centre of Amsterdam, with many visitors, can provide higher sales than a big store with
fewer visitors. Therefore, the number of equivalents does not have a high influence on the sales of a
store. Furthermore, bigger stores will be used in cities were the sales is already high, otherwise small
stores would be used.

The research shows that, in general, the number of equivalents is highly important for the sales of a
store. A possible explanation is that the situation described by the experts rarely occurs. In both
regression models, the number of equivalents has a positive influence on the sales. This implies that the
bigger a store is, the higher the sales will be. Hence, it cannot be stated that stores can be expanded
unlimitedly to generate higher sales.

BVO

The BVO of a store (i.e. the total surface of the store in squared meters, including the stock room,
canteen, etcetera) is related to the number of equivalents. However, it has a negative effect on the sales
per visitor. The reason is that some stores have an extreme high BVO in relation to their VVO (i.e. the
surface of the store in squared meters, excluding the stock room, canteen, etcetera). For example, some
stores have to rent all floors of a building, while only the ground floor is used for the actual store. WE
aims for a BVO to VVO ratio of 80 %. However, this cannot always be achieved.

Findings Sales per store versus Sales per visitor

Finally, the influential variables of the sales of a store have some similarities with the influential
variables of the sales per visitor. However, the most influential variables of the sales per visitor might be
overshadowed by the variable ‘total number of visitors per year’ by determining the sales of a store.

Formulas regression models

This section shows the formulas of the regression models. The log of the sales is described with
regression model 3, see formula (7). Subsequently, the sales are calculated by using formula (8):

\[
\begin{align*}
\text{Log total sales } 2011_i & = 5.759 + 0.249 \times \text{Perc. Men}_i - 0.007 \times \text{Perc. Boys}_i + 0.232 \times \text{Perc. Girls}_i + \\
& 0.000000887 \times \text{Visitors } 2011_i - 0.074 \times \text{Banding } 2011_i + 0.002 \times \text{Total EQ}_i + 0.030 \times \\
& \text{The Sting}_i + \epsilon_i
\end{align*}
\]

\[
Sales = 10^{\text{Log Sales}}
\]
The sales per visitor is determined with regression model 6, see formula (9):

\[
\text{Sales per visitor 2011} = 3.861 + 2.881 \times \text{Perc. Men}_i + 5.328 \times \text{Perc. Boys}_i + 3.396 \times \text{Perc. Girls}_i - 0.627 \times \text{Bandi}_i + 0.781 \times \text{Shopping centre vs Dummy City centre}_i + 0.190 \times \text{Avg. income per resident}_i + 0.007 \times \text{Total EQ}_i - 0.263 \times \text{Perc. visitors of residents}_i - 1.185 \times \text{C&A}_i - 0.000378 \times \text{VVO}_i - 0.0000161 \times \text{Residents aged between 0 – 17}_i - 0.412 \times \text{Zara}_i + \epsilon_i
\]  

\text{(9)}

Forecasting the number of visitors

This section describes the use of the regression analyses to estimate the number of visitors of a store per year. The regression model is provided, the performance of this model is tested, and its advantages are described.

Regression model number of visitors

The regression models of the previous section can be used to forecast the sales of coming years as well. This aspect is described in detail in paragraph 4.7. Most variables are fixed for many years or known beforehand, e.g. the number of residents will be approximately the same for years. However, the number of visitors cannot be known in advance. Therefore, a regression model is developed to forecast this number of visitors as well.

The formula of this regression model 7 is provided below (10). To avoid multicollinearity, the number of equivalents and the format W (which correlates with the percentage of equivalents for the Women's department) are excluded in this model. The adjusted \( R^2 \) value of the model is 0.809 and the forecast accuracy is 78.5%.

\[
\text{Visitors 2011}_i = 388,370 + 70,593 \times \text{Perc. Men}_i - 366,241 \times \text{Perc. Boys}_i + 147,998 \times \text{MB vs Dummy MWB}_i + 138,726 \times \text{MB vs Dummy MWBG}_i - 68,252 \times \text{Bandi}_i + 27,458 \times \text{Zara}_i - 60,315 \times \text{WE vs Dummy New store concept}_i + \epsilon_i
\]  

\text{(10)}

Forecast of the sales

Subsequently, this estimate of the number of visitors is used for predicting the sales of a store. Therefore, the forecasted value of the number of visitors is implemented in regression model 3 (formula 10). The forecast accuracy of the sales is 87.1%, while the forecast accuracy with the actual number of visitors is 88.3%. Hence, the use of the forecasted number of visitors instead of the actual number does not influence the forecast accuracy greatly, e.g. the coefficient of the number visitors is very low: \( 8.87 \times 10^{-7} \). This method has the advantage that the number of visitors of new stores and, subsequently, the sales of new stores, can be calculated as well.

Forecast of the sales per visitor

Furthermore, forecasted value of the number of visitors is used for regression model 6 in which the sales per visitor is determined. If the actual number of visitors is multiplied by the sales per visitor, the forecast accuracy is 88.8%. If the forecasted number of visitors (regression model 7) is used instead of the actual numbers, the forecast accuracy is 79.7%.

Conclusion

In conclusion, the total sales of 2011 can be predicted very well, i.e. according to regression model 3 (Log sales) the forecast accuracy of the sales is 88.3 % and according to regression model 6 (Sales per
visitor) the forecast accuracy is 88.8 %. However, the number of visitors is not known in advance. Fortunately, if regression model 3 uses the forecasted number of visitors instead of the actual number, the forecast accuracy remains almost equal (87.1 %). In addition, if regression model 6 is multiplied by the forecasted number of visitors instead of the actual number, then the forecast accuracy decreases slightly to 79.7 %.

### 4.7 Validation model

The results of the regression analyses are described in paragraph 4.6. The performance of the regression model is investigated, including the adjusted $R^2$ value and the forecast accuracy for 2011. Paragraph 4.6 shows that regression model 3 has the best fit with the data, i.e. the forecast accuracy is 88.3 % and the adjusted $R^2$ value is 0.926. A minimum required value for the forecast accuracy and the adjusted $R^2$ value cannot be set, because this depends on the context of the research, e.g. an adjusted $R^2$ of 0.20 can be high for a research in social sciences (Huberty, 2002). However, it can be stated that a value of 0.926 for the adjusted $R^2$ implies a very good fit of the model with the data. In this paragraph, the regression model is applied to 2010 and 2012 as well.

### Fit for 2010 and 2012

Table 4 shows a summary of the fit of regression model 3 with the total sales of the stores in 2010, 2011 and 2012. Six stores are opened or renovated in 2010, therefore, these stores are not taken into account in predicting the model fit for 2010. The performance of the regression model for 2012 is measured by using the budget for 2012.

Table 4 shows that the forecast accuracies for 2010 and 2012 are just slightly decreased in comparison to the forecast accuracy for 2011. In addition, the standard deviation values of the MAPE are slightly increased. Chapter 8 describes the general applicability of the findings to other countries, formats, and new stores.

<table>
<thead>
<tr>
<th>Regr. 3</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAPE</td>
<td>14.4%</td>
<td>11.7%</td>
<td>12.00%</td>
</tr>
<tr>
<td>St. dev. MAPE</td>
<td>0.163</td>
<td>0.092</td>
<td>0.107</td>
</tr>
<tr>
<td>Forecast accuracy</td>
<td>85.6%</td>
<td>88.3%</td>
<td>88.0%</td>
</tr>
</tbody>
</table>

**Table 4 Fit regression models 2010-2012**

### Validity of the models

The fit of the model with the data is high, i.e. the total sales of the stores can be predicted very well. However, it has to be mentioned that the regression model is still a theoretical model, therefore, bigger differences between the forecasted and the actual sales for a particular store are possible.
5. Step 2 Grouping stores

This chapter elaborates on the regression analyses and the identification of the control variables. Chapter 4 identified the variables that affect the sales of a store, based on regression analyses. However, the research question is not answered yet, because it is not clear what the preferred format and division of the departments should be for a certain store. Therefore, this chapter groups stores such that the preferred format and division of departments can be determined for each group (class) in chapter 6. The findings on the control variables of chapter 4 are used for this grouping.

Paragraph 5.1 describes the grouping of the stores. The stores within a certain class are comparable with each other and should therefore have the same preferable format and division of departments. However, the turnovers of the stores can still differ a lot between stores within a class. Therefore, a best practice research (Blumberg et al., 2005) is performed to identify the other variables that influence the turnover of a store. Paragraph 5.2 provides the method used for executing these best practice analyses. Paragraph 5.3 describes the actual analyses. Finally, paragraph 5.4 provides the conclusions.

5.1 Criteria grouping

This paragraph describes the grouping of the stores. The stores are grouped based on their current format and their yearly number of visitors. Firstly, this paragraph explains why these variables are used as division criteria. Subsequently, the classes are selected for the best practice analyses.

Current format

The first division criterion is the current format of a store. The Women’s collection currently perform below their standard, which causes the fact that the Women’s departments are performing worse than the Men’s and Boys’ departments. Moreover, the Girls’ department, which started in 2009, still performs worse than the other departments. Hence, it is recommended to only have Men’s and Boys’ departments, see chapter 6 as well. These differences in assortment quality overshadow the other reasons why stores are performing better or worse than comparable stores. Grouping based on the format of the stores compensates the problem of collection differences and, therefore, new insights are obtained with respect to the performance differences between stores. Furthermore, because of strategic reasons and already made investments, WE stated that there should be Women’s and Girls’ departments. Hence, the current formats of stores are not changed.

Because the Girls’ departments are very small, the MB and MBG stores are grouped together. Similarly, the MWB and MWBG stores are grouped together.

Number of visitors

The second division criterion is the yearly number of visitors of a store. This control variable has the greatest influence on the store’s sales, see chapter 4. The variable is divided into three classes. With a division into two classes the big difference between the number of visitors would explain why stores perform better or worse than other stores. With a division into four classes the number of stores within each class would be too low to draw conclusions from. Hence, a division into three classes is used.

Unfortunately, there is no ‘natural break’ which divides the stores into three classes. Moreover, no theoretical reasons can be provided for the limitations of the classes. Hence, the stores are chosen to be
divided into three equal classes with rounded boundaries, namely: ≤ 150,000 visitors, 150,000 – 250,000 visitors, and > 250,000 visitors per year.

**Final grouping**

Table 5 shows the final grouping of the stores: it shows the number of stores within a certain class. The different classes are numbered.

<table>
<thead>
<tr>
<th>Visitors/ year</th>
<th>W</th>
<th>MB(G)</th>
<th>MWB(G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150,000</td>
<td>4</td>
<td>1a</td>
<td>35</td>
</tr>
<tr>
<td>150,001-250,000</td>
<td>6</td>
<td>2a</td>
<td>23</td>
</tr>
<tr>
<td>&gt;250,000</td>
<td>8</td>
<td>3a</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 5 Grouping stores based on the number of visitors and format

The two most extreme classes of each format are investigated, i.e. the classes with less than 150,000 visitors per year and the ones with more than 250,000 visitors per year. These classes are chosen for further investigation, because extreme cases provide the most information about the differences between stores (Voss, Perkins, & Segal, 1991).

**5.2 Research method**

Paragraph 5.1 stated that six classes are investigated in depth. This paragraph describes the method used for the best practice analyses. The analyses are performed for each class in paragraph 5.3. The analyses show why stores are still performing better or worse than comparable stores.

The five best and worst performing stores within a class are investigated, because the extreme cases provide the most information about the differences between stores (Voss et al., 1991). In addition, multiple case studies are used because their results are considered as more robust (Blumberg et al., 2005). If a class contains less than ten stores, the class is divided into two equal parts, i.e. the better performing stores and the lower performing stores. If the class contains an unequal number of stores, the store in the middle is excluded from the analyses. For example, class 3a contains eight stores. The four stores with the lowest turnover are classified as ‘worst performing stores’ and the four stores with the highest turnover are classified as ‘best performing stores’. By using this method, the best practice analyses are corrected for the number of visitors.

**Method of interviewing**

A two step approach is used to perform the best practice analyses. This approach is based on quantitative and qualitative research. The first step consists of qualitative interviews that are held to identify the general variables that have an effect on the performance of a store. In the second step, it is examined which of the general variables are applied in each particular store. A combination of quantitative and qualitative research is used in this step.

**General interviews area managers**

The first step contains open interviews with the two area managers of The Netherlands and the area manager of Belgium. The goals of these interviews are to identify the general variables that have an important effect on the performance of a store and to verify the influence of the control variables. The interviews are held with each area manager individually, such that the area managers did not influence
each other. It are explanatory, semi structured interviews with open and closed questions (Blumberg et al., 2005). Semi-structured interviews have two main advantages: on the one hand, the perspective of the area managers becomes clear, and on the other hand, the area managers can confirm the findings that are provided by the regression analyses (Blumberg et al., 2005).

The interviews started with specific questions about the influence of the control variables. Later on there were more open questions and the thoughts of the area managers were followed. In this way, also new insights about other influential variables were provided. Appendix G shows a general overview of the questions used in the interviews. The influential variables mentioned by the area managers are subsequently clustered into internal and external variables.

Specific interviews district managers

In the second step is checked which of the general variables, as indicated in the first step, applies to the specific stores. The specific stores are the five best and worst performing stores in each class, see paragraph 5.1. A survey is send to the responsible district managers to examine this. The Netherlands is divided into eight districts and Belgium into two districts. Each district manager is responsible for approximately 15 to 20 stores. Therefore, the district managers know what is going on in their stores, they are able to compare this with other stores, and they have a good overview of what is happening in the total district.

Each district manager is asked to fill in a survey for the selected stores of their district. An explanation of the research subject is included in the email in an attempt to enhance their motivation to participate. One week after the original mailing a new questionnaire is send to maximize the response rate, and two weeks after the original mailing the district managers are called (Blumberg et al., 2005).

Appendix G shows the questionnaire. Each district manager has to score their stores for the different variables on a Likert scale from 1 (positive effect) to 5 (negative effect) (Blumberg et al., 2005). There was also an explanation asked for each given score. This combination of quantitative and qualitative research is most likely to lead to the most results (Blumberg et al., 2005). The average score of the best and worst performing stores in each class is calculated. Paragraph 5.3 describes the results.

5.3 Best practices

Paragraph 5.2 described the research method for the best practice analyses. The interviews provided general variables. These variables explain why stores are performing better or worse than others. The general variables are divided into internal and external aspects, see Table 6. Firstly, this paragraph describes these general variables. Secondly, this paragraph provides the results of the best practice analyses.

Internal variables

The first variable within the internal aspects is the format of a store. As mentioned before, the presence of a Women’s department can cause a lower performance of the store. This problem is avoided with the grouping method. However, recommendations can still be given to add or delete certain departments. The second variable contains the quality of the store manager and their team. An aspect of quality is the degree of focus on service and customers. The third variable, the attractiveness of the store, includes the store concept that is used and the latest renovation of the store. An old store that is not currently renovated will be less attractive for customers than stores with the fresh, new store concept. The fourth variable, the division of the equivalents, focuses on the ratio between the
equivalents among the different departments. Moreover, recommendations could be given by the district managers to increase or decrease the number of equivalents for certain departments. The fifth variable within the internal aspects is the surface of the store. Recommendations can be provided to increase or decrease the surface of the store. The final variable contains the accessibility within the store, for instance, if the aisles are wide enough and if the second floor can be accessed easily, e.g. if the store has an elevator or escalator.

External variables

The first variable within the external aspects is the attractiveness of the city or shopping centre. This variable includes the catchment area of the centre, and the relative amount of visitors of the centre. The second variable, the economical environment of the city, includes for instance the degree of unemployment in the city, the average income per resident and the amount of immigrants in the city. Thirdly, the presence or absence of competitors in the same centre as the WE store can have a positive or negative influence on the performance of the store. On the one hand, competitors can generate more traffic and visitors, but on the other hand, visitors can go to competitors instead of going to the WE store. The final variable that can have an effect on the performance of a store is the accessibility of the store itself. In general, WE stores are located at A1 locations, but because of, for instance, the building of new stores or road constructions, the attractiveness of the location can decrease.

Additionally, remaining factors that may influence the performance of a store can be identified by the district managers.

Results

This section describes the results of the best practice analyses. The stores are checked for internal and external variables by the district managers, such that it is clear why stores have a higher or lower turnover than comparable stores. In addition, the findings are compared with the results of the regression analyses.

Table 6 shows the results of the best practice analyses. Appendix H provides more detailed results. The results are clustered such that it is easier to identify the most remarkable findings.
General differences higher and lower performing stores

A t-test is executed to obtain insight into the differences between the lowest and the highest performing stores. The results are shown in Table 7. If Levene’s test is not significant, i.e. p > 0.05, it is assumed that the variances are roughly equal (Field, 2009).

<table>
<thead>
<tr>
<th>Equal variances assumed</th>
<th>Format store</th>
<th>Quality store manager and team</th>
<th>Attractiveness store</th>
<th>Division departments</th>
<th>Surface store</th>
<th>Accessibility store</th>
<th>Attractiveness centre</th>
<th>Economical environment city</th>
<th>Competitors</th>
<th>Accessibility store</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.056</td>
<td>.825</td>
<td>1.756</td>
<td>2.987</td>
<td>2.121</td>
<td>.796</td>
<td>.323</td>
<td>1.288</td>
<td>1.484</td>
<td>.002</td>
</tr>
<tr>
<td>Levene's Test for Equality of Variances</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>.815</td>
<td>.372</td>
<td>.197</td>
<td>.096</td>
<td>.157</td>
<td>.381</td>
<td>.575</td>
<td>.267</td>
<td>.234</td>
<td>.968</td>
</tr>
</tbody>
</table>

Table 7 Results t-test highest and lowest performing stores

Table 7 shows that the highest and lowest performing stores do not have significantly different causes of why these stores are performing better or worse than comparable stores. However, this might also be due to the small dataset and response rate, see Table 6 and Appendix H.

Table 6 shows that the attractiveness of the centre causes the highest difference in scores between the best and worst performing store. However, this difference is not significant, see Table 7. Nevertheless, this insight can be used when new stores are opened. The district managers mentioned that the attractiveness of the city or shopping centre has an effect on the number of visitors of a store, and subsequently, on the turnover of a store. In addition, a relatively large catchment area of the centre results mostly in more visitors. Moreover, if visitors have to travel a lot to visit the store, they are probably willing to spend more money. Furthermore, the district managers mentioned several times that stores in shopping centers receive more visitors especially when the weather is bad.

Differences higher and lower performing stores per format

The t-test between the lowest and the highest performing stores does not provide much insight into the reasons why stores are performing better or worse than other stores, see Table 7. Therefore, t-tests are performed for each format to obtain more insights. Table 8 shows the results for these t-tests per format.
Table 8 Results t-test highest and lowest performing stores per format

Format W

Table 8 shows the differences between the lowest and the highest performing stores per format. Difference in performance of the stores with format W can be caused by the economical environment of the city. Table 6 shows that especially the high performing stores with a W format are located in cities with a high economical environment. In addition, Table 6 shows that there are big differences in the scores for this variable for the other stores with other formats as well. However, these differences are not significant, see Table 8. The district managers explained that the degree of unemployment and the average income per resident are important aspects of the economical environment in a city. These variables are included as well in the regression analyses. However, these variables do not have a significant influence on the store’s sales. Nevertheless, this might also be due to the fact that only data from 2009 were available while the economic environment in most cities dramatically changed between 2009 and 2011 (Grant & Wilson, 2012). Hence, the effect of the variable ‘economical environment city’ cannot be tested correctly in the regression analyses and, hence, the regression cannot be compared with the best practice analyses.

Format MWB(G)

Furthermore, Table 8 shows that differences in the performance of the stores with format MWB(G) can be caused by the variables ‘attractiveness store’, ‘division departments’, and ‘accessibility store’. These variables are all internal variables. Therefore, these stores can be optimized. The variables do not significantly differ between the stores with other formats, see Table 8. However, the variable ‘attractiveness store’ causes differences in scores between the other formats, see Table 6. These findings imply that the internal variables are particularly influential on the store’s sales for the stores with format MWB(G). However, the district managers explained that outdated old stores or stores which are internally not perfectly accessible are mostly not renovated, because these investments would probably not pay back. Unfortunately, the experience of the district managers cannot be tested with statistical analyses, because data about these variables are not available.

Remaining findings

It is mentioned that the absence of significant differences might be due to the small dataset and the low response rate. However, the scores of the different variables provide two other findings about important variables, see Table 6:
• The quality of the store managers causes differences between high and low performing stores of all formats. This variable is already mentioned in step 1 (chapter 4) and is described in appendix D. The district managers mentioned that store managers who are focussed on the customers and who motivate their employees to do this as well, are generating higher sales than store managers who focus more on, for instance, visual merchandising aspects. Unfortunately, data about the quality of the store managers are not available. Therefore these findings cannot be verified with statistical analyses.

• The availability of competitors has conflicting effects. The district managers mentioned that on the one hand, competitors attract extra visitors. On the other hand, those visitors may buy their products at the competitors instead of buying them at WE. The district managers mentioned, for instance, that the stores of big competitors (like Esprit and Mexx) are more attractive than the stores of WE. In addition, especially for the lower performing stores, the disadvantages of the appearance of independent entrepreneurs are mentioned: these stores are not attracting residents from a big catchment area and these stores are not open on Sundays, which leads to fewer visitors. Furthermore, they mentioned several times that the kids’ department performs much better when fewer stores with kids’ departments are around in the same city.

5.4 Conclusion

The best practice analyses are based on internal and external variables. The internal variables are the most interesting variables, because these aspects can be changed by WE. The external variables can only be changed by opening a new store.

The negative effect on the store’s sales of the presence of the Women’s and Girls’ departments is compensated by the use of the grouping method per format. Moreover, the effect of the number of visitors on the store’s sales is compensated by the grouping based on the number of visitors.

The best practice analyses provide insight into the causes why stores are performing better or worse than comparable stores. The analyses show that differences in performance are mostly caused by specific circumstances in a particular store or city. However, these differences are not statistically significantly different for high and low performing stores. Although, this insignificance might also be due to the small dataset and response rate.

Additionally, best practice analyses are executed for each format separately to obtain more insight. These analyses show that the variable ‘economical environment city’ has a significant influence on the sales of the higher and lower performing stores with a W format. Moreover, the performance of the stores with format MWB(G) significantly differs due to certain internal variables, namely ‘attractiveness store’, ‘division departments’, and ‘accessibility store internal’.

Some of these significant variables are not included in the regression analyses, because of the absence of data. Therefore, it is recommended to further investigate these significant variables, because those insights can be used to optimize the performance of a store.
6. Step 3 Store optimization

In chapter 5 the grouping and classifications of the store are described. The stores are grouped, based on the format of the stores and the number of visitors per year. In addition, the best practice analyses are described and the variables are described that causes a higher or lower performance of the stores. However, the store’s sales can also be optimized by adjusting the format and size of the departments within the store, which is the main purpose of this research. This chapter provides these recommendations.

Paragraph 6.1 describes the Linear Programming model that is used to determine the recommendations for each class in the grouping. Subsequently, paragraph 6.2 describes the results of this model, i.e. the best division of the departments for each class are provided. Finally, the implementation is discussed in paragraph 6.3.

This chapter contains the fourth step of the regulative cycle of Van Strien (1997): Model adaption, see Figure 9.

6.1 Method and restrictions

The best division of equivalents is determined with the use of a Linear Programming (LP) model. LP is a method to determine the best outcome, i.e. the highest sales, by taken into account a list of requirements. The linear requirements are represented as linear relationships (Silver, Pyke, & Peterson, 1998).

Firstly, this paragraph describes the restrictions of the LP problem. These are restrictions regarding the minimum and maximum number of equivalents per department. Secondly, the performance of the different departments is described. Finally, this paragraph describes the method of analyses and the LP model which is used to investigate each class and to provide recommendations for each class.

Restrictions equivalents

Number of equivalents

A number of restrictions are set by WE regarding the minimum and maximum number of equivalents (EQ) for each department. The Men’s and Women’s departments have to contain respectively at least 44 and 37 EQ. The size of the Boys’ departments has to be between 12 and 24 EQ, and the Girls’ department between 8 and 12 EQ. These restrictions are set such that the presentation possibilities are optimal and the collection width and depth is optimal.
The restrictions of the maximum number of equivalents are compared with the data. For example, Figure 10 shows the sales per equivalent for the Boys’ department versus the size of the department. Figure 10 shows that the sales per equivalent indeed decrease when the size of the Boys’ department is above approximately 24 equivalents. In addition, Figure 10 shows that the stores with 12-18 EQ have the lowest sales per equivalent. Experts within WE explain that in practice, a store starts with 24 EQ, i.e. the maximum size of the Boys’ department. If the Boys’ department does not perform very well, then the size of the department is decreased. Hence the group of 12-18 EQ contains the stores that are not performing very well in the Boys’ department, and it seems that the sales per equivalent of these stores still remains lower than the sales per equivalent for other stores. Finally, it is chosen to keep the limitations of WE for the analyses, i.e. the Boys’ department has to be between 12 and 24 equivalents.

The analysis on the sales per equivalent for the Girls’ department provides similar results and these limitations are kept as well. In contradiction, a maximum number of equivalents for the Men’s and Women’s departments are not set by WE and are also not identified with the quantitative analyses.

Sales per equivalent

Besides the restrictions on the size of the departments, the LP model uses the sales per equivalent per department. Unfortunately, it cannot be determined what the effect on the sales per equivalent is if the number of equivalents of a certain department is adjusted. On the one hand, if a department increases, for instance, more products can be stored and products can be better displayed, hence, the sales per equivalent can increase. On the other hand, if the number of products stays equal, or when the total sales of the store remain unchanged, then the sales per equivalent decrease. Because these hypotheses cannot be underpinned with data or experiences from experts, it is assumed that the sales per equivalent are constant for a store, independent of the number of equivalents. In addition, the analyses show that generally only a small number of equivalents should be changed (i.e. less than 7.5 equivalents), therefore, the assumptions can be kept.

Performance of the departments

This research states that the performance of the Women’s and the Girls’ departments are below the performance of the Men’s and the Boys’ departments. This section investigates this statement. Therefore, the sales per equivalent are used to compare the different formats and departments. The unit of measure ‘sales per equivalent’ is chosen, because this variable makes it possible to compare stores with different sizes.
Figure 11 shows the sales per equivalent per format and per department. The sales per equivalent of the Men’s department in a MB store are used as a baseline for the index, because MB is the most common format and the Men’s department is the largest department within this format.

Figure 11 indicates that the Men’s and Boys’ departments have the highest sales per equivalent. Therefore, if an extra equivalent can be added to a store, then this equivalent should be added to the Men’s or Boys’ department, dependent on the format of the store.

Effect Girls’ department

Furthermore, Figure 11 indicates that the Girls’ department has indeed the lowest sales per equivalents in all formats. However, Figure 11 indicates as well that a MBG format is preferred above a MB format and a MWBG format above a MWB format, i.e. the addition of the Girls’ department has a positive influence on the total sales per equivalent of the store. Unfortunately, this finding is not necessarily caused by the addition of the Girls’ department, because the Girls’ departments are added to the stores that have already high sales per equivalent for the Boys’ department. Namely, if the Boys’ department has a high performance, then WE assumes that the Girls’ department can have a high performance as well. In the stores with an ‘average’ sales per equivalent for the Boys’ department, the Girls’ department will not be added. Furthermore, if a Girls’ department is added to a store, then the size of another department should be decreased, consequently, this means that a higher sales per equivalent is exchanged for a lower sales per equivalent (i.e. the Girls’ department has in each scenario the lowest sales per equivalent, see Figure 11). In conclusion, the formats with a Girls’ department have higher sales per equivalent, however, this is probably not due to the Girls’ department itself.

Effect Women’s department

Besides the addition of the Girls’ department, the addition of the Women’s department is investigated as well. Figure 11 indicates that the sales per equivalent for the Men’s department slightly increase and the sales per equivalent for the Boys’ department decrease when the Women’s department is added. Finally, the average total sales per equivalent for a store decrease. Hence, the analysis shows that the addition of the Women’s department has a negative effect, i.e. a MB format is preferred above a MWB format and a MBG format is preferred above a MWBG format.

Format W

Subsequently, the performances of the stores with format W are investigated. These stores seem to have an acceptable level of sales per equivalent, see Figure 11. However, the data are biased by two
outliers. Without these two stores, the sales per equivalent of the format W decrease to an index of 83. Hence, this finding indicates that the format W is not the most preferable format for a store.

Conclusions Women’s and Girls’ departments

The analyses indicate that the Girls’ and Women’s department indeed have a negative influence on the sales of a store. However, the regression analyses (chapter 4) and the best practice analyses (chapter 5) indicate that there are more factors that have an influence on the sales of a store. Hence, Figure 11 cannot be used to make direct conclusions. By contrast, Figure 11 can be used to obtain insights into the differences between formats and departments.

Furthermore, because of tactical reasons and investments that have been made, it is not preferred to close Women’s and Girls’ departments. The Girls’ department came into existence in 2009, and experts within WE stated that this department need more time to grow. In addition, the experts indicated that the performance of the Women’s department is due to the lower quality of the Women’s collection. The Women’s collection was performing better in the past, see figure 2 in paragraph 1.3, therefore, the current lower performance could be just temporarily. Hence, the Women’s and Girls’ departments should not be removed from the stores.

In conclusion, analyses indicate that the Men’s and the Boys’ departments are indeed performing better than the Women’s and the Girls’ departments. However, the Women’s and Girls’ departments may not be removed from stores. Therefore, no recommendations can be provided to add or remove departments from a store. Suggestions are provided in paragraph 6.2 for adjusting the division of the equivalents by keeping the current formats of the stores.

Linear Programming model

Chapter 5 described the grouping of stores into classes. Each class is optimized by adjusting the sizes of the departments. The classes are optimized with the use of a LP model. The restrictions for this model are described in the previous section. Firstly, this section provides the final LP model. Subsequently, the assumptions of linear programming are verified. Finally, this section describes how the LP model is used to define the best division of the departments.

Objective model

The sales per equivalent per department and the total number of equivalents in a store are known for current stores. The best division of the departments needs to be determined, such that the total sales of all stores in a class are optimized. The LP model is used to define this best division of the departments. A separate division is determined for each class and each format, e.g. for a class with format MB(G) two divisions are provided: one for the stores with format MB and one for the stores with format MBG. The final LP model is described in Appendix I.

Assumptions model

The assumptions of the LP model are verified before the model is used. Five conditions pertain to the LP model (Silver et al., 1998):

1. **Limited resources**: The number of equivalents is limited within a store; otherwise there would be no problem.
2. **Explicit objective**: The objective is to maximize the total sales of all stores in a class.
3. **Linearity**: An equivalent in each department in each store represents the same number of products that are stored on this equivalent (furniture), namely, 60-80 products are displayed on one equivalent. In extreme cases, fewer or many more products are stored on one
4. **Homogeneity**: Each type of furniture is transformed into a number of equivalents. It is assumed that each equivalent contains an equal number of products.

5. **Divisibility**: Equivalents can be subdivided. Not every type of furniture is transformed into an integer number of equivalents. Therefore, the total size of a department does not have to be an integer number of equivalents.

In conclusion, all assumptions of the LP model are met, therefore, the model can be used.

**Approach**

The Microsoft Excel Solver is used to execute the LP model. The best general division of departments of each class and each format is determined, which is called the standard division.

Subsequently, this standard division is applied to each store in that particular class. However, for a particular class, the current division of equivalents can be more beneficial than the standard division. Appendix J contains an elaborated example of the optimization of a particular store in a particular class.

Finally, the expected sales per store for 2011 are calculated for the situation that the new division of equivalents would have been used; the new number of equivalents of each department is multiplied with the current sales per equivalent. This ‘new sales’ is compared with the actual sales. Paragraph 6.2 describes the results of the LP model and shows the advantages of the model.

**6.2 Results**

Paragraph 6.1 explained how the best standard division of the equivalents is determined by using the LP model and also explained how the ‘new sales’ is calculated. This paragraph provides the results: i.e. the paragraph describes the best standard division for each class, the increase in sales, and the average number of equivalents that have to be exchanged between departments in a store.

Table 9 provides the results of the analyses. The classes with 150,000 to 250,000 visitors per year are excluded from the analyses, see chapter 5. Paragraph 6.1 described that the format of the stores may not be changed.
Table 9 shows the preferred standard division of the departments for each class. In addition, the table provides insight into the extra turnover that could have been generated if these divisions of the equivalents would have been applied in 2011.

Naturally, the stores with format W cannot be optimized by adjusting the division of equivalents. In addition, the three MWB stores with less than 150,000 visitors cannot be optimized, because two of the three stores have too less equivalents to fulfill the restrictions of the minimum number of equivalents for the Men’s, Women’s, and Boys’ departments. Therefore, the ‘new sales’ could not be calculated.

Results Microsoft Excel Solver

Table 9 shows that the Excel Solver sometimes provides remarkable results. For instance, 0 % from the equivalents is allocated to the Girls’ department, because the sales per equivalent for this department are lower than the sales per equivalent for the other departments. However, the Excel Solver has already taken into account the restriction of the minimum size of the Girls’ department. Therefore, this recommendation has to be interpreted as to use 8 equivalents for the Girls’ department.

6.3 Implementation

Paragraphs 6.1 and 6.2 provided recommendations for current stores regarding the best division of the departments. These recommendations are based on the current format of the stores. This paragraph describes the implementation of the method and the findings, which is the fifth step of of the regulative cycle by Van Strien (1997), see Figure 12. Subsequently, this paragraph describes how the method can be extended to determine the best format for a particular store as well. This extended method can be used when the formats of the current stores are going to be changed, and to determine the best format and division of departments for new stores.

Expand or reduce departments

The recommendations regarding the division of the departments show which departments have to expand or reduce their number of equivalents. However, because of practical reasons, it is not always possible to implement these recommendations directly. For example, if the Men’s department is located on the ground floor and the Boys’ department on the first floor, then it is practically illogical to increase one department and to decrease the other department due to the physical separation in the building. Therefore, the recommendations have to be interpreted as guidelines, which have to be adapted to the specific circumstances of the stores.

If equivalents are exchanged between departments, it has to be determined which equivalents have to be exchanged. Table 10 shows the different options for increasing and decreasing the departments. The cut-off point between a small and a large number of equivalents that has to be exchanged depends on the circumstances of the store. Experts within WE mention that a cut-off point of 7.5 equivalents can be used as a general guideline.
Changing the format of current stores and new stores

The analyses of paragraph 6.1 and 6.2 are based on current stores with fixed formats. This section provides insight for new stores and for current stores if the format might be changed.

Criteria grouping

The format of the stores becomes a decision variable. Therefore, the stores are not grouped based on their format. The variable ‘number of visitors’ is again used as grouping variable. The number of visitors is calculated by using the regression formula of chapter 4. Moreover, these regression analyses of chapter 4 showed that the number of equivalents is the second most influential variable on the store’s sales. In addition, for current and for new stores the number of equivalents is known. Hence, this variable is used as a second grouping variable.

The variable ‘number of equivalents’ is divided into three classes. Based on the restrictions of the size of the departments and the experience of WE, stores with less than 80 equivalents can contain only a Men’s or Women’s department, and stores with more than 160 equivalents have to contain a Men’s and Women’s department. In all cases, Boys’ or Girls’ departments can be added to the stores.

Preferred format

The preferred format is determined for each class in this new grouping. Similar to the analyses of the recommendations per format, the analyses are based on the sales per equivalent, i.e. the preferred format has on average the highest sales per equivalent for the total store. The analyses use data of the current stores of 2011. Table 11 shows which format is preferable for each class in the new grouping.

<table>
<thead>
<tr>
<th>Grouping Equivalents</th>
<th>Recommended to decrease size of the department</th>
<th>Recommended to increase size of the department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>Store more products on one EQ. Decrease in the future slightly the number of products bought for this department.</td>
<td>Store the products on more EQs. Increase in the future slightly the number of products bought for this department.</td>
</tr>
<tr>
<td>≤ 80</td>
<td>MB</td>
<td>MB</td>
</tr>
<tr>
<td>&gt; 80 - 160</td>
<td>MB</td>
<td>MB</td>
</tr>
<tr>
<td>&gt; 160</td>
<td>MB</td>
<td>MB</td>
</tr>
</tbody>
</table>

Table 11 Recommendations formats

Table 11 shows that MB is the most preferred format. Paragraph 6.1 described this finding as well. The class with less than 80 equivalents and more than 250,000 visitors per year contains currently only stores with format W, and therefore, formats could not be compared. Moreover, the stores in the class with more than 160 equivalents have to contain a Men’s and Women’s department.

The preferred format of a store can be determined with Table 11. Subsequently, paragraph 6.2 described how the best division of equivalents is determined with a given format, i.e. the best division of the equivalents for the new stores can be defined with Table 9.
7. General applicability

In the previous chapters is described how the turnover of a store can be estimated with the use of a regression model, which format is preferable for a store to achieve the highest turnover, and what the best division of the departments is. Paragraph 7.1 contains the investigation of the general applicability of these results to other countries, formats and years. Paragraph 7.2 describes the general applicability of the findings to new stores.

7.1 General applicability to other countries, formats, and years

The general applicability of the regression analyses is investigated by using regression model 3, as described in chapter 4. This model is applied to other countries, formats, and years. The general applicability of the regression models to other years is described in paragraph 4.7 as well. In addition, the general applicability of the performance of each department is investigated. The results of the analyses are provided in Table 12.

Table 12 shows that the forecast accuracy decreases a bit when the regression model is applied to other countries, formats, and years. Subsequently, it can be stated that the general applicability of the regression models is high.

Besides the general applicability of the regression model, the general applicability of the second and third step is investigated as well. Because the general applicability of the regression models is high, it is assumed that for other formats, years, and countries, the variables ‘number of equivalents’ and ‘number of visitors’ are also the most important variables that have an influence on the sales of the stores. In addition, Table 12 shows the ranking of the departments for each case, based on the sales per equivalent. In each case, the Men’s and Boys’ departments generate the highest sales per equivalent. In the case of ‘other formats’, the ranking for the Women’s and the Boys’ departments is different, which might be due to the small number of stores in this group and the relatively high number of stores with a Women’s department.

If the variables ‘number of equivalents’ and ‘number of visitors’ are also the most important variables that have an influence on the sales of the stores in other countries, years, and formats, then the procedure to determine the best format and size of the departments (as described in chapters 5 and 6) can be generalized as well. However, further investigation is required to the preferred formats and division of the departments in these stores.
7.2 General applicability to new stores

This paragraph describes the general applicability of the findings to new stores. Therefore, regression model 3 is applied to these stores, see chapter 4. Subsequently, these findings are compared to the estimates of WE and the actual sales. The five stores that were opened in 2009 or 2010 are investigated. The performance of these stores in 2011 is researched and the results are presented in Table 13.

The general applicability of the findings is investigated for just five stores, because these are the only stores in The Netherlands or Belgium that were opened in 2009 or 2010, that were opened during whole 2011, and that have one of the selected formats. Due to this small dataset, the general applicability of the regression model to new stores cannot be proved statistically. Hence, this paragraph has to be interpreted as an indication for the general applicability and the usability of the regression analyses for WE.

Furthermore, the performance of the new stores is measured for 2011, even when the store is opened in 2009. This is chosen because this is in line with the regression analyses in chapter 4 which are all based on 2011 as well. In addition, the stores have some time to start up and to stabilize their performance.

Table 13 shows that the forecast accuracy of the regression model is in general higher than the estimates of WE. The estimates of WE are in all cases higher than the actual values, while the estimates with the regression model are both lower and higher than the actual sales. However, it is mentioned that the two analyses use different information, because the estimates of WE are made in 2009, while the regression model uses the actual values of 2011. Moreover, the objective of the analysis might be different for WE, i.e. the regression model is used to predict the actual sales and number of visitors, while the analysis of WE might be adjusted positively to approve that the new stores should be opened.

In paragraph 6.3 is already described how the best format and division of departments can be determined for new stores.
8. Discussion

This chapter evaluates the research. The main findings of the study are discussed in paragraph 8.1. Paragraph 8.2 discusses the contribution of the research to the literature and to WE Fashion. Finally, paragraph 8.3 reviews the limitations of the study and provides recommendations for future research.

8.1 Main findings

Format store

One of the main purposes of this research was to determine the best format for each store. The research shows that the Men’s and Boys’ departments have both a high sales per equivalent, while the Women’s and Girls’ departments are performing lower. Therefore, it is preferable to have the Men’s and Boys’ departments as large as possible and the Women’s and Girls’ departments as small as possible. Hence, it is found that the Men-Boys format provides the best results for a store. The addition of a Women’s or Girls’ department decreases the total sales per equivalent of a store.

However, changing the format of a store needs to be done with caution, because other variables have an influence on the store’s sales as well. For example, in areas of stores with format Women are almost always also Men’s-Boys’(-Girls’) stores located. Therefore, the addition of a Men’s or Boys’ department to the Women’s store will not lead to the expected increase in sales, and could even have a negative influence on the other MB(G) store.

Nevertheless, if the Women’s or Girls’ department have a higher sales per equivalent in the future, then the procedure as proposed in this research can still be used to determine the new best format and division of the departments for each store.

Furthermore, the size of the store has an influence on the best format of a store. Minima and maxima on the size of the Boys’ and the Girls’ departments are set by WE. However, only minimum sizes are set for the Men’s and the Women’s departments. However, the sales per equivalent of these departments should decrease after a certain size. Unfortunately, an ideal maximum number of equivalents for these departments could not be found in the data. Nevertheless, the best format of a store also depends on the size of the departments, and this influence should be taken into account when the format of a store is determined.

Sales per equivalent

Besides determining the best format for a store, the best division of equivalents is determined. Adjusting the current division of equivalents generates approximately 1 % extra sales, in comparison with the current sales. However, the current sales per equivalent are used for these calculations, while it is not known whether these increase or decrease when the size of the department is adjusted.

On the one hand, if a department increases in the number of equivalents, more products can be presented, which can also attract more visitors, and more products can be sold. Hence, the sales per equivalent remain constant or can even increase. On the other hand, if the same number of products as in the old situation is presented, e.g. the products are displayed twice in the new situation, and if an expanded department does not attract more visitors, then the sales per equivalent will decrease. This research assumes that the sales per equivalent remain constant.
Data

The forecast accuracy of the regression models became high, i.e. the best regression model has a forecast accuracy of 88.3%. However, this high value can be caused by the relatively small dataset and some data are arguable. The research is restricted due to limitations in the available time and data, i.e. some data were not available, outdated, not reliable, or too confident. Therefore, not all variables are included into the regression models. The best effort is done for all data to obtain the most recent and complete data. This section discusses the most arguable data that are used.

Firstly, the data about the presence of competitors are not fully correct. The data are gathered from the websites of the different competitors. However, if the competitor has a store in the same city as WE, it is not investigated if the competitor’s store is next to the WE store or in a different part of the city. Moreover, it is not taken into account which departments the competitor’s store contains and which departments the WE store contains. For example, the Women’s H&M store would have less influence on a WE store that contains only a Men’s and a Boys’ departments, while this H&M store would have a greater influence on a WE store that has a Women’s department.

Secondly, the data about the demographical variables, for instance the average income per resident, were a bit outdated, because they were from 2009, while the economical situation changed dramatically between 2009 and 2011 (Grant & Wilson, 2012). Moreover, the external environment, including the economical and demographical situation of a city, is measured by just a few variables. Of course, many more external variables have an effect on a store, but the ones included in the regression model belong to the most influential variables.

Finally, the division of the city and shopping centres is arguable. For this variable, the division of WE is used. However, WE sometimes classifies stores that are located in a roofed part of a city centre (a passage) into a shopping centre, while in this research a shopping centre refers to a separate mall.

Regression analyses

Regression analyses are used to predict the store’s sales. The forecast accuracy of the best regression model is 88.3%. The regression analyses show the variables that have the greatest influence on the store’s sales. These variables are ‘total number of visitors per year’ and ‘total number of equivalents’. In addition, a wider assortment in a store has a positive influence on the store’s sales. This section discusses the most remarkable findings of the regression analyses.

The research shows contradicting findings regarding the influence of the presence of competitors in the same area as the WE store. Namely, the influence of The Sting has a slightly positive influence, while C&A and Zara have a negative influence. It can be the case that C&A and Zara have the same target group as WE, and that customers in this target group therefore buy at these stores instead of at WE. The Sting, on the other hand, has the same target group as WE as well, but does attract more customers for WE. Moreover, as explained in the previous section, the data about the competitors are also arguable.

Besides the influence of the competitors, also the influence of the surface of a store is contradictory. The regression analyses make clear that the total number of equivalents has a positive influence on the sales per visitor, while the BVO (i.e. the total surface of the store in squared meters, including the stock room, canteen, etcetera) has a negative effect on the sales per visitor. The research explains that this might be due to the fact that some stores have an extreme high BVO in comparison to their VVO (i.e. the surface of the store in squared meters, excluding the stock room, canteen, etcetera).
Finally, the influential variables of the sales of a store have some similarities with the influential variables of the sales per visitor. However, by determining the sales of a store, the most influential variables of the sales per visitor are overshadowed by the variable ‘total number of visitors per year’.

Regression models are developed to predict the sales of the stores in 2011. Therefore, the actual values of the variables are used in the models. The coefficients of the different variables in the regression formulas will slightly change among years. Fortunately, the research to the general applicability of the findings showed that the regression model could be used for other years as well. However, it is recommendable to update the coefficients regularly.

Best practice analyses

After the regression analyses, the stores a grouped and a best practice analysis is performed for each class in this grouping to determine why stores perform better or worse than other stores. The best practice analysis is based on internal and external variables. The internal variables are the most interesting variables, because these aspects can be changed by WE. The external variables can hardly only be changed by opening a new store.

The best practice analysis shows that there are no significantly different causes for why stores perform better or worse than other, comparable stores. However, it might be that no significant differences are found, because of the small dataset and response rate.

Additionally, best practice analyses are executed for each format to obtain more insight. These analyses show that the variable ‘economical environment city’ has a significant influence on the sales of the better and worse performing stores with a W-format. Moreover, the performance of stores with a MWB(G)-format significantly differs due to certain internal variables, namely: ‘attractiveness store’, ‘division departments’, and ‘accessibility store internal’. However, the results might again be influenced due to the small dataset and response rate.

The findings of the best practice analyses can be used for further research. The significant variables can be further investigated and included into the regression models. Hence, the findings can be used to enhance the sales of stores. For example, the different elements of the variable ‘attractiveness store’ could be defined, such that these insights can be used to further optimize the store’s sales.

Optimization stores

After the classification of stores, the sales of each class are optimized with a Linear Programming model. This model provides the best percentage of equivalents of each department for each class. Of course, the stores with format W cannot be optimized by exchanging equivalents among departments. Moreover, some classes contain just a few stores. Therefore, it is hard to provide accurate recommendations regarding the best division of departments. Fortunately, the procedure that is used to provide the recommendations can be useful and valuable in the future as well.

Furthermore, practical objections by calculating the extra turnover that can be generated by exchanging equivalents are ignored in this research. For example, if the Men’s department is located on the ground floor and the Boys’ department on the first floor, then it is practically illogical to increase one department and to decrease the other department due to the physical separation in the building. Therefore, the recommendations have to be interpreted as guidelines, which have to be adapted to the specific circumstances of the stores.
Confounding aspects of the findings

This research states that the Men’s and the Boys’ departments are performing better than the Women’s and the Girls’ departments. This statement is mainly investigated by quantitative research. However, this section attempts to explain this finding by the history of WE and by the shopping behaviors of men and women.

The history of WE still has a large impact on the performance of the different departments. WE started in 1962 as a specialist in fashion articles for men under the name ‘HIJ’. The Women’s department was added in 1986 under the name ‘ZIJ’. However, the sales of the Men’s department has always been at least 1.5 times bigger than the sales of the Women’s department, while the total Women’s market is at least 1.5 times bigger than the total Men’s market. On the one hand, the Women’s market has more competitors than the Men’s market. On the other hand, the total Women’s market is bigger as well. Therefore, there are probably still chances for WE to increase the market share in the Women’s market.

Experts from WE think that customers still mainly think of WE as a specialist in menswear. In addition, the experts stated that the Men’s collection is always better matched with the customer’s needs than the Women’s collection. Subsequently, it is stated that the history of WE still has an impact on the success of the different departments and formats.

Besides the history of WE, the customer’s behavior also has an influence on the performance of the departments and the formats. For example, experts mentioned that women also buy clothes for their husband and kids. However, the experts did not think that men buy clothes for their wife or kids. Therefore, it can be beneficial for stores with a Men’s, Boys’ and Girls’ department to have a Women’s department as well, while it probably will not be beneficial for stores with a Women’s department to have a Men’s department in the same store. However, these statements have to be verified by further research.

8.2 Contribution

This study provides important information for both academics and practitioners. Therefore, this paragraph describes the contribution of this research to the literature and the company.

Contribution to literature

Chapter 2 described that hardly any preliminary scientific literature concerning the allocation of space to different departments in the fashion retail industry is available. Therefore, this research fills a part of this literature gap.

This research used regression analyses to determine the best format and size of the departments for each store. In addition, these analyses are used to estimate the store’s sales and to identify and rank the other variables that have an influence on the turnover of a store (the control variables).

Currently available research uses experiments to prove hypotheses, instead of using regression analyses. Furthermore, no literature is known that provides recommendations regarding the best format of a store and the size of departments in a fashion retail environment. Moreover, no literature is found that investigates the performance of a store by taking into account the combination of the format of a store, the size of the departments, and the influence of the control variables. Finally, no literature is known that ranks the control variables based on the degree of influence on the turnover of a store.
Furthermore, the research contains a classification of stores. Best practice analyses are performed for each class. The classification is based on the current format of a store and the number of visitors per year. No literature is found that uses the same classification and that executes a best practice analysis based on this classification.

Finally, the research provides a Linear Programming (LP) model that optimizes the sales of each class by adjusting the percentage of equivalents of each department. No literature is known that uses exactly the same model, however, LP models are commonly used for optimizing sales by taking into account restrictions regarding the resources (e.g. the total number of equivalents in a store) (Silver et al., 1998).

**Contribution to WE Fashion**

The research has several advantages for WE Fashion. The main purpose of this research was to determine the best format and size of the departments within a store. This research provides a procedure and the findings of the procedure, such that stores can be optimized by adjusting the format and size of the departments. Hence, extra sales can be generated by applying these recommendations in the stores. In addition, the provided procedure can be used in the future to update these recommendations.

Furthermore, this research underpins the feeling of WE that the Women’s and Girls’ departments are performing below their standard in comparison to the Men’s and Boys’ departments. Moreover, this research shows that the Men’s and Boys’ format is the preferred format for most stores, except for stores with a large number of equivalents. Hence, this research can help WE to think about the strategic plan for the future of these departments and formats.

In addition, WE can use the regression models to predict the sales of the stores. Moreover, WE can enhance the store’s sales by using the insights into the influential variables on these stores’ sales. Furthermore, the provided knowledge about these influential variables can be used for the finding of new buildings for new stores.

**8.3 Limitations and recommendations for future research**

Due to restrictions in time and available data, the scope of this research is defined as described in paragraph 3.2. This paragraph describes the limitations of the research and also provides recommendations for future research.

**Data availability**

Problems with data availability caused the main limitations of the research. Some data were not available, outdated, not reliable, or too confident. Therefore, not all variables could be included into the regression models.

For example, data about the quality of the store managers and their team were too confident. However, in the best practice analyses this variable became important for the performance of a store. Unfortunately, this could not be tested with quantitative data in the regression analyses.

Furthermore, the best practice analyses showed that the economical and demographical environment is important for a store. However, data about the demographical variables, for instance the average income per resident, were a bit outdated, because these data were from 2009, while the
Economical situation changed dramatically between 2009 and 2011 (Grant & Wilson, 2012). Moreover, it is practically impossible to include all variables of the economical and demographical environment.

Finally, it is recommended to further investigate the control variables. For instance, more research on the internal and external variables is required. An example of an internal variable that can be investigated more deeply is the influence of a department on the ground floor or on the first floor of a store. Examples of external variables that can be investigated more deeply are: the influence of the number of parking places and the parking fee, and the influence of competitors.

Size of the departments

A recommendation for future research is to further investigate the relation between the size of a department and the sales of the department. This research assumed that the sales per equivalent remain equal, independently of the size of the department, see paragraph 8.1. However, further investigation to the effect of an increase or decrease in the number of equivalents of a department on the sales per equivalent is required.

Furthermore, WE sets restrictions on the minimum and maximum number of equivalents for the Boys’ and Girls’ departments and on the minimum number of equivalents for the Men’s and Women’s departments, see paragraph 6.1. However, a maximum size for the Men’s and the Women’s departments are not determined. Therefore, further investigation is required as well to determine these maximum sizes in the different formats.

Variable division of departments

This research provided recommendations regarding the best division of equivalents during the whole year. However, further research into the performance of the departments during a year is required to be able to properly adjust the division of the departments during the year.

For example, in the period when boys and girls go back to school, i.e. the period in August when the new school year starts, a peak in the kids’ sales is found. Therefore, it can be preferable to expand the size of the Boys’ and Girls’ departments in this time of the year. Another example is that the best division of the departments during the spring-summer and autumn-winter period could be different from each other.

Furthermore, extra research is required regarding the implementation of the exchange of equivalents among departments. Table 10 stated that with increasing or decreasing the size of a department, it should be studied which styles (i.e. Business, Casual, Smart, Basics, or No Direction) should be expanded or reduced. The procedure that is provided in this research can be used as a basis for this.

Unit of measure

The purpose of this research was to enhance the sales of a store, by adjusting the format and the number of equivalents per department. To gain more insight into this space management, it is recommendable to repeat this research for the gross or net margin, the unit sales, the number of transaction, etcetera. In addition, the research could be extended by taking into account the turnover rate of the stock of a store, because this can provide more insight into the store’s sales than only using the size of a store, i.e. a small store with a high turnover rate can sell just as much as a big store with a low turnover rate.
9. Conclusion

This master thesis project is conducted at the fashion retailer WE Fashion (WE). The research question is defined as: How can the turnover of each store be optimized by adjusting the format and sizes of the departments? The format of a store is defined as the combination of Men’s, Women’s, Boys’, and Girls’ departments. To assist WE with determining the best format and division of the departments within a store, a three step approach is executed. Step 1 contains the regression models. Subsequently, Step 2 groups the stores and performs a best practice analysis. Finally, Step 3 provides insight into the best format and division of departments such that the highest sales can be generated.

The regression analyses in Step 1 show that the store’s sales can be predicted with a forecast accuracy of 88.3%. The use of the forecasted number of visitors instead of the actual number of visitors (which is not known beforehand), has no significant influence on the forecast accuracy of the models. In addition, the regression analyses show that the variables ‘number of visitors per year’ and the ‘total number of equivalents’ have the greatest influence on the store’s sales.

Step 2 groups stores, based on their number of visitors per year and current format. Best practice analyses are executed for each class in the grouping with the goal of obtaining extra insight into the other variables that causes higher or lower sales of a store. These analyses are based on the experience and knowledge of employees within WE. The analyses show that differences in performance are mostly caused by specific circumstances in a particular store or city. However, these differences are not statistically significant. In addition, best practice analyses are performed for each format separately to obtain more insight. These more detailed analyses show that the variable ‘economical environment city’ has a significant influence on the sales of the stores with a Women format. Moreover, the performance of the stores with format Men-Women-Boys(-Girls) significantly differ due to internal variables, namely ‘attractiveness store’, ‘division departments’, and ‘accessibility store internal’.

Step 3 defines a Linear Programming model which optimizes the total sales of each class, see Step 2, by adjusting the division of the departments. Reallocation of equivalents among the departments will generate approximately 1 % extra sales per format in comparison with the current division. Moreover, it is shown that the Men’s and Boys’ departments are in general the best performing departments, i.e. these departments have the highest sales per equivalent, while the Women’s and Girls’ departments are performing worse. Especially for the Women’s department, this lower performance is caused by a lower quality of the collection. Therefore, a Men-Boys format is mostly the preferred format for a store.

The general applicability of the findings is investigated for other countries, formats, and years. The forecast accuracy remains above 80 %, and in these situations the Men’s and Boys’ departments are also performing very well, while the Women’s and Girls’ departments are also performing worse. Therefore, it is stated that the findings can be generalised to other countries, formats, and years.

In summary, the research question can be answered by stating that, in general, a Men-Boys format is preferred above other formats. The Men’s and Boys’ departments are generating the highest sales per equivalent, and should therefore receive the highest number of equivalents. In all cases, the provided restrictions regarding the minimum and maximum number of equivalents for each department should be taken into account. Furthermore, the recommendations should be applied to the stores with caution, because specific circumstances of a particular store can have a contradicting effect on the store’s sales.
10. References


## Appendix A Differences and similarities food and fashion retail industry

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Food retail industry</th>
<th>Fashion retail industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complementary products and elasticities</td>
<td>High. Many complementary products, i.e. spaghetti and spaghetti sauce.</td>
<td>High. Complementary products in the form of complete outfits and accessories.</td>
</tr>
<tr>
<td>Presentation of products</td>
<td>High. Logical presentation important: it has to be clear where products are stored.</td>
<td>High. An attractive presentation of products and complete outfits can generate higher sales.</td>
</tr>
<tr>
<td>Promotion</td>
<td>High. Promotions are causing an increase in sales and an increase in the number of visitors.</td>
<td>High. Promotions can increase the number of visitors, simultaneously, promotions can increase the sales.</td>
</tr>
<tr>
<td>Place/geographical influence</td>
<td>High. Important variables are for instance the availability of parking spaces, the presence of competitors, and the number of traffic in the area.</td>
<td>High. Important variables are for instance the availability of parking spaces, the presence of competitors, and the number of visitors of the city or shopping centre.</td>
</tr>
<tr>
<td>Product</td>
<td>High. Customers want the choice between private labels and A-brands.</td>
<td>High. The quality of the collection is important, i.e. if customers like the apparel or not.</td>
</tr>
</tbody>
</table>

## Differences

| Life-cycles                                      | Short & long. Fresh products are very perishable (days), while other products and non-food products are less perishable (months/years). | Medium. Apparel has a technical long life time (months/years), however, due to fashion influences, the products have a medium life-cycle (months). |
| Service                                          | Low. Customers can mostly find the products by themselves.                            | High. Service can be an important competition strategy.                                 |
| Relation with economy                            | Low. In times of financial crisis, customers do not save a lot of money on food products. | High. In times of financial crisis, customers tend to save a lot of money on apparel.  |
| Assortment change                                | Low. Assortment is relatively constant per store.                                    | High. Assortment changes continually, due to new collections.                          |
| Price                                            | High. A low price is an important competition factor.                                 | Low. Ratio price/quality is more important. Moreover, collection and status of brand are important as well. |
| Predictability demand                            | Medium. Except for promotions, the demand is relatively stable in the long run.       | High. Demand is rarely stable or linear. Demand is for instance influenced by weather, mode, films, or pop stars. |
| Impulse purchasing                               | Low. Except for a few products stored at the cash desks, most customers make a shopping list beforehand. | High. Many buying decisions in the store and at the point of purchase.                 |

Similarities and differences Food and Fashion retail industry (Arnold, Oum, & Tigert, 1983, Christopher et al., 2004, Cotterill, 1986, Priest, 2005)
### Appendix B Atmospheric variables

<table>
<thead>
<tr>
<th>External variables</th>
<th>General interior variables</th>
<th>Layout and design variables</th>
<th>Point-of-purchase and decoration variables</th>
<th>Human variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior signs</td>
<td>Flooring and carpering</td>
<td>Space design and allocation</td>
<td>Point-of-purchase displays</td>
<td>Employee characteristics</td>
</tr>
<tr>
<td>Entrances</td>
<td>Color schemes</td>
<td>Placement of merchandise</td>
<td>Signs and cards</td>
<td>Employee uniforms</td>
</tr>
<tr>
<td>Exterior display windows</td>
<td>Lighting</td>
<td>Grouping of merchandise</td>
<td>Wall decoration</td>
<td>Crowding</td>
</tr>
<tr>
<td>Height of building</td>
<td>Musix</td>
<td>Work station placement</td>
<td>Degrees and certificates</td>
<td>Customer characteristics</td>
</tr>
<tr>
<td>Size of building</td>
<td>P.A. usage</td>
<td>Placement of equipment</td>
<td>Pictures</td>
<td>Privacy</td>
</tr>
<tr>
<td>Color of building</td>
<td>Scents</td>
<td>Placement of cash registers</td>
<td>Artwork</td>
<td></td>
</tr>
<tr>
<td>Surrounding stores</td>
<td>Tobacco smoke</td>
<td>Waiting areas</td>
<td>Product displays</td>
<td></td>
</tr>
<tr>
<td>Lawns and gardens</td>
<td>Width of aisles</td>
<td>Waiting rooms</td>
<td>Usage instructions</td>
<td></td>
</tr>
<tr>
<td>Address and location</td>
<td>Wall composition</td>
<td>Department locations</td>
<td>Price displays</td>
<td></td>
</tr>
<tr>
<td>Architectural style</td>
<td>Paints and wall paper</td>
<td>Traffic flow</td>
<td>Teletext</td>
<td></td>
</tr>
<tr>
<td>Surrounding area</td>
<td>Ceiling composition</td>
<td>Racks and cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking availability</td>
<td>Merchandise</td>
<td>Waiting cues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congestion and traffic</td>
<td>Temperature</td>
<td>Furniture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior walls</td>
<td>Cleanliness</td>
<td>Dead areas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Atmospheric variables (adopted from Barry & Evans (1998) and Turley & Milliman (2000))*
Appendix C Comparison countries

This appendix describes the selection of the countries that are included into the research.

Paragraph 3.4 described that the stores that are used in the regression analyses have to be located in comparable countries. In addition, by applying the rules of thumb of Park & Dudycha (1974), the countries with less than ten stores are not taken into account. Therefore, Luxembourg, France, and Austria are not included into the research. The remaining stores are in The Netherlands, Belgium, Germany, and Switzerland. This appendix compares these countries by using a t-test.

The countries are compared with each other by using a t-test. This t-test tests whether two group means significantly differ from each other, by using Levene’s test. According to Field (2009), a non significant Levene’s test (significance is above 0.05) implies that the means of the different countries does not significantly differ from each other.

The findings of the t-tests are summarized in the table below. The total sales and the sales of the Men’s department are critical in the decision of the countries are comparable or not, because the Men’s department is the biggest and most import department within WE, see chapter 6.

<table>
<thead>
<tr>
<th>Comparing countries</th>
<th>NL &amp; BE</th>
<th>NL &amp; GE</th>
<th>BE &amp; GE</th>
<th>NLBE &amp; GE</th>
<th>NL &amp; CH</th>
<th>BE &amp; CH</th>
<th>NLBE &amp; CH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign. Levene’s test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Total 2011</td>
<td>0.414</td>
<td>0.063</td>
<td>0.044</td>
<td>0.041</td>
<td>0.049</td>
<td>0.026</td>
<td>0.035</td>
</tr>
<tr>
<td>Sales Men 2011</td>
<td>0.273</td>
<td>0.049</td>
<td>0.029</td>
<td>0.033</td>
<td>0.293</td>
<td>0.115</td>
<td>0.219</td>
</tr>
<tr>
<td>Sales Women 2011</td>
<td>0.673</td>
<td>0.004</td>
<td>0.008</td>
<td>0.002</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Sales Boys 2011</td>
<td>0.507</td>
<td>0.002</td>
<td>0.015</td>
<td>0.000</td>
<td>0.001</td>
<td>0.004</td>
<td>0.000</td>
</tr>
<tr>
<td>Sales Girls 2011</td>
<td>0.000</td>
<td>0.000</td>
<td>0.977</td>
<td>0.000</td>
<td>0.000</td>
<td>0.026</td>
<td>0.000</td>
</tr>
<tr>
<td>Significantly different</td>
<td>No</td>
<td>Ambiguous</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Comparing countries with t-tests

The table shows that The Netherlands and Belgium do not significantly differ, while both countries significantly differ with Germany and Switzerland. As an extra validation, The Netherlands and Belgium are grouped as one country, and compared with Germany and Switzerland.

It is decided to exclude Germany and Switzerland from the research, because these countries significantly differ with The Netherlands and Belgium, based on the total sales of the stores. In addition, paragraph 3.4 described that the experts within WE stated that the stores and market in Belgium are comparable with The Netherlands, while the market in Germany differs from these two countries. Furthermore, the experts explained that the other European countries are not comparable, because these are relatively new markets for WE, and encounter other regulations, economies, experience, and tastes.

In conclusion, it is shown that the group means of The Netherlands and Belgium are comparable with each other, however, the group means of Germany and Switzerland differ significantly. Hence, the research contains only the stores in The Netherlands and Belgium.
## Appendix D Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Data year</th>
<th>Description</th>
<th>Unit of measure</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total sales</td>
<td>2011</td>
<td>The total turnover that is generated by a store.</td>
<td>€/store</td>
<td>Scale</td>
</tr>
<tr>
<td><strong>Predictor variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fixed predictors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perc. Men</td>
<td>2012</td>
<td>The size of the Men department as a percentage of the total number of equivalents.</td>
<td>% Men/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>Perc. Boys</td>
<td>2012</td>
<td>The size of the Boys department as a percentage of the total number of equivalents.</td>
<td>% Boys/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>Perc. Girls</td>
<td>2012</td>
<td>The size of the Girls department as a percentage of the total number of equivalents.</td>
<td>% Girls/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>MB vs Dummy MBG</td>
<td>2011</td>
<td>Dummy indicating a store with format Men-Boys-Girls (1) or another format (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>MB vs Dummy MWB</td>
<td>2011</td>
<td>Dummy indicating a store with format Men-Women-Boys (1) or another format (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>MB vs Dummy MWBG</td>
<td>2011</td>
<td>Dummy indicating a store with format Men-Women-Boys-Girls (1) or another format (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>MB vs Dummy W</td>
<td>2011</td>
<td>Dummy indicating a store with format Women (1) or another format (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Visitors</td>
<td>2011</td>
<td>The total number of visitors per year of a store (traffic).</td>
<td># visitors/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>Banding</td>
<td>2011</td>
<td>Indicator of the assortment depth and width. Stores in band 1 receive all products and in the highest quantities.</td>
<td>1,2,3,4/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>Average income/ resident</td>
<td>2009</td>
<td>The average income per year per resident in the city.</td>
<td>€/ resident/ year/ city*</td>
<td>Scale</td>
</tr>
<tr>
<td>Total # residents in city</td>
<td>2009</td>
<td>The total number of residents in a city.</td>
<td># residents/</td>
<td>Scale</td>
</tr>
<tr>
<td>Shopping centre vs Dummy City centre</td>
<td>2011</td>
<td>Dummy indicating a store in a city centre (1) or in a shopping centre (mall) (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>WE vs Dummy New store concept</td>
<td>2011</td>
<td>The design of a store: dummy indicating a store with a new store concept (1) or a WE store concept (old) (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td># residents 0-17 years</td>
<td>2009</td>
<td>The total number of residents in a city aged between 0-17.</td>
<td># children/ city*</td>
<td>Scale</td>
</tr>
<tr>
<td># residents 18-64 years</td>
<td>2009</td>
<td>The total number of residents in a city aged between 18-64.</td>
<td># adults/ city*</td>
<td>Scale</td>
</tr>
<tr>
<td>% visitors of # residents in city</td>
<td>2011/ 2009</td>
<td>The number of visitors as a percentage of the total number of residents in a city.</td>
<td>%/ city</td>
<td>Scale</td>
</tr>
<tr>
<td>Furniture density</td>
<td>2011/ 2012</td>
<td>The density of furniture in a store, calculated with the number of squared meters VVO divided by the total number of equivalents.</td>
<td>m2/ EQ/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>VVO</td>
<td>2011</td>
<td>Total surface of the building, incl. stock room, canteen, etc. (in Durch: ‘Bruto Vloer Oppervlak’).</td>
<td>m2/ store</td>
<td>Scale</td>
</tr>
<tr>
<td>Total # equivalents</td>
<td>2011</td>
<td>The total number of equivalents in a store</td>
<td># EQ/ store</td>
<td>Scale</td>
</tr>
<tr>
<td># shop floors</td>
<td>2011</td>
<td>The number of shop floors in a store.</td>
<td>1,2,3,4/ floor</td>
<td>Nominal</td>
</tr>
<tr>
<td>H&amp;M</td>
<td>2012</td>
<td>The presence of a H&amp;M store in the same area as the WE store (1) or the absence of a H&amp;M store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Zara</td>
<td>2012</td>
<td>The presence of a Zara store in the same area as the WE store (1) or the absence of a Zara store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Mexx</td>
<td>2012</td>
<td>The presence of a Mexx store in the same area as the WE store (1) or the absence of a Mexx store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Esprit</td>
<td>2012</td>
<td>The presence of a Esprit store in the same area as the WE store (1) or the absence of a Esprit store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>C&amp;A</td>
<td>2012</td>
<td>The presence of a C&amp;A store in the same area as the WE store (1) or the absence of a C&amp;A store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Jack and Jones</td>
<td>2012</td>
<td>The presence of a Jack and Jones store in the same area as the WE store (1) or the absence of a Jack and Jones store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Coolcat</td>
<td>2012</td>
<td>The presence of a Coolcat store in the same area as the WE store (1) or the absence of a Coolcat store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>The Sting</td>
<td>2012</td>
<td>The presence of a The Sting store in the same area as the WE store (1) or the absence of a The Sting store (0).</td>
<td>0,1/ store</td>
<td>Nominal</td>
</tr>
<tr>
<td>Number of competitors*[^2]</td>
<td>2012</td>
<td>The number of competitors in the same area as the WE store and the squared number of competitors.</td>
<td>0-8/ store</td>
<td>Scale</td>
</tr>
</tbody>
</table>

* Source: Centraal Bureau voor de Statistik (Statistics The Netherlands) and Nationaal Instituut voor de Statistik (Statistics Belgium)

Variables included in the analyses

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[^2]: The number of competitors is squared to capture the potential influence of having a significant number of competitors in the same area as the WE store.
<table>
<thead>
<tr>
<th>Possible influencing factors</th>
<th>Findings interviews and literature</th>
<th>Literature papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>Naturally, the number of visitors is highly related with the sales of the store.</td>
<td>No literature available.</td>
</tr>
<tr>
<td>Banding</td>
<td>The width (and depth) of the assortment. Tradeoff between basic and fashion products. Management and consumers do not always have the same perceptions of the available assortment.</td>
<td>Downs &amp; Haynes (1984), Köks, Fisher, &amp; Vaidyanathan (2009), Rajaram (2001)</td>
</tr>
<tr>
<td>Design: New store concept or WE store concept (i.e. old store concept)</td>
<td>Store image is an important aspect for attracting consumers in specific target markets. Moreover, the characteristics and preferences of the customers are important. An up-to-date design is essential to maintain competitiveness in a rapidly changing environment.</td>
<td>Kent (2007), (Williams, Slama, &amp; Rogers, 1985), Bellenger, Robertson, &amp; Greenberg (1977), Corstjens &amp; Doyle (1989), Kirby &amp; Kent (2010) Downs &amp; Haynes (1984)</td>
</tr>
<tr>
<td>Quality store manager and team</td>
<td>High influence on service, and subsequently on the sales of a store. The store manager has to motivate and train his team.</td>
<td>Landy &amp; Conte (2008)</td>
</tr>
<tr>
<td>Competitors in the same city</td>
<td>Opposite effects: number of visitors can be increased, but the number of paying customers can be decreased. Difficult to identify the competitors, because other retailers are mostly focusing on slightly different markets.</td>
<td>Porter (1998), Kind (1996)</td>
</tr>
<tr>
<td>Store specifications:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- City Centre or Shopping Centre (mall)</td>
<td>Internal environment has a stronger effect on emotions in SC than in CC, and has a negative effect in SC on the willingness to pay more.</td>
<td>Andreu et al. (2006)</td>
</tr>
<tr>
<td>- Number of shop floors</td>
<td>Contradicting findings. Unclear of an additional floor level withhold visitors. With multiple floor levels the store is less flexible in changing sizes of the departments, and an extra effort is required to create the atmospherics on both floors.</td>
<td>No literature available.</td>
</tr>
<tr>
<td>- Surface store VVO or the total number of equivalents</td>
<td>Best surface depends on the number and kind of products that have to be stored, which relates with the assortment strategy.</td>
<td>No literature available.</td>
</tr>
<tr>
<td>- Surface store BVO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Façade  No data available</td>
<td>Positive impact of large glass facades that focus attention on the products within the store and more unplanned store visits. However, spillover effects can occur.</td>
<td>Kirby &amp; Kent (2010), Cornelius, Natter, &amp; Faure (2010), (Oh &amp; Petrie, 2011), (Cornelius et al., 2010)</td>
</tr>
<tr>
<td>- Furniture density</td>
<td>Related with image brand, high density stores can look ‘cheaper’.</td>
<td>No literature available.</td>
</tr>
<tr>
<td>Demographical data of a city:</td>
<td>Contradicting findings in literature and in the interviews on the significance of the effects of the demographic variables. The number of residents in a city and the age distribution of a city have an influence on the number of visitors and on the number of residents within the target group.</td>
<td>Carpenter &amp; Moore (2006), Summers, Belleau, &amp; Wozniak (1992), (Mulhern, Williams, &amp; Leone, 1998)</td>
</tr>
<tr>
<td>- Total number of residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Number of residents aged between 18-64</td>
<td>Several papers found a significant influence of average income on patronage.</td>
<td>Carpenter &amp; Moore (2006), Summers et al. (1992), (Mulhern et al., 1998)</td>
</tr>
<tr>
<td>- Number of residents aged between 0-17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Average income per resident</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings of the control variables out of interviews and literature review
Appendix E Assumptions linear regression

This appendix contains the description of the assumptions of linear regression. Moreover, the assumptions are verified for regression model 3.

1. **Normally distributed errors**

Linear regression assumes random, normally distributed residuals with a mean of zero. This assumption means that the differences between the model and the observed data are most frequently zero or very close to zero, and that differences much greater than zero happen only occasionally. The assumption is checked by looking at the histogram of the residuals, which should look like the classic bell shape, and by checking the normal probability plot that plots the expected cumulative probability on the observed cumulative probability. This latter plot should form a straight line from (0,0) to (1,1) (Field, 2009).

**Regression model 3**

![Histogram and Normal P-P Plot](image)

The histogram and the normal probability plot show that the residuals are normally distributed.

2. **No perfect multicollinearity**

Variables can correlate with each other when two or more predictor variables both measure the same underlying structure, i.e. when one variable increases, the other variable will increase (with the same value) as well. This causes a potential problem for linear regression when predicting the influence of each individual factor, potentially causing an over- or underestimation of variables and a lower model fit. Therefore, no perfect linear relationship, i.e. multicollinearity, is required between the variables (Hair et al., 2010).

Multicollinearity can be tested by multiple measures. The Pearson correlation is the standard one-tail correlation coefficient and should be below 0.8 (Field, 2009). The Variance Inflation Factor (VIF) can indicate a more subtle form of multicollinearity, and it is suggested by Myers (1990) and Bowerman & O’Connell (1990) that the VIF should be below 10 and above 1 for a model to be not biased.
Regression model 3

<table>
<thead>
<tr>
<th>Correlation Table</th>
<th>Log Total Sales</th>
<th>Perc Men EQ</th>
<th>Perc Boys EQ</th>
<th>Perc Girls EQ</th>
<th># Visitors</th>
<th>Banding</th>
<th>EQ Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Total Sales</td>
<td>1.00</td>
<td>.122</td>
<td>-.212</td>
<td>.231</td>
<td>.857</td>
<td>-.706</td>
<td>.847</td>
</tr>
<tr>
<td>Perc Men EQ</td>
<td></td>
<td>1.000</td>
<td>.784</td>
<td>.014</td>
<td>-.226</td>
<td>.098</td>
<td>.024</td>
</tr>
<tr>
<td>Perc Boys EQ</td>
<td>-.212</td>
<td>.784</td>
<td>1.000</td>
<td>.090</td>
<td>-.498</td>
<td>.286</td>
<td>-.280</td>
</tr>
<tr>
<td>Perc Girls EQ</td>
<td>.231</td>
<td>.014</td>
<td>.090</td>
<td>1.000</td>
<td>.090</td>
<td>-.186</td>
<td>.250</td>
</tr>
<tr>
<td># Visitors</td>
<td>.857</td>
<td>-.226</td>
<td>-.498</td>
<td>.090</td>
<td>1.000</td>
<td>-.593</td>
<td>.839</td>
</tr>
<tr>
<td>Banding</td>
<td>-.706</td>
<td>.098</td>
<td>.286</td>
<td>-.186</td>
<td>-.593</td>
<td>1.000</td>
<td>-.397</td>
</tr>
<tr>
<td>EQ Total</td>
<td>.847</td>
<td>.024</td>
<td>-.280</td>
<td>.250</td>
<td>.839</td>
<td>-.397</td>
<td>1.000</td>
</tr>
</tbody>
</table>

The correlation table suggests that multicollinearity occurs between the variables ‘Log total sales’, ‘Number of visitors’, and ‘Total equivalents’. However, the highest VIF in this regression model is 6.817. Based on this VIF value it is concluded that the assumption of no perfect multicollinearity is not violated. Although, also a regression model is provided in Table 2 and Appendix F that excludes the predictor variables ‘Number of visitors’ and ‘Total equivalents’.

3. Independent errors

Since the original predictor variables should not be correlated, the residuals should be uncorrelated as well, i.e. the residuals should be independent. This assumption is tested with the Durbin-Watson test, where the outcome should be as close to 2 as possible and at least between 1 and 3 (Durbin & Watson, 1951).

Regression model 3

The value of the Durbin-Watson test is 1.787. Therefore, independent errors are assumed.

4. Homoscedasticity

The variance of the residual terms should be constant at each level of the predictor variables, i.e. the residuals at each level of the predictor variables should have the same variance (homoscedasticity). Heteroscedasticity implies that variances are unequal at different levels of a predictor variable. Homoscedasticity is verified by looking at the partial plots, i.e. the plots of the standardized residuals versus the standardized predicted values (Field, 2009).

Regression model 3
The scatterplot shows that the assumption of homoscedasticity is slightly violated, because a bow can be identified. However, the points are mostly randomly and evenly dispersed throughout the plot. Hence, this assumption is partly violated.

5. **Linearity**

The assumption of linearity indicates that the relationship between the predictor variables and the outcome variable is linear. If a non-linear relationship is modeled by using a linear regression model, then the general applicability of the findings is limited. This assumption is tested by creating scatterplots of the predictor variables and the dependent variables. These scatterplots should look like linear lines.

**Regression model 3**

A scatterplot is created for all independent variables. All scatterplots show a linear relationship between the independent variable and the dependent variable. Therefore, it is concluded that the assumption of linearity is met.
## Appendix F Results regression analyses

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regr.1</th>
<th>Regr.2</th>
<th>Regr.3</th>
<th>Regr.4</th>
<th>Regr.5</th>
<th>Regr.6</th>
<th>Regr.7</th>
<th>Regr.8</th>
<th>Regr.9</th>
<th>Regr.10</th>
<th>Regr.11</th>
<th>Regr.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perc. Men</td>
<td>-0.286</td>
<td>0.392</td>
<td>0.140</td>
<td>0.243</td>
<td>0.318</td>
<td>0.378</td>
<td>0.334</td>
<td>0.258</td>
<td>0.248</td>
<td>0.244</td>
<td>0.440</td>
<td>0.139</td>
</tr>
<tr>
<td>Perc. Boys</td>
<td>-0.159</td>
<td>0.149</td>
<td>0.050</td>
<td>-0.117</td>
<td>-0.063</td>
<td>-0.166</td>
<td>-0.008</td>
<td>-0.241</td>
<td>-0.044</td>
<td>-0.054</td>
<td>0.342</td>
<td>-0.303</td>
</tr>
<tr>
<td>Perc. Girls</td>
<td>-0.268</td>
<td>-0.179</td>
<td>0.059</td>
<td>0.099</td>
<td>0.017</td>
<td>0.285</td>
<td>0.036</td>
<td>0.023</td>
<td>-0.245</td>
<td>-0.002</td>
<td>-0.401</td>
<td></td>
</tr>
<tr>
<td>MB vs Dummy MBG</td>
<td>-0.055</td>
<td>0.155</td>
<td>0.157</td>
<td>0.008</td>
<td>0.289</td>
<td>0.011</td>
<td>0.019</td>
<td>0.019</td>
<td>0.110</td>
<td>0.411</td>
<td>0.411</td>
<td></td>
</tr>
<tr>
<td>MB vs Dummy MWB</td>
<td>-0.002</td>
<td>-0.219</td>
<td>-0.243</td>
<td>-0.236</td>
<td>0.243</td>
<td>0.243</td>
<td>0.102</td>
<td>0.102</td>
<td>0.102</td>
<td>0.102</td>
<td>0.102</td>
<td></td>
</tr>
<tr>
<td>MB vs Dummy W</td>
<td>-0.140</td>
<td>0.287</td>
<td>-0.245</td>
<td>-0.245</td>
<td>0.245</td>
<td>0.245</td>
<td>0.245</td>
<td>0.245</td>
<td>0.245</td>
<td>0.245</td>
<td>0.245</td>
<td></td>
</tr>
<tr>
<td>Control variables (stepwise2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Visitors</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td>0.648</td>
<td></td>
</tr>
<tr>
<td>Banding (assortment depth and width)</td>
<td>-0.222</td>
<td>-0.208</td>
<td>-0.392</td>
<td>-0.392</td>
<td>-0.405</td>
<td>-0.405</td>
<td>-0.405</td>
<td>-0.405</td>
<td>-0.405</td>
<td>-0.405</td>
<td>-0.405</td>
<td></td>
</tr>
<tr>
<td>Avg. income / resident</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
<td></td>
</tr>
<tr>
<td>Shopping centre vs Dummy city centre</td>
<td>0.069</td>
<td>0.069</td>
<td>0.069</td>
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<tr>
<td>Furniture density</td>
<td>-0.594</td>
<td>-0.594</td>
<td>-0.594</td>
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<td>-0.594</td>
<td>-0.594</td>
<td>-0.594</td>
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<tr>
<td>BVO</td>
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<td>-0.008</td>
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<td>YVO</td>
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<td>-0.654</td>
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<tr>
<td>Total # equivalents</td>
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<td>0.257</td>
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<td>0.118</td>
<td>0.118</td>
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<td>0.118</td>
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<td># competitors</td>
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<td># competitors squared</td>
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<td>0.077</td>
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<td>Performance</td>
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<tr>
<td>R²-adjusted</td>
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<td>0.934</td>
<td>0.934</td>
<td>0.768</td>
<td>0.768</td>
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<td>35.8%</td>
<td>15.6%</td>
<td>17.2%</td>
<td>13.2%</td>
<td>23.8%</td>
<td>13.4%</td>
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</tr>
<tr>
<td>Forecast accuracy (+1-MAPE)</td>
<td>64.2%</td>
<td>86.4%</td>
<td>86.4%</td>
<td>76.2%</td>
<td>86.6%</td>
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<td>99.3%</td>
<td>99.3%</td>
<td>99.3%</td>
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<tr>
<td>Forecast accuracy sales</td>
<td>64.2%</td>
<td>86.4%</td>
<td>86.4%</td>
<td>76.2%</td>
<td>86.6%</td>
<td>63.1%</td>
<td>99.3%</td>
<td>99.3%</td>
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<tr>
<td>Forecast st.dev.</td>
<td>0.33</td>
<td>0.17</td>
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<td>0.348</td>
<td>0.169</td>
<td>0.386</td>
<td>0.006</td>
<td>0.006</td>
<td>0.010</td>
<td>0.006</td>
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<tr>
<td>MAPE st.dev.</td>
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</table>

### Assumptions

- **Linearity**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Homoscedasticity**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Independence errors**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Multicollinearity [max VIF<10]**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Normally distributed errors**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **No multicollinearity [max VIF<10]**: No, No, No, No, No, No, No, No, No, No, No, No
- **Independent errors**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Linearity**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Homoscedasticity**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Independence errors**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
- **Multicollinearity [max VIF<10]**: No, No, No, No, No, No, No, No, No, No, No, No
- **Linearity**: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes

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Appendix G Interviews best practice analysis

This chapter shows the questionnaire that is used for the interviews with the area managers and the questionnaire that is send to the district managers.

Questionnaire area managers

This paragraph describes the questionnaire that is used as a basis for the interviews with the area managers.

1. Which of the control variables, as shown in Appendix D, has an influence on the turnover of a store? Which of these variables have the greatest influence on the store’s sales?

2. Table 3 shows the findings of the regression analyses and the degree of influence of the variables. Do these outcomes match with your experience? Are some variables more or less important in practice? Is this list of variables complete, or have variables to be added or deleted from this list?

3. Which other variables have an influence on the performance of a store? Have these variables a positive or a negative influence? Are these variables specific for a few stores or can they be applied for all stores?

4. According to the list of stores with the best and worst performing stores: What are the common reasons that these stores are performing better or lower than their comparable stores? Which variables cause the differences between better and lower performing stores?

Questionnaire district managers

This paragraph provides the questionnaire that is send to the district managers, together with an explanation of the purpose of this research. Each district manager has to fill in the questionnaire for each selected store separately.

Store: ...

Indicate the degree of influence of each variable on the sales of the store.

<table>
<thead>
<tr>
<th></th>
<th>Strong negative influence (5)</th>
<th>Negative influence (4)</th>
<th>Neither positive or negative (3)</th>
<th>Positive influence (2)</th>
<th>Strong positive influence (1)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format store</td>
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<td></td>
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</tr>
<tr>
<td>Quality store manager and team</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractiveness store</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Division departments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface store</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility store (internal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility store (external)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractiveness centre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economical environment city</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, namely ...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Explanation variables:

Internal variables:

- **Format store**: The influence of the current format of the store on the store's sales. A negative influence can indicate that departments should be added or deleted in the store to generate higher sales, while a positive influence can indicate that the format of the store is already optimal.

- **Quality store manager and team**: The influence of the store manager and the team on the store's sales. A negative influence can indicate that higher sales can be generated with another store manager or team, while a positive influence can indicate that the store manager and team are generating the maximum sales of the store.

- **Attractiveness store**: The influence of the attractiveness of the store on the store's sales. A negative influence can indicate an old store that should be renovated and does not attract visitors, while a positive influence can indicate an inspiring store which triggers visitors to buy more.

- **Division departments**: The influence of the current division of the departments on the store's sales. A negative influence can indicate that departments should be much bigger or smaller in the store to generate higher sales, while a positive influence can indicate that the division of the store is already optimal.

- **Surface store**: The influence of the size of the department on the store's sales. A negative influence can indicate that the store is too small or too big for presenting the products in an optimal way, while a positive influence can indicate that the surface of the store is already optimal.

- **Accessibility store (internal)**: The influence of the accessibility in the store on the store's sales. A negative influence can indicate that not all departments are easily accessible, e.g. a kids department on the first floor without an elevator or escalator, while a positive influence can indicate that all departments are very good accessible, e.g. the store has extra wide aisles.

External variables:

- **Attractiveness centre**: The influence of the attractiveness of the centre (city centre or shopping centre) on the store's sales. A negative influence can indicate an outdated, non-touristic centre which does not attracts visitors, while a positive influence can indicate a sparkling, touristic centre that inspires visitors to buy.

- **Economical environment city**: The influence of the economical circumstances in a city on the store's sales. A negative influence can indicate a low average income per resident or a high degree of unemployment, while a positive influence can indicate a city with a high degree of wealth.
- **Competitors**: The influence of the competitors in the same area on the store's sales. A negative influence can indicate that competitors are attracting buyers away from the store or the absence of competitors can cause less visitors, while a positive influence can indicate that competitors attract more visitors to the centre and to the WE store, which subsequently causes higher sales.

- **Accessibility store (external)**: The influence of the accessibility of the store on the store’s sales. A negative influence can indicate that the store was not accessible very well because of, for instance, a path that was broken up or the location is decreased because of the building of new stores in other parts of the centre, while a positive influence can indicate that the store is very good accessible and that the store is in the perfect location in the centre because it is in the walking route of most visitors of the centre.

*Other*: Indicate if other variables have an influence on the store's sales as well, please name and describe these variables and score the variables on the degree of influence.
## Appendix H Results best practice analyses

<table>
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<tr>
<th>Lowest/ highest performing stores</th>
<th>Lowest</th>
<th>Highest</th>
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<tr>
<td><strong>Format and class</strong></td>
<td>W 1a</td>
<td>W 3a</td>
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<tr>
<td># stores</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Response # stores</td>
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<td>4</td>
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<td><strong>Internal variables</strong></td>
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<td></td>
</tr>
<tr>
<td>Format store</td>
<td>2,0</td>
<td>2,5</td>
</tr>
<tr>
<td>Quality store manager and team</td>
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<td>2,8</td>
</tr>
<tr>
<td>Attractiveness store</td>
<td>2,0</td>
<td>2,3</td>
</tr>
<tr>
<td>Division departments</td>
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<td>3,0</td>
</tr>
<tr>
<td>Surface store</td>
<td>3,0</td>
<td>2,5</td>
</tr>
<tr>
<td>Accessibility store</td>
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<td>2,8</td>
</tr>
<tr>
<td><strong>External variables</strong></td>
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<td></td>
</tr>
<tr>
<td>Attractiveness centre</td>
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<td>3,8</td>
</tr>
<tr>
<td>Economical environment city</td>
<td>3,0</td>
<td>3,5</td>
</tr>
<tr>
<td>Competitors</td>
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<td>2,3</td>
</tr>
<tr>
<td>Accessibility store</td>
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<td>2,5</td>
</tr>
</tbody>
</table>

Results best practice analyses per class (Likert scale from 5 to 1)
Appendix I Linear Programming model

This appendix defines and describes the final LP model.

\[
\begin{align*}
\text{Maximize} & \quad \sum_{t=1}^{K} (EQ \ M_t \ast \frac{\epsilon}{EQ \ M_t} + EQ \ W_t \ast \frac{\epsilon}{EQ \ W_t} + EQ \ B_t \ast \frac{\epsilon}{EQ \ B_t} + EQ \ G_t \ast \frac{\epsilon}{EQ \ G_t}) \\
\text{(Maximize the sales of a class. Firstly, the sales of each department in a particular store } i \text{ is calculated by multiplying the number of equivalents with the sales per equivalent for each department. Secondly, the sales of a store } i \text{ is calculated by summing the sales of each department. Finally, the sales of all stores in the class are summed to obtain the sales of a class. These total sales are maximized in this LP model.)}
\end{align*}
\]

Subject to

\[
EQ \ Total \ New_i = EQ \ Total \ Current_i, \quad 1 \leq i \leq K
\]

\{For each store } i, \text{ the new total number of equivalents in the store has to be the same as the current number of equivalents in the store. This current number of equivalents is known in advance.}\}

\[
EQ \ Total \ New_i = EQ \ M_i + EQ \ W_i + EQ \ B_i + EQ \ G_i, \quad 1 \leq i \leq K
\]

\{For each store } i, \text{ the new total number of equivalents in the store is calculated by summing the number of equivalents of each department.}\}

\[
EQ \ M_i = \% \ M \ast EQ \ Total \ Current_i, \quad 1 \leq i \leq K
\]

\{The number of equivalents of the Men’s department is calculated by multiplying the total number of equivalents in store } i \text{ with the percentage of the Men’s department. This percentage of the Men’s department is calculated by the LP model and holds for all stores in the class.}\}

\[
EQ \ M_i \geq 44, \quad 1 \leq i \leq K
\]

\{The size of the Men’s department has to be above 44 equivalents, for each store } i.\}

\[
EQ \ W_i = \% \ W \ast EQ \ Total \ Current_i, \quad 1 \leq i \leq K
\]

\{The number of equivalents of the Women’s department is calculated by multiplying the total number of equivalents in store } i \text{ with the percentage of the Women’s department. This percentage of the Women’s department is calculated by the LP model and holds for all stores in the class.}\}

\[
EQ \ W_i \geq 37, \quad 1 \leq i \leq K
\]

\{The size of the Women’s department has to be above 37 equivalents, for each store } i.\}

\[
EQ \ B_i = \% \ B \ast EQ \ Total \ Current_i, \quad 1 \leq i \leq K
\]

\{The number of equivalents of the Boys’ department is calculated by multiplying the total number of equivalents in store } i \text{ with the percentage of the Boys’ department. This percentage of the Boys’ department is calculated by the LP model and holds for all stores in the class.}\}

\[
12 \leq EQ \ B_i \leq 24, \quad 1 \leq i \leq K
\]

\{The size of the Boys’ department has to be between 12 and 24 equivalents, for each store } i.\}

\[
EQ \ G_i = \% \ G \ast EQ \ Total \ Current_i, \quad 1 \leq i \leq K
\]

\{The number of equivalents of the Girls’ department is calculated by multiplying the total number of equivalents in store } i \text{ with the percentage of the Girls’ department. This percentage of the Girls’ department is calculated by the LP model and holds for all stores in the class.}\}
\[ 8 \leq EQ_{G_i} \leq 12, \quad 1 \leq i \leq K \]
{The size of the Girls’ department has to be between 8 and 12 equivalents, for each store \( i \).}

\[ \% M + \% W + \% B + \% G = 100\% \]
{The sum of the percentages of each department has to be 100 \%.}
Appendix J Optimization per store

Chapter 6 described in general how the best division of equivalents is determined for each class by using the LP model. This appendix contains an elaborated example of the division optimization of a specific store, such that the highest sales can be generated for the store.

The Microsoft Excel Solver is used to execute the LP model. This tool is available within WE, therefore, the procedure can be used in the future to update the best divisions of the departments. The Excel Solver provides the best division of equivalents for each class. However, for a particular store within the class, the current division of the departments might be better than the recommended division for the class. Furthermore, the provided division cannot be directly used in the store, because of the restrictions regarding the minimum and maximum sizes of the departments.

The following steps are used to determine the best division of departments within a store. For each department is considered if the current size of the department or the recommended size of the department is better. An example is added, based on a MWB store with more than 250,000 visitors per year. The current division of the Men’s, Women’s, and Boys’ departments for this store is respectively 50, 35, and 15 %. The recommended division for the class is respectively 56, 38, and 6 %.

1. Determine the department with highest sales per equivalent.
   *E.g. The Men’s department has the highest sales per equivalent.*

2. Set the new percentage of this department on the maximum of the current percentage and the preferred percentage.
   *E.g. The Men’s department is currently 50 %, while the preferred percentage is 56 %. Increase the size of the Men’s department to 56 %.*

3. Repeat step 1 and 2 for the department with the second highest sales per equivalent, and in case of an MWBG store, for the third highest sales per equivalent.
   *E.g. The Boys’ department has the second highest sales per equivalent. This department has currently 15 % of the equivalents and is therefore keeping unchanged.*

4. Set the percentage of the department with the lowest sales per equivalent as 100 % minus the percentages for the other departments.
   *E.g. The Women’s department is set on 100 % - 56 % - 15 % = 29 %.*

5. Check the restrictions for each department: Men’s ≥ 44 EQ, Women’s ≥ 37 EQ, Boys’ 12 - 24 EQ, and Girls’ 8 - 12 EQ. Adjust the number of equivalents to meet these requirements.

6. Check if the total new number of equivalents is equal to the old total number of equivalents.
   a. If too many equivalents are used, then decrease the number of equivalents from the department with the lowest sales per equivalent. If this is not possible
because of the restrictions (see step 5), then decrease the number of equivalents of the department with the second lowest sales per equivalent, etcetera.

b. If too little equivalents are used in the new situation, then increase the number of equivalents from the department with the highest sales per equivalent, such that the old total number of equivalents is equal with the new total number of equivalents. If this is not possible because of the restrictions (see step 5), then increase the number of equivalents of the department with the second highest sales per equivalent, etcetera.