ANALYSIS OF RECOMMENDER SYSTEMS IN SWISS E-SHOPS:
ANALYSIS OF THE TWO LARGEST SWISS E-SHOPS FOR
ELECTRONICS

Seminar Thesis

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# CONTENTS

LIST OF FIGURES .......................................................................................................................... 3  

BACKGROUND AND PROBLEM STATEMENT .............................................................................. 4  

OBJECTIVES .............................................................................................................................. 4  

RESEARCH QUESTIONS ............................................................................................................... 4  

RESEARCH DESIGN AND METHODOLOGY .................................................................................. 4  

PRESENTATION OF THE COMPANIES AND THEIR E-SHOPS ..................................................... 5  

DIGITEC ......................................................................................................................................... 6  

BRACK.CH ..................................................................................................................................... 10  

RECOMMENDER SYSTEMS OF THE COMPANIES ....................................................................... 14  

DIGITEC ......................................................................................................................................... 14  

BRACK.CH – A SEMANTIC SOLUTION OF PREDIGGO ................................................................. 16  

COMPARISON OF THE TWO RECOMMENDER SYSTEMS .............................................................. 17  

BUSINESS VALUE IMPACT OF RECOMMENDER SYSTEMS .......................................................... 17  

THE VALUE OF PERSONALIZED RECOMMENDER SYSTEMS TO E-BUSINESS ....................... 18  

BUSINESS VALUE IMPACT OF PERSONALIZED RECOMMENDATIONS ON A LARGE ONLINE RETAILER ................................................................................................................................. 20  

CONCLUSION AND OUTLOOK ..................................................................................................... 21  

REFERENCES .................................................................................................................................. 23  

APPENDIX ...................................................................................................................................... 24  

A – WRITTEN INTERVIEW WITH DIGITEC ..................................................................................... 24  

B – ORAL INTERVIEW WITH DR. VINCENT SCHICKEL-KÜNG, CEO OF PREDIGGO (04/21/2015) ................................................................................................................................. 25
LIST OF FIGURES

Figure 1: Main categories on the digitec frontpage ................................................................. 7
Figure 2: Sub-menu for the category "PC components" .......................................................... 8
Figure 3: Ventilation & cooling sub-menu .............................................................................. 8
Figure 4: Detailed filtering for PC fan characteristics ............................................................ 9
Figure 5: Display of products meeting all the requirements ................................................. 9
Figure 6: Sub categories on the Brack.ch front page ............................................................. 11
Figure 7: Filtering system in the printer category ................................................................. 12
Figure 8: Special offers on the Brack.ch frontpage ............................................................... 12
Figure 9: Main categories and special offers on the Brack.ch frontpage ............................. 13
Figure 10: Recommended products after choosing a topic .................................................. 14
Figure 11: Recommendations on detailed product page ...................................................... 15
Figure 12: General architecture design (Codina, Ceccaroni 2010) ...................................... 16
BACKGROUND AND PROBLEM STATEMENT

In the market economy, competitive pressure results from close proximity of competitors. Today, in the age of the internet, where our world is thoroughly connected, competitors are closer than ever and businesses and organisations are increasingly under competitive pressure. Thanks to the internet, a supplier from the other side of the world can become a serious competitor in our home country market and vice versa. While the technological progress changed the way we conduct business, some of the traits remained the same. In the pre-internet era, people had to physically visit shops and seek advice from vendors and salespersons. If the received consulting wasn’t enough, they asked their peers for feedback about the product in question. On the opposite side of the trade, a shop owner could try to maximize his sales by training his employees or by setting on word of mouth propaganda. Today, people don’t have to leave their homes for shopping anymore. Therefore, businesses have to adapt their way of talking to the customer and are forced to find new sources of competitive advantages. Instead of a human sales advisor in a physical store, businesses use recommender systems for their online shops. Instead of using word of mouth as a marketing instrument, product reviews inform potential buyers about the experiences made by previous buyers. Today’s businesses must understand that a reliable and sophisticated recommender system is an important tool to satisfy their most important asset; the customer base.

OBJECTIVES

The aim of this study case is to investigate and identify the different recommender systems in use by the two largest Swiss online shops for electronics, Digitec.ch and Brack.ch. Based on our findings, we try to provide suggestions for improving the respective systems’ recommendation-capabilities.

RESEARCH QUESTIONS

The following questions will be answered in this study case:

1. What technique is used for recommender systems?
2. What are the differences of the two companies recommender systems?
3. What is the input/output relation between maintenance of the recommender systems and its value for the companies?

RESEARCH DESIGN AND METHODOLOGY

This thesis will first contain a short presentation of both companies and the characteristics of their respective online shops. In the following chapter, both recommender systems are being analyzed,
described and compared. Finally, suggestions for improving the recommender systems are presented.

Gathering of Information
In order to succeed with this study case, contacting Digitec and Brack is inevitable and crucial. Contacting both shops as soon as possible has to be prioritized. Interviews are intended as most important information gathering tool. Further, web analysis will be used to complement first-hand information.

PRESENTATION OF THE COMPANIES AND THEIR E-SHOPS

Selection criterion
The scale of the e-commerce landscape in Switzerland changed and increased drastically over the last decade. Since its introduction, the home electronics segment shows by far the highest share of online turnover based on the total turnover of the segment. The share of online trade of home electronics based on the total segment turnover continuously grew from 7% in 2007 to 23% in 2013 (GfK 2014, p. 13) with an average growth rate of 15.3% from 2011 to 2013 (Credit Suisse 2015, p. 19). The home electronics sector is followed by the clothing segment, which generated 12.4% of its turnover via online retailing in 2013 (Credit Suisse 2015, p. 18). The absolute amount of generated turnover of the online home electronics segment and the clothing segment for 2013 is estimated as 1.3bn CHF and 1.2bn CHF (Credit Suisse 2015, p. 18) while the total amount of online turnover for the same year is estimated as 6.25bn CHF (GfK 2014, p. 8). In 2013, the home electronics segment generated 28.7% of total turnover for the Swiss B2C online retailing market. (GfK 2014, p. 12).

Many reasons can be found that justify the success of online home electronics retailing. The first main reason is that most characteristics of electronic products are easily observable and comparable over the internet and thus don’t need physical inspection. Due to the uniformity of electronic products, online-customers take a smaller risk in buying said products compared to products where a physical inspection is an important part of the decision-making process. (e.g. food). The second main reason for the success of electronics online retailing is due to the technological progress. Today’s electronic products have shorter product lifecycles and are embedded in an increased competitive environment, which leads to declining prices. In order to stay competitive in such an environment, companies have to adjust to the cost pressures by covering larger customer areas while minimizing company costs. Online-shops are a suitable instrument to achieve both business objectives at the same time.
After stating the relevance of the market share of online retailing of home electronics for the Swiss online retailing landscape, the selection process for two companies to be investigated in this study case were based on the following criteria:

1. The companies’ headquarters must be in Switzerland.
2. The companies are primarily invested in the B2C online electronics market.
3. The companies are selected based on the amount of financial turnover.

The first company to meet all three requirements is Digitec. With an annual turnover of 550 million CHF in 2013, Digitec is the largest online retailer for electronics in Switzerland. Besides being the biggest online retailer for electronics, Digitec is also the number one online store in Switzerland in general, followed by Amazon and Nespresso and Zalando (Handelszeitung 2013). The second largest online retailer for electronics in Switzerland is Brack with an annual turnover of 120 million CHF in 2013. In total, Brack is the 6th largest online store in Switzerland (Handelszeitung 2013).

**Digitec**

**Company Portrait**

In 2001, the three young entrepreneurs Oliver Herren, Florian Teuteberg and Marcel Dobler founded a general partnership named Nägeli Trading & Co. and created their first online shop right from the beginning under the name digitec.ch (SHAB: 092 /2001). In 2005, a general partnership under the name Digitec AG was incorporated (SHAB: 118 / 2005). Due to continuous growth over the years, Digitec had to move several times to other locations with bigger warehouses. In 2010, the digitec operators launched Galaxus, a new online shop with a broad range of product categories (e.g. interior, DIY + Garden, Sports, Toys etc.) and operated it independently from Digitec. As from 2014, Digitec and Galaxus were merged to form Galaxus (Switzerland) (SHAB: 184 / 2014). While Galaxus.ch remains an online shop for a broad range of products, Digitec.ch, as market leader in his field, continues its specialization on IT, consumer electronics and telecommunication.

In 2012, the Swiss retail giant Migros announced to purchase 30% of the shares from Galaxus with the option to become the majority shareholder in the future (Tagesanzeiger 2012). In 2013, Migros confirmed that the company will make use of the option to become the major shareholder by the end of the year 2015 (Tagesanzeiger 2013). Today, Galaxus (Switzerland) employs over 460 people and the logistics center spans a total area of 24’000m² located in Wohlen, which is located in the Canton of Aargau.
Besides its online shop, Digitec also operates 9 physical stores mainly in the Swiss German part of Switzerland but also one store in Lausanne. While those stores mostly display smaller consumer electronics like mobile phones, tablets, laptops and cameras, they also serve as a quick pick-up station for orders from customers.

**Digitec’s filtering system**

Digitec’s success was and still is mostly due to an unusually user-friendly product filtering system. Said filtering system allows the user not only to browse through rough sorted product categories such as “Audio & HiFi” or “Computers”, but allow the user to search more specifically for the products in mind. Figure 1 shows the available main categories displayed on the front page of the online shop from which the user can chose from:

![Main categories on the digitec frontpage](image)

After selecting one of the categories, the user is then navigated to a sub-menu which displays him a more detailed categorization of the before selected product category. In our example, the user selects the category “PC components”. The sub-menu then lists all of the corresponding hardware belonging to this category (Fig. 2):
Depending on which sub-category the user is selecting, he is directed to a second sub-menu to further specify the product category he is interested in. In our example, the user is looking for a new fan for his computer tower. After selecting the sub-category “Ventilation & cooling”, he is directed to the following “sub-sub-menu” (Fig. 3):

In order to see all available products in question, the user now clicks on the category “PC fan”, the category the user wishes to buy a product from. At this stage, the users product type filtering is specific enough to confront him with a detailed filter which helps him to determine all major characteristics about products to be considered (Fig. 4):
After defining the product criteria, the filter shows that out of 438, there are 25 products that meet the users’ requirements. By clicking on “Show products”, the user gets an overview over said 25 products¹ (Fig. 5):

This form of presentation gives the user a good overview of important information about all products meeting his requirements. First, the five star rating scale on the bottom of each product indicates how the product has been rated by previous customers. This is a very useful tool to further restrict the number of potential products by ignoring all products with a bad rating. Secondly, the green dot in the upper right corner indicates if the product is in stock at Digitec (white check mark) or if it is on stock in an external warehouse (no white check mark). This indication can vary based on how long it takes Digitec to ship the product in question, from “more than 10 pieces on stock” to “3 weeks procurement time”. Hovering over said dot gives additional information concerning the

¹ In order to safe space, we only show the top row of the 25 products recommended.
available quantity of the product in different physical store locations, ready to be picked up by the customer.

The products are sorted according to the sales ranking by default so users automatically see the most popular products. But the user has also the possibility to sort the listed products based on the average user rating, availability and highest / lowest price or by release date.

At this point, the user also has the possibility to look at each of the remaining products in detail. The page of each product gives him information about the number of customers who rated the product, including all of their reviews on the lower half of the page. He also has the possibility to carry out a comparison between 2 or more products in case he wants to check through the specifications step-by-step.

**Brack.ch**

**Company Portrait**

Brack was founded 1994 under the company name Brack Consulting. The founder Roland Brack assembled PCs in the house of his parents. Two years later he hired his first employee and the startup moved to Mägenwill. The company grew fast and invented 1998 a new software to transact processes efficiently. The increased productivity brought higher sales and the company expanded furthermore. The online shop of Brack Consulting was invented 1999/2000 and contributed 20% to total sales. The warehouse became one of the most modern logistics-centers in Switzerland. With the help of barcode-scanners it was possible to check the applies for accuracy and completeness. In cooperation with the IT-Service company Belos Informatik, Brack invented a shop-in-shop-solution for resellers. With the opening of a purchasing office in Taiwan, Brack developed a better position for the price negotiations and quality assurance and secured the continuous growth. In the year 2013, the online shop was renewed. The development is based on neuroscientific findings and optimal user-friendliness. The brand alignment as an online retailer represents the best and proven in production quickly.

Brack.ch is a Microsoft Gold Certified Partner in the field of OEM-solutions. They are able to consult students, teacher, and institutes to the Microsoft-Education-Box-products and deliver specific products. Another partner is HP. As a HP Platinum Partner Brack.ch has the opportunity to provide customized solutions and access to programs and products of HP. Other partnerships are with Lenovo and Buffalo Technology (Brack.ch, 2015).

Nowadays the Brack Electronics AG is part of the Competec Holding AG, which also includes Alltron, Competec Logistics and the Competec Service AG (handelsregister.help.ch, 2015).
Brack.ch delivers private and business customers with PC complete systems and individual components. Alltron operates as a second core of the group in the wholesale. Competec Logistik AG takes over all logistics tasks of Competec group. In the Competec Service AG central services such as IT, technology, human resources, finance and business development are housed. The Group generated sales of 445 million Swiss francs in the year 2013. Today Brack.ch offers more than 70,000 products from over 1,000 manufacturers from stock. The company has 200,000 residential and business customers. With over 20 years of experience, Brack.ch provides advice via phone, e-mail, Twitter and Facebook.

**Brack.ch filtering system**

The filtering system of Brack.ch has a logical construction. The online shop differentiates the products generally between IT-Hardware, Software & Office, Multimedia & HiFi, Telecommunications & Electro, House & Garden, Family & Leisure, RC & Model Making and Music & Instruments. Brack.ch has also an integrated search engine to find already known products. Within the different categories, there are further subcategories. The subcategories are broken down into further product features to offer a more detailed possibility to search. The system provides also an overview over the category for special offers, novelties, clearance items and gifts (Fig.6).

The filtering system of the online shop shows the number of hits after searching a product. To find the desired product, the filtering system of Brack.ch gives different options to specify the search. The filter sorts the items for the user according to the manufactures, the price, special offers, novelties, clearance items and product specifications (Fig.7).
The front page of Brack.ch has also a commercial part (Fig. 8). There are the main offers and services listed. Those are sorted by gender, season, price offers and product category. It is located on the top of the front page, directly under the headline. This helps to guide the customer to the best-sellers and current fashion.
Under the commercial part is an overview with the branches with the highest market share. The structure is reminiscent of a catalogue. There are products listed from IT, office equipment, multimedia and electronic devices. The filtering system shows again topsellers in the categories promotion, new releases, bestseller and recommendations. The same is shown for house, garden, leisure and music.

<table>
<thead>
<tr>
<th>IT, Büro, Multimedia und Elektro</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLX.ScanMouse inkl. App</td>
</tr>
<tr>
<td>Maus und Scanner in einem</td>
</tr>
<tr>
<td>Scannen Bilder, Texte und Dokumente</td>
</tr>
<tr>
<td>Für alle CH-Einzahlung','scheine</td>
</tr>
<tr>
<td><strong>CHF 79.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>ABBYY PDF Transformer+</td>
</tr>
<tr>
<td>Öffnen, Lesen, Zusammenfassen</td>
</tr>
<tr>
<td>Interaktive Kommentar, Funktionen</td>
</tr>
<tr>
<td>Dokumente mit Signaturen versehen</td>
</tr>
<tr>
<td><strong>CHF 63.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>Sony Playstation 4 (500 GB)</td>
</tr>
<tr>
<td>8-Core x86 AMD-Prozessor</td>
</tr>
<tr>
<td>Blu-ray Laufwerk – für Spiele</td>
</tr>
<tr>
<td>2x USB 3.0, Bluetooth und WLAN</td>
</tr>
<tr>
<td><strong>CHF 379.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>HP ProBook 470 G2</td>
</tr>
<tr>
<td>Intel Core i5-5200U, 2,2-3,7 GHz</td>
</tr>
<tr>
<td>8 GB DDR3-RAM, 1 TB HHD</td>
</tr>
<tr>
<td>AMD Radeon R5 M255, 2 GB RAM</td>
</tr>
<tr>
<td><strong>CHF 959.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Haus, Garten, Freizeit und Musik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staubsauger Miele Complete</td>
</tr>
<tr>
<td>Mit schöner Parkettzunge</td>
</tr>
<tr>
<td>Kraftvoller 700-Watt-Motor</td>
</tr>
<tr>
<td>Maximale Lufthygiene</td>
</tr>
<tr>
<td><strong>CHF 379.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>GARDENA Wand-Schlauchbox</td>
</tr>
<tr>
<td>25 Meter Schlauch</td>
</tr>
<tr>
<td>Automatisch einsetzbar</td>
</tr>
<tr>
<td>Schwenkbare Wandhalterung</td>
</tr>
<tr>
<td><strong>CHF 129.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>Frühlingsputz mit P&amp;G</td>
</tr>
<tr>
<td>Alles fürs saubere Zuhause</td>
</tr>
<tr>
<td>Zahlreiche Reinigungsprodukte</td>
</tr>
<tr>
<td>Praktischer Kunststoffreiniger</td>
</tr>
<tr>
<td><strong>CHF 29.90</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
<tr>
<td>FireKING LUXOR IV</td>
</tr>
<tr>
<td>Gasgrillwagen mit 4 Brenner</td>
</tr>
<tr>
<td>2-teilige Grilltrife</td>
</tr>
<tr>
<td>Grillrost und -platte aus Gusseisen</td>
</tr>
<tr>
<td><strong>CHF 499.00</strong></td>
</tr>
<tr>
<td>Details</td>
</tr>
</tbody>
</table>

*Figure 9: Main categories and special offers on the Brack.ch frontpage*

If a user choses something out of the recommendations on the frontpage and click on it, the product page opens and presents the chosen item. The filtering system gives information about the specific undercategory of the article. A picture of the product, the most important informations, the stock, the number of the article and the number of the manufacturer sum up the main points. It is followed by a description of the item, the specifications of the product, reviews and accessories. On the bottom of the article description, Brack.ch provides recommendation for the user (Fig.10). The recommendations offer alternatives to the shown item and also accessoire.
RECOMMENDER SYSTEMS OF THE COMPANIES

Digitec

In order to gain detailed information about the recommender system in use at Digitec, a questionnaire was created and sent to the company via e-mail. Besides an introductory letter, the document included 14 questions, covering different aspects of the topic (see Appendix A).

In August 2014, together with a reworked online shop, Digitec also implemented a new recommender system as a feature to their shop. Before being introduced to the Digitec online shop, said recommender system was already in use at the Galaxus online shop. Just as the rest of Digitec’s ERP environment (Leimstoll 2009), the recommender systems were developed internally by the programming department which counts 26 employees. In the interview, Digitec stated that the recommender systems in use at their online shop are hybrid systems, since both, a collaborative, item-based and a content-based filtering system are implemented. The system operates autonomous, manual interventions are not desired. Due to operating reasons, Digitec so far did not make use of personalised recommendations for customers during their online shopping sessions but would rather give personalised recommendations via newsletter or banners. The recommender systems operate mostly invisible for the respective customer and recommended products are only then displayed, when enough results are available. The recommender systems are only visible for the customer when he is looking at a detailed product page. For example, if a customer is looking for a new and more powerful CPU, the CPU bestsellers and the most visited products, which can also be products from other categories, will be displayed on the bottom right of the detailed product page.
While products displayed under “bestseller” depend on actual sales, the products displayed under the “most visited” category change rather frequently.

Figure 11: Recommendations on detailed product page

Digitec sees their recommender systems more as support for customers, who are not as experienced or determined as users who use the extended filter function of the shop. Nevertheless, the recommender systems primary function is to increase the size of the shopping cart and thus contribute to an increase of turnover. While not naming any numbers, Digitec confirms that the impact of their recommender systems on sales numbers of recommended products is significant and simultaneously acknowledge a positive correlation between recommender systems and company success.

For Digitec, the importance of recommender systems and its elements will tend to increase in the future. As a part of the ongoing development of Digitec’s online shop, these elements will be implemented accordingly. In this context, the most important factor lies in the scalability of future solutions. Future solutions must fulfil the condition to work in a potentially growing diversity. Manual interventions therefore tend to be undesirable.
Brack.ch – A semantic solution of Prediggo

The recommender system software of Brack.ch is based on an external solution. The provider of this solution is Prediggo with headquarters in Lausanne (Brack.ch 2015). The recommender system of Prediggo is used by Brack.ch since 2011. Before the implementation of the software, Brack.ch had an own basic solution. The algorithm of Prediggo integrates semantic attribute understanding to establish more comprehensive links between products than transactions alone. This algorithm is a hybrid filtering system that combines characteristics of the collaborative-based and the content-based systems. The target is to minimize the disadvantages of each respective system. It improves the overall efficiency of the system’s performance in terms of comprehensiveness and precision (Schickel-Küng 2015).

Semantic recommendation systems are generally characterized by the incorporation of semantic knowledge in their processes to improve the quality of the recommendation. The semantic approach in the e-shop of Brack.ch applies domain-based inferences, which consist of making inferences about the interests of the user, based on the hierarchical structure defined by the ontology. The upward-propagations’ idea is to assume that the user is interested in a general concept, if he is also interested in a given percentage of its direct sub-concepts. This mechanism allows creating new knowledge about the long-term user’s interests and modelling user-profiles (Codina, Ceccaroni 2010).

![General architecture design](Codina, Ceccaroni 2010)

**Advantages of semantic-ontologic recommender systems**

The performance of semantic recommender systems is based on a knowledge base. In the case of Brack.ch it is based on the ontology. The use of the ontology has the advantage in limiting specific problems (Peis, Morales-del-Castillo, Delgado-López 2008). It guarantees the inter-operability of sys-
tem resources and provides a homogenous representation of information and also allows the dy-
namic contextualization of the preferences of users. Another point is that those engines facilitate
performance in collaborative filtering and social networks. The communication processes between
agents and between agents and users is much better. The “cold start” problem is lower because of
completing the incomplete information through inferences. The user contextual factors of the users
are described by the ability to semantically extend. The description and representation of different
system elements is improved like the description of systems logic, because an inclusion of a set of
rules are admitted. (Peis, Morales-del-Castillo, Delgado-Lóp 2008).
Prediggo also supports any selling strategy by giving marketers the ability to set merchandising,
recommendation and search rules specific to any product category, product type, brand and more.
Prediggo tracks clicks, queries and purchases for every visitor, but also captures product attribute
and price range preferences for even more relevant results. Prediggo makes search results, home
and category page merchandising dynamic to new visitors by using a global behaviour built with
clicks and purchases across the site. The software is hosted on Prediggo’s servers and has a dy-
namic core. It works autonomous and doesn’t need any maintenance. The implementation needs
the transaction data and the product catalogue. Then it is important to know what kind of a platform
the base is. Prediggo works with a plug-in. The implementation on a homemade platform like
Brack.ch need some days (Schickel-Küng 2015).

Comparison of the two recommender systems

While Digitec’s strategy always was and still is to develop as much as possible internally, in 2011
Brack took a slightly different way. After gathering information about the recommender systems in
use at Digitec and Brack through interviews, we can state that today both companies are using
hybrid recommendation systems. Digitec is using an in-house hybrid recommendation system
comprised of an item-based collaborative filtering system and a content-based filtering system.
Brack on the other hand is using the services of Prediggo as provider of recommendation systems
which works with a semantic-ontologic approach. Both systems are using different approaches for
dealing with the cold start problem. Digitec’s recommender system does not display any recom-
mendations until enough results are available. Prediggo’s recommender system tries to guess
missing information through inferences.

BUSINESS VALUE IMPACT OF RECOMMENDER SYSTEMS

The view on the business aspects of recommender systems tries to figure out how valuable those
systems are for the e-shops and what important is to consider. To analyze the economic perspec-
tive it is important for companies to continuously monitor the input/output-relation of the various
business tools in use. In the case of a recommender system, the company should be able to estimate the added value of the recommender system to their turnover to see if the recommender system is still a good investment. In a best case scenario, the company is able to determine the utility and the business value impact of said recommender system. Out of strategic reasons, Brack and Digitec were not willing to comment their respective value additions resulting from the implementation of recommender systems in more detail. The Software Prediggo uses for the online-shop of Brack.ch gives some information about pricing a semantic solution. The price of this solution is based on the traffic on the homepage. Previously the RecSys-Softwares had worked on a commission. But the fact, that the online-shops have to report and calculate costs has led to licenses with monthly costs. The smallest price of a licence of Prediggo is 300€ and goes up to 6000€ per month. The price also depends on the hosting costs. An internal hosting is less expensive (Schickel-Küng 2015). Therefore, this chapter gives an overview over existing literature and case studies related to the business value impact of recommender systems.

The value of personalized recommender systems to e-business

The value of personalized recommender systems to e-business: A case study (Dias M.B. et. al., 2008)

The first case study was developed in a collaboration of Unilever corporate research Bedfordshire UK, two universities from Manchester UK and LeShop.ch, a pioneer in the field of e-grocery shopping, based in Switzerland. The aim of the case study was to increase sales volume by using personalized recommendations and gather evidence of the real added business value of a personalized recommender system. From May 2006 to January 2008, two types of recommender systems were implemented in the LeShop.ch – online store: An in-store and a checkout recommender system.

For the in-store recommender system, up to eight within-category (dairy, fruits & vegetables, butcher, snacks etc.), non-personalized recommendations were initially provided, selected by category managers. As of October 2007, the authors personalized the first two of these eight in-store recommendations via their model-based system. While these two personalized recommendations could be any items available in the store, the remaining six programmed recommendations were restricted to within-category items. In contrast to the programmed in-store recommendations which were updated regularly by the category managers, the personalized recommendations were only updated once.
The checkout recommender system provided the customer with six recommendations at the checkout. The first three recommendations were generated automatically by the LeShop.ch system and contained items the respective shopper usually buys, but are not currently in the basket. The three remaining recommendations were items with the highest probability of purchase, given the contents of the basket. The selection of these recommendations based on computations using the frequency of past purchases method. Similar to the in-store recommender system, the recommendations at the checkout given by LeShop.ch were updated regularly while the personalized recommendations were not.

**Results**

The authors state that it doesn't matter how good the recommendations are, if the users don't use the system, it will not generate any additional value for the company. This is why the most important measure of the value of a recommender system is the shopper penetration, which means the use of each recommender system spread over time. For measuring the penetration, the authors represented the shoppers who accepted at least one of the both recommendation systems as a percentage of all shoppers who bought at least one item from LeShop.ch. The results show that consistently updating the checkout recommender files resulted in an increase in the number of new shoppers using the recommender system from initially 0.6% in 2006 to nearly 4% in 2008. The authors state that this development of increased usage could be due to the fact that the shoppers were becoming more comfortable with new technology. In contrast to the checkout recommender system, the penetration of the in-store recommender system was increasing rapidly since its launch in October 2007 from 0 to 2% in January 2008. A possible reason for this highly increased growth in penetration of the in-store recommender system is that shoppers are on average nine times more exposed to it than to the checkout recommender system.

**Direct and indirect extra Revenue**

The direct extra revenue is the total amount of money shoppers spent on purchasing items recommended by the recommender systems. In terms of direct extra revenue resulting from the recommender systems, both recommender systems together generated 0.30% monthly extra revenue for LeShop.ch (0.1% for the checkout recommender system and 0.2% for the in-store recommender system). The authors note that this percentage seems like a small amount, but depending on the monthly turnover of the e-commerce business, the actual value generated can be substantial. The authors also registered substantial additional, indirect extra revenue generated by the recommender systems by introducing shoppers to new categories from which they continued to purchase. The following top five increases in sales were observed by introducing shoppers to new categories: Delicatessen (26.02%), Dairy (19.67%), Fruits & Vegetables (17.12%), Butcher (9.04%) and Snacks (8.17%). Both, direct and indirect extra revenue together totaled for 0.47% monthly extra revenue generated by the recommender systems.
Business Value Impact of Personalized Recommendations on a Large Online Retailer

Case Study on the Business Value Impact of Personalized Recommendations on a Large Online Retailer (Belluf, Xavier and Giglio 2012)

The case study on the business value impact of personalized recommendations on a large online retailer describes the methods and results of an ongoing investigation conducted on the business value impact of personalized recommendations on different portals of Nova Pontocom, the second largest Latin American online retailer. The work presents methods and results of an online experiment. The experiment was carried out for a month in three independent portals and summed up to 600,000 different users, 50 million page views, 1 million online orders and generated revenues of USD 230 million. The treatment groups were randomized collected and personalized recommendations were presented. There was also a control group with no recommendations. This was the experimental design during the test period of one month. With a statistical significance of 95%, it could be observed that there was an overall increase in revenues in the order of 8-20%. The results of the study with regard to the revenue of per user is statistically significant in most of the large product categories. In categories with less than 1,000 users the results are not significant. One possible explanation would be that the experiment period in this category was probably too short. For the three websites the overall figures are 8-19%, 9-19% and 8-22%. They show the total revenue generated and the number of different products sold. These figures are higher due to the fact that the control group in their experiment manually edited contain recommendations. The analysis of the number of page views per user showed a slightly different picture. While the observation duration there were more page views than actual purchases. There are significant differences for all the major categories have been found out and it could be demonstrated that the existence of recommendations increased. The number of page views per user in the order of 5-8%, 7-9% and 5-7%, respectively. In addition to the financial metrics presented so far, has also been tested for the difference in the diversification between the test groups. With regard to the five largest product categories each portal (a total of 15 tests), statistically significant differences in ten of them in the order (average) from 4% to 15% were found.

Conclusion of the results

The article presents the results of an online experiment in the context of the three portals of Nova Pontocom, a large Brazilian online retailer. Statistically significant differences were observed between the treatment (personalized recommendations were submitted) and control (no recommendations) groups in terms of key business metrics such as revenue per user (8-20%), sales diversity (4-15%) and page views per user (5-9%). These results support the use of personalized recommendations in the context of a large multi-product online retailers, even if no reviews available. Future research has still to examine how recommendations influence consumer behavior and
therefore added value required. The authors of the study intend this problem by examining the difference in performance between the CF algorithms (features) that are presented in different navigation situations by buying cycle.

**CONCLUSION AND OUTLOOK**

It is difficult to analyze the business impact of a recommender system especially for Brack.ch and Digitech. Comparing the financial statements before and after the implementation of the system doesn’t provide any arguments for a correlation between a good or bad development of the statement and the recommender system. There are too many effects, which can have an influence, for example the market development, suppliers, political behaviour and acquisitions. So any predication of the business impact can just be tested on a study over a longer period. As illustrated in the case studies, the use of personalized recommendations in the context of large multi-product online retailers is recommended. Even if there are no reviews available. The most important measure of the value of a recommender system is the shopper penetration. The direct extra revenue of a recommender system is the total amount of money shoppers spent on purchasing items recommended by the systems. Updating checkout recommender files leads to an increasing number of new shoppers using the recommender system.

**Challenges of recommender systems:**

The structure of a recommender system has to depend on the client. Crucial is what he wants to sell and what his business force is. The system should filter products out, but not influence them. Another important function of the recommender system is to create and use the cross-selling potential. But after opinion of some experts in the industrial sector is the age of recommender systems gone. The interest and demand for such systems goes back. Recommender systems in eShops are like a blackbox. The option of tuning the recommendations uses the legal aspects "What have you bought in the past?". In this field, Amazon has for example a huge amount of data to sell. Important in the future will be merchandising solutions integrating user interface and specific business force for the user. The trend goes to personalization and the disappearance of homemade platforms. There was just the website and a retail store in the past. Today’s challenge is to manage the multi-channel-marketing like shopping via smartphone or tablet. Homepages have to report their performance to the headquarters and are no longer autonomous. Knowledge based recommender systems and selling data becomes necessary.

Other challenges are to consider different data imports and give a history-feedback. Another important point is keeping the software clear and simple. An example for a good approach is the Boltzmann Machine for collaborative filtering at Netflix. The solutions have to be understandable in a way that non-engineers are able to understand the system (Schickel-Küng 2015).
Of all the semantic recommender systems, those using semantic web technology to define the knowledge base are the most promising in terms of short and mid-term results. However, the most solid future line of research focuses on the development of mixed systems that use tools involved in developing the semantic web project, along with additional filters, like those based on a trust network (ensuring the processes’ results reliability) and those using contextual information allowing to increase filtering precision (Peis, Morales-del-Castillo, Delgado-López 2008).
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APPENDIX

A – Written Interview with Digitec

Fragebogen zu Recommender Systems und deren Einsatz bei digitec.ch

1. Seit wann ist bei digitec ein Recommender System im Einsatz?

2. Was sind die entscheidenden Kriterien, welche ein RecSys bei digitec erfüllen sollte?
   Es soll die Attach-Rate erhöhen. Das heisst, es soll zur Vergrösserung des Warenkorbs und damit letztlich zur Steigerung des Umsatzes beitragen.

3. Wurde das Recommender System, welches bei digitec zum Einsatz kommt, intern entwickelt oder wurde eine Applikation eingekauft?
   Interne Entwicklung.

4. Welche Formen von Recommender Systems kommen bei digitec zum Einsatz? Handelt es sich um ein collaborative filtering system, ein content-based filtering system oder um ein hybrides Recommender System?
   Es handelt sich insofern um ein hybrides System, als in unterschiedlichen Kontexten beide Modelle zum Einsatz kommen.

5. Falls das Recommender System mit dem collaborative filtering-approach arbeitet; wird ein nearest neighbor Algorithmus angewendet oder handelt es sich um ein item-based collaborative filtering System?
   Es handelt sich um ein Item-based System.

6. Wie ist das Recommender System im Gesamtsystem implementiert und wie arbeitet es?
   (Für den User unsichtbar/sichtbar)
   Es arbeitet für den User unsichtbar. Stehen genügend Resultate zur Verfügung, werden Felder Angebote eingeblendet, sonst nicht.

7. Wie muss das Recommender System gepflegt werden (Manuelle, automatisierte Vorgänge)?
   Aktuell arbeitet das System weitgehend automatisiert. Manuelle Eingriffe sind nicht erwünscht.


10. Digitec zeichnet sich seit seiner Gründung durch eine überdurchschnittlich benutzerfreundliche Filterfunktion für den Produktdkatalog aus und besitzt dadurch im Vergleich zur Kon-
B – Oral Interview with Dr. Vincent Schickel-Küng, CEO of Preddigo
(04/21/2015)

1. Since when does Brack use a recommender system? Since when does Brack use Prediggo recommender system?
   The Recommender system of Prediggo is used by Brack.ch for 3,5 years. Before they had a basic own solution.

2. What are the specific criteria a recommender system has to fulfill?
   It depends on the client. What he wants to sell and what his business force is. The system should filter products out, but not influence them. Also it is important to use the cross-selling potential. But the Age of RecSys is gone. People will not interest in those. The RecSys in eShops is like a blackbox. The option of tuning the recommendations uses the legal aspects “What have you bought in the past?”. In this field has Amazon for example a huge amount of sell data. Important in the future will be Merchandising solutions integrating user interface and specific business force for the user.

3. Was the recommender system developed internally or was it procured externally?
   Answer Brack.ch: Procured externally from Prediggo.

4. Which type of recommender system is used at Brack? Which types of recommender systems does Prediggo provide? Collaborative filtering system, content-based filtering system or hybrid recommender systems? Does Prediggos recommender system make personalized recommendations to customers? If the recommender systems works with the collaborative filtering approach; does it use a nearest neighbor algorithm or is it an item-based collaborative filtering system? What alternatives exist?
The algorithm of Prediggo integrates semantic attribute understanding to establish more comprehensive links between products than transactions alone. It also supports any selling strategy by giving marketers the ability to set merchandising, recommendation and search rules specific to any product category, product type, brand and more. Prediggo tracks clicks, queries and purchases for every visitor, but we also capture product attribute and price range preferences for even more relevant results. Prediggo makes search results, home and category page merchandising dynamic to new visitors by using a global behavior built with clicks and purchases across the site.

5. How is the recommender system implemented and how does it work? How does the maintenance of the recommender system look like?
The Software is hosted on the Prediggo server and has a dynamic core. It works autonomous and doesn't need any maintenance. The implementation needs the transaction data and the product catalogue. Then it is important to know what kind of a platform is the base. We work with a kind of plug-in. The implementation on a home made platform like Brack.ch need some days. The trend goes to personalization and the disappearing of home made platforms.

6. How many recommender system solutions has Prediggo to offer?
In the context of RecSys Prediggo offers one solution.

7. As seen on your homepage, your semantic merchandising solution has a pricetag of 499 euros per month. Is this price company-size dependend? Which criteria matter to determine the specific price the customer has to pay?
The price of the solution is based on the traffic on the homepage. Years ago, the RecSys-Softwares had worked on a comission. But the fact, that the online-shops have to report and calculate costs has led to licenses with monthly costs. The smallest price of our solution is 300€ and goes up to 6000€ per month. The price also depends on the hosting costs. An internal hosting is less expensive.

8. What future challenges do you see for recommender systems? Why does an online shop need a recommender system?
A few years ago there was just the Website and a retail store. The actual challenges are to manage the multi-channel-marketing like shopping via smartphone or tablet. The homepages have to report and are not anymore autonomous. So you need a knowledge based RecSys and the sell data. Other challenges are to consider different Data imports and give a history-feedback. Another point is to keep the software simple. An example for a good approach is the Boltzmann Machine for Collaborative Filtering of Netflix. The solutions have to understand, that users are not ingenieurs.