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Design of Dynamic Pricing Systems for Online-Retailer's-Core Functionalities and Qualitative Insights

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DESIGN OF DYNAMIC PRICING SYSTEMS FOR ONLINE-RETAILER'S – CORE FUNCTIONALITIES AND QUALITATIVE INSIGHTS

Research in Progress

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Abstract

The intense competition in e-commerce makes many small- and medium-sized retailers striving for dynamic pricing. Therefore, the core functionalities of a dynamic pricing system are investigated using single case study research method. They embrace both external and internal factors for price calculation. First, there are functions to get external information such as price information from competing retailers. They provide important information for calculation and forecasting. Second, internal oriented functions exist, which analyse personal information such as the birthday in order to influence the buyers' decisions in a positive way.

Keywords: Dynamic-Pricing, E-Commerce, Case study research, Revenue Management

1 Introduction

Pricing is highly relevant for business practice as well as business research. Beside classical strategies, the developing information and communication systems revealed meaningful approaches to implement adequate pricing approaches. One of them is known as Dynamic Pricing. Dynamic pricing can be seen as a new capability for revenue management, where retailers can monitor the demand in real time and adjust the product's or service's price dynamical based on different individual patterns like prices of the competitors or customer individual preferences (Levin et al., 2009).

This approach for strategical pricing started in industries with perishable capacities (Gallego and Van Ryzin, 1994) such as airlines and hotels. However, it is used increasingly in industries with storable goods (Elmaghraby and Keskinocak, 2003). Three factors foster the use of dynamic pricing in these sectors: the availability of demand data, the possibility to change prices easily and the availability of decision support (Elmaghraby and Keskinocak, 2003). Especially in the field of e-commerce, dynamic pricing is a very common topic and challenge as well (Hinz et al., 2011). Online retailers, like Amazon or Wal-Mart, use dynamic pricing to skim off consumer's surplus and maximize their profits.

Nowadays, more and more small- and medium-sized retailers try to implement dynamic pricing as well, because of the high competitive environment in e-commerce. Customers in general focus on aspects like the price, because of uncertainty and financial risk in e-commerce (Gefen, 2000; Pavlou, 2003). Therefore, if a customer is going to buy a product, for instance a notebook of the brand "A", he might buy the notebook at the cheapest retailer in order to reduce costs as well as risk. The retailer, who is offering this notebook have to adjust the prices with regards to the offer of the competitors. Otherwise, the risk to lose customers increase and the competiveness might decrease at the same time.

Besides the aspect of minimize risk and costs, many customers see prices as an indicator for product quality (Lichtenstein et al., 1993). Especially, if other quality aspects are missing, the price become more and more important (Zeithaml, 1988). In online retailing the products mostly cannot differentiated by characteristics (e.g. quality) because many retailers sell the same product or indiscernible substitutes. Therefore, dynamic pricing and the connected frequently adjusting of the price can improve the perception of price and quality. Subsequently, this approach can help to cope with the challenges in this competitive market.

Research shows different insights into the field of dynamic pricing (Hinz et al., 2011; Weisstein et al., 2013). But there is sparse research for the design of dynamic pricing systems with regards to the recent scientific literature. This research-in-progress paper will address to this research gap and define basic core functionalities of such a dynamic pricing system from the viewpoint of an European online retailer. After defining core concepts of dynamic pricing, we determine our single case study research method. Based on qualitative insights, we describe core functionalities of dynamic pricing systems and give prospects for future research.

2 Research Background

In general, the concept of price can be defined as consumer's perception of the trade-off between cost and benefit (Zeithaml, 1988). According to Monroe (1990), this trade-off often can be standardized as price-quality trade-off (Varki and Colgate, 2001). As mentioned above, this relation can help to improve the performance of a retailer by an adequate pricing strategy. Furthermore, price is an important factor because it is involved into the concept of value (Zeithaml, 1988). Value perceptions can be actively managed by price perceptions (Dodds et al., 1991). Research found that they can have a direct effect on customers' satisfaction and consequentially their behavioral intention (Dodds et al., 1991). Therefore, an agile price strategy, such as dynamic pricing, can help to increase customer's value and avoid negative effects.

Dynamic pricing systems set new prices according to an individual pricing strategy and related to the prices of competing retailers. For instance, Amazon changes product's prices several times a day in relation to the prices of other retailers (Schwartz, 2014). Furthermore, different customer characteristics can be integrated in the dynamic pricing system.

Dynamic pricing is a common and routine topic in the airline sector as well as the hotel business (Sahay, 2012). Many enterprises in other branches use only simple pricing strategies such as cost-plus pricing (Sahay, 2012). In the e-commerce sector more and more online retailers like Amazon or Wal-Mart adopt this technique. Online retailers can use this technique to maximize their profits by setting prices predicted on the customer's individual willingness-to-pay (Hinz et al., 2011). However, customers can react negative on this technique and retailers must cover this problem by different strategies (Weisstein et al., 2013).

Research refers to this topic in different ways. Some authors examined this strategy for the price comparison of competing retailers based on their online shop (Chen and Huang, 2013), where price crawlers can be implemented. A price crawler can be seen as a special implementation of a web crawling algorithm focusing on the price and product specifications for comparison. In general, web crawlers (also often described as spider or robots) are implemented by search engines like Google to discover web page content (Madhavan et al., 2008; Olston and Najork, 2010). The architecture of a web crawler consists of different crawling sub-processes like DNS resolve and cache, link extractor, etc. (Olston and Najork, 2010). Nowadays, different providers like Google Shopping collect product prices of online retailers mostly in a B2C setting, however these data is often not complete or actual for all of the products. Further, there exist a lack in a B2B online retailing context.

Xu and Li (2013) investigated the dynamic pricing of cloud computing resources and adopt a revenue management framework. Furthermore, optimality conditions are characterized. Dynamic pricing and the use of skimming and penetration in highly complex branded market is scrutinized by Spann et al. (2014). The authors find, that a market-based pricing pattern is applied to most new products. Gallego and Hu (2014) investigated dynamic prices in an oligopolistic market. Furthermore, they assume a mix of substitutable and complementary products. An important result is that any equilibrium strategy has a simple structure. Capacity externalities are measured using a finite set of shadow prices. The combination of dynamic pricing and sponsored search is investigated by Ye et al. (2014).

We refer to the findings of prior research by integrating and developing the finding in our case study research in order to build a framework about the basic core functionalities of a dynamic pricing system for European online retailers.

3 Research design and Data collection

Current research does not take a deeper look in the core functionalities of dynamic pricing systems according to a review of the recent literature in databases like SpringerLink, IEEExplore, AiSeL, Sciencedirect of the last decades based on general guidelines of a literature review (Cooper, 1998). In general, functional requirements determine what the system must accomplish or able to do and define the interaction between components as well as the environment (Leonard, 1999; Roman, 1985). These core functions are important to design, to implement and to evaluate such a system. There exist only some research e.g. based on some aspects of price comparison systems (e.g., Chen and Huang, 2013). Other research in this field is more on the strategic or empirical validation side like described in section 2. Therefore, our research investigates these interesting and current challenging research question: *What are the core functionalities of dynamic pricing systems in e-commerce practice?.*

For this purpose we applied the following research method. We investigate the core functions of a dynamic pricing system based on a single case study research method according to Yin (1994). Single case studies can be used to get interesting, deep as well as understandable insights, which are generable and

generate empirical circumstances (Darke et al., 1998). Furthermore, single case study research is often used in information systems research (e.g., Laumer et al., 2014; Seidel et al., 2013).

To ensure a high quality of research we contact and shortly discuss this research topic formal and informal with different senior managers in the observed area Europe. Finally, we selected and got the chance to take a look in this research area in a dynamic pricing project of a European medium-sized online retailer. The retailer is comparable to many other online retailers in this sector. The retailer design as well as customize his individual information systems. These circumstances allow us to take a deeper look in the design of dynamic pricing systems. The online retailer is headquartered in Europe and wishes to remain anonymous. The retailer operates in a Business-2-Customer (B2C) as well as Business-to-Business (B2B) environment in different retailing categories (office products, outdoor / facility products, etc.). The project starts in the middle of 2015 and last until spring 2016.

During the research we collected different data with regards to dynamic pricing. Overall, personal discussions/interviews, documents and working-software-prototypes were collected and analysed. The analysis of textual data was implemented by textual coding like e.g. open coding (Strauss and Corbin, 1990) and followed established guidelines (e.g., Yin 1994). Furthermore, the results were discussed and evaluated with the management team (with regards to the importance). We focus only on the core functions related to the main challenge of dynamic pricing. The results of the analysis of the qualitative data are presented in the following section.

4 Results

The data analysis of our case study reveals interesting insights according to our research question. First of all, there are core functions to get external information like product prices from competing retailers (F1-F6). The collected information by these functions are further processed and combined with internal information gained by the other functions (F7-F10). The core functions with regards to the importance of implementation are summarized in table 1 as well as described in the following:

Core function	Function name	Importance	Short description
F1	Get actual price	high	Get for each product and configurations the actual price (including discounts).
F2	Get availability	low	Availability of a product or product configurations is important to know. Otherwise maybe the shop listed not available products.
F3	Get article number	medium	Getting the article number is important for internal price matching.
F4	Get product title	high	Collecting the product title is important for article matching.
F5	Get further product information	medium	In case of different white label products, collecting the dimensions, weights and colours are important for internal product matching.
F6	Get shipping and further additional costs of an order	medium	The final price of the order includes shipping and further costs. Therefore, it is important to know the other costs associated with an order.
F7	Price calculation	high	Price calculation based on different internal settings (e.g., contribution margin, inventory) and the prices of the competitors.
F8	Price forecasting	low	To manage a future category and price management, price forecasts can support these processes.
F9	Psychologic price manipulation	low	Use prices, which signalize the customer quality, reduce the perceived risk to lose money and like.
F10	Product matching	high	Matching of internal and external products.

Table 1. Core functions

Getting the actual price (F1) including discounts (like daily-deal discounts) of a product from a set of different other competing (online) retailers is very important function of the dynamic pricing system. Based on this information, the actual internal price can be later compared with the prices of other retailers.

Another important aspect is to get information about the availability of a product (F2) from different competing retailers. From the experience of our case, many retailers list unavailable products, because of an impact on their search engines ranking. Therefore, a price adjustment is maybe not needed, if other competitors cannot deliver the products in the next time.

For the comparison of the prices of each product, a product matching (F10) is needed, where each product can be assigned to the similar product of a competing retailer. Therefore, the core functions described in F3, F4, F5 are important. It is possible to match the products based on a collected article number (F3) like EAN, UPC, ISBN or ASIN (Liu et al., 2015). If there is no standardization or only internal numbers, a matching based on the collected product title (F4) or product dimensions, weights, colours etc. (F5) is conceivable.

Shipping and further costs associated with the order from different retailers can be called as another important comparator. For instance, if a product is cheaper to buy at retailer B's online shop than retailer A's one, but retailer B has higher additional costs (like e.g., shipping, insurance fees), buying the product at the web shop of retailer A could be cheaper in consequence. Therefore, it is important to get this additional price information (F6).

If the dynamic pricing system has the information, for instance about actual prices, availability and additional costs of different products, a re-pricing function (F7) should be applied. In case of no differences, in general no re-pricing is needed. The goal of this function is to set a competitive price not below the contribution margin of each product in order to earn better margins as without dynamic pricing. From viewpoint of our case, two fundamental possibilities of re-pricing are possible as well as feasible:

1) Non-customer-individual re-pricing based on the contribution margin (Kumar et al., 2006), product availability and the comparison of the prices of the competing retailers.
2) Customer-individual re-pricing based on the contribution margin (Kumar et al., 2006), product availability, the comparison of the prices of the competing retailers and information of the individual customer or a special group of customers.

For the calculation of customer-individual or customer-group individual prices further internal information about the individual customer or group of customers (customer-lifetime-value's, purchase history, master data, etc.) are needed. The customer-lifetime value can be calculated in different ways according to Jain and Singh (2002).

A price forecast function (F8) can be used to predict the competitors' future products prices. These information can be used for strategic price management and related operational decisions. Forecasts can be made based on e.g. regression analysis, ARIMA models or artificial neural network analysis (Shmueli, 2010). Furthermore, it can be a good solution to transfer very data-intensive processes into an (public) cloud environment (Schmidt and Möhring, 2013).

Considerations about the impact of psychologic price manipulation is also an interesting function (F9), but not implemented so far. As an interesting approach the implementation the person's individual birthday-numbers into the price is conceivable. Prior research affirmed the assumption of this phenomenon so called as birthday-number effect and found evidence, that people like prices more, if they involving their individual numbers (Coulter and Grewal, 2014; Jones et al., 2004; Kitayama and Rarasawa, 1997). If people recognize a congruence between themselves and an object, positive feelings can be evoked and an unconscious transfer of their positive characteristics onto the stimulus can arise (Greenwald and

Banaji, 1995). Furthermore, this subject could help to avoid negative reactions in relation with a dynamic pricing technique as mentioned above in 2. This function can also be seen in some cases as a sub-function of Function F7. But for our empirical case it is an additional function, which must be carefully tested and maybe dynamical switched on or off. By implementing this new pricing approach maybe challenges in terms of privacy, complexity and customer acceptance arise.

The retailer in our case implement this core functions in several prototypes (Naumann and Jenkins, 1982) and live application with analytics and business intelligence tools like Rapidminer (Kotu, 2014) as well as several workflow engines. Practical challenges in our case can be found in the area of price crawling. For instance, some retailers may track and react to the crawler activity.

5 Discussion and future directions

Dynamic pricing - design as well as implementation - is a very important topic in an ever-expanding customer-centric and dynamic e-commerce environment. Our research show core functions of such a solution and give indications how dynamic pricing systems can be designed in order to cope with the related challenges.

Our research contributes to the current information systems literature in different ways. Researchers can use the results to develop further theories for the use and implementation of dynamic pricing systems. Furthermore, it illustrates current challenges and approaches in this area, which are not addressed so far by research.

There are also practical implications according to results and insights of the conducted research. Managers can use the outcomes to get a better understanding of the design and implementation of dynamic pricing engines. Furthermore, they can use our approach to evaluate and proof the implementation of different variants.

Limitations can be seen in by developing only core functional aspects. There are more detailed (part) functions as well as non-functional aspects. Further, we only looked at a single case study. However, this is common and widely used in IS research (e.g., Seidel et al., 2013; Laumer et al., 2014).

Therefore, future research should further develop our work by describing and defining more part functions and requirements based on the system environment. The impact of dynamic pricing systems on different aspects of consumer behaviour, like returning a product, should be observed in the future. Furthermore, more cases and possibilities of different re-pricing possibilities should be integrated as well as different research methods like quantitative ones should be applied. The examination of the behaviour of other competing retailers to such systems can be also a good opportunity for future research as well as the investigation of product type specific adoptions.

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