Marmara Üniversitesi
İ.İ.B.F. Dergisi
YIL 2011, CİLT XXX, SAYI I, S. 321-340

VISUALIZATION OF SUCCESS OF CONSUMER SALES PROMOTIONS THROUGH GIS BASED ON RFID-CAPTURED CONSUMER BEHAVIOR

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Abstract:

Informing loyal customers about consumer sales promotions that are special to them is an important way of promoting sales for retailers. This study discusses first how RFID (Radio Frequency Identification) systems contribute to the mentioned informing process. Naturally the evaluation of the success of executed promotions is also an important point. In this context the study deals also with the maps that are created by GIS (Geographic Information Systems) based on promotional information that loyal customers gain through RFID systems. These maps are important to visualize the success of promotions. Visualization highlights important information and helps individuals to understand new concepts, problems and solutions for these problems better. Through created maps marketing managers can determine which type of loyal customers (e.g. customer with a silver card or customer with a golden card) react on the executed promotion, they can decide whether the right incentive is applied or not. They can also decide to carry on consumer sales promotions or to initiate new promotions. To introduce the collaboration of RFID systems and GIS data flow diagrams are developed in the study. These diagrams can be used within the context of (structured) system analysis by IT departments of retailers who want to realize the mentioned collaboration in their stores. The developed DFDs (Data Flow Diagrams) form the reference for developing retailer specific DFDs.

Key Words*: Consumer Sales Promotions, Data Flow Diagram (DFD), Geographic Information Systems (GIS), Marketing Mix, Radio Frequency Identification (RFID) Systems*

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TÜKETİCİ SATIŞ PROMOSYONLARI BAŞARISININ RFID İLE ELDE EDİLEN TÜKETİCİ DAVRANIŞLARI TEMELİNDE GIS VASITASIYLA GÖRSELLEŞTİRİLMESİ

Özet:

Sadık müşterilere özel tüketici satış promosyonları hakkında söz konusu müşterileri bilgilendirmek, perakendeciler için satışları arttırmanın önemli bir yoludur. Bu çalışma öncelikle RFID sistemlerinin adı geçen bilgilendirme sürecine katkısını ele alır. Şüphesiz yürütülen promosyonların başarısının değerlendirilmesi de önemli bir husustur. Bu bağlamda çalışma sadık müşterilerin RFID sistemleri vasıtasıyla elde ettiği promosyonlar ile ilgili bilgiler temelinde, GIS ile oluşturulan haritalara da temas eder. Bu haritalar adı geçen başarının görselleştirilmesi için önemlidir. Görselleştirme, önemli enformasyonu öne çıkarır ve yeni kavramları, problemleri, problemler ile ilgili çözümleri daha iyi anlamada bireylere yardımcı olur. Üretilen haritalar ile pazarlama yöneticileri hangi tip sadık müşterilerin promosyonlara reaksiyon gösterdiğini tespit edebilir, doğru teşviğin uygulanıp uygulanmadığına, yürütülen promosyona devam edilip edilmeyeceğine ya da yeni promosyonlara başlanıp başlanmayacağına karar verebilir. Çalışmada ayrıca RFID sistemleri ve GIS işbirliğinin tanıtımı için veri akış diyagramları çizilmiştir. Bu diyagramlar söz konusu işbirliğini gerçekleştirmeyi arzu eden perakendecilerin IT departmanlarınca (yapısal) sistem analizi kapsamında uygulanabilir. Geliştirilen VAD'lar (Veri Akış Diyagramları) perakendecilere özgü geliştirilecek VAD'lar için referans oluştururlar.

Anahtar Kelimeler*: Tüketici Satış Promosyonları, Veri Akış Diyagramı (VAD), Coğrafi Enformasyon Sistemleri (CES), Pazarlama Karması, Radyo Frekanslı Tanımlama Sistemleri*

Introduction

Loyal customers are important for businesses because most of the revenues come from small percentage of high loyal customers and customer retention costs are generally lower than customer acquisition costs. In this context, frequent shoppers program (FSP) is a good way of rewarding loyal customers such as by providing member discount price, sending coupons or the latest product/service information. Generally FSP enables customers that have loyalty cards to benefit from the proposed incentives by showing their cards at the checkout counter. In such a situation it is impossible to reward loyal customers while they are shopping, which actually affects customer's purchase decision. This problem can be solved by using RFID systems. Through these systems loyal customers can identify themselves while they are shopping and they get information about the discount price of a product[1]. Executing one-to-one marketing by informing loyal customers about sales

[1] T. Inaba, "Realization of SCM and CRM by Using RFID-Captured Consumer Behavior Information", **Journal of Networks**, 4, 2009, pp. 92-93.

promotions through RFID systems is important to improve customer satisfaction and to promote sales. Naturally, it is important not only to inform customers about sales promotions but also to evaluate whether the executed promotions have achieved their purposes. In this context, maps are created by GIS based on promotional information that loyal customers gain through RFID systems. These maps are important to visualize the success of promotions. Visualization highlights important information and helps individuals to understand new concepts, problems and solutions for these problems better. Through created maps marketing managers can determine which type of loyal customers react on the executed promotion, they can decide whether the right incentive is applied or not. They can also decide to carry on consumer sales promotions or to initiate new promotions. In this study the mentioned collaboration of RFID systems and GIS is introduced by using data flow diagrams.

1. RFID Systems

RFID-Systems are Auto-ID Systems, whose main components are tags (transponders), readers and software[2].

RFID tags are small electronic devices that are affixed to objects or embedded in them. They comprise an antenna and a microchip. On microchips unique identifiers, additional data about objects, to/in which tags are affixed/embedded, are saved. Each tag may have other features such as environmental sensors and security mechanisms. Antenna sends data about tagged object to readers by radio waves[3].

RFID readers comprise an antenna, a reader or a reader/writer unit. Readers communicate with tags through radio waves and read data on tags. If readers have writing function, then they can change data on tags or write a new data on them. Through antennas of readers digital data can be transmitted to related tags as radio waves[4].

RFID system software, RFID middleware and application system are softwares that are relevant to RFID systems[5].

RFID system software is essential for interaction between tags and readers. It is necessary to read tags, to write on tags, to determine erroneous data as well as to fix error and to realize authentication between tags and readers[6].

RFID middleware is responsible for preparing data collected from readers to application systems such as ERP-System that directly support business processes. Middleware collects data from readers and save them in a database. Saved data are

[2] E. S. Bayrak Meydanoğlu, **Yaygın Hesaplama Teknolojisi ve RFID**, Türkmen Kitabevi, İstanbul, 2009, p. 38.

[3] A. Kavas, "Radyo Frekans Tanımlama Sistemleri", **Elektrik Mühendisliği Dergisi**, 430, 2007, pp. 75-77.

[4] E. S. Bayrak Meydanoğlu, **op. cit.**, p. 40.

[5] A. Üstündağ, **RFID ve Tedarik Zinciri**, Sistem Yayıncılık, İstanbul, 2008, p. 31.

[6] A. Üstündağ, **op. cit.**, pp. 31-32.

filtered, aggregated and transmitted to relevant application systems by middleware. Monitoring and management of RFID tools are also functions of RFID middleware[7].

Application systems serve to correlate RFID data with non-RFID business records imported from other databases[8].

2. GIS

Scholten and van der Vlugt (1990) classify information systems into spatial and non-spatial information systems. Non-spatial information systems (e.g. transaction processing systems, management information systems, decision support systems) do not store, display spatial information and their outputs are usually either graphs and tables. Spatial information systems can store, display spatial data and their outputs are not limited to tables and graphs but also include the dynamic presentation of maps[9]. Spatial data is data that defines position dimension and form of a geographical entity. Under a geographical entity a geographical object (e.g. lake, forest region, river), a human made object (e.g. school, shopping center, hospital), a natural event (e.g. earthquake, landfall) and an unnatural events (e.g. migration, terror) has to be understood[10]. Attribute (non-spatial) data is data that describes the geographical entity whose location is given. For example, position of a building is a spatial data. Data about the owner, age, structure of this building form the non-spatial data of the building.

Based on their capabilities spatial information systems can be classified into spatial design system (e.g. CAD), land-use information systems (LIS) and geographic information systems (GIS) (Table 1)[11].

[7] T. Karygiannis et al. , **Guidelines for Securing Radio Frequency Identification (RFID) Systems - Recommendations of the National Institute of Standards and Technology (NIST)**, NIST Special Publication 800-98, Computer Security Division Information Technology Laboratory National Institute of Standards and Technology, Gaithersburg,, 2007, p. Sec.2, 15.

[8] T. Karygiannis et al., **op. cit.**, p. Sec.2, 16.

[9] S. Jarupathirun, F. M. Zahedi, "GIS as Spatial Decision Support Systems", **Geographic Information Systems in Business**, Ed: J. B. Pick, Idea Group Publishing, Hershey, London, 2005, p. 156.

[10] **http://tr.wikipedia.org/wiki/Co%C4%9Frafi_varl%C4%B1k**, (21.05.2010).

[11] S. Jarupathirun, F. M. Zahedi, **loc. cit.**

Table 1. Classification of Information Systems and Their Capabilities

Information Systems	Visualization		Analysis	
	Spatial	Attribute	Spatial	Attribute
Non-Spatial Information System				
Transaction Processing System		x		
Management Information System		x		x*
Decision Support System		x		x
Spatial Information System				
Spatial Design System	x	x		
Land-Use Information System	x	x		
Geographic Information System	x	x	x	x

* analytical capabilities are limited when compared to those of decision support systems.

Source: S. Jarupathirun, F. M. Zahedi, "GIS as Spatial Decision Support Systems", **Geographic Information Systems in Business**, Ed: J. B. Pick, Idea Group Publishing, Hershey, London, 2005, p. 157.

While all types of spatial information systems can store, manage and visualize spatial and attribute data, only GIS can perform analyses.

Like GIS, MIS and DSS have analytical capabilities. However, their analytical capabilities are limited to attribute data. GIS has the capability to analyze spatial and attribute data by using various statistical, mathematical, geometric and cartographic methods. This capability is used to answer questions related to location which can range from simple calculative questions (e.g. the distance between two locations) to more complex quantitative questions (e.g. the most suitable location for a new retailer)[12].

Based on the explanations above, GIS is defined as a spatial information system that enables the storage, processing, retrieval and display of information with spatial and attribute dimensions and has capabilities for manipulating data into different forms, extracting additional meaning and presenting the information in various forms (map, table, graph, etc.)[13].

3. The Role of GIS for Developing Marketing Mix Strategies

GIS has various application areas such as urban and regional planning, urban governance, insurance trade, real estate dealing, healthcare services. Using GIS in business for marketing activities is also an important application area of this

[12] S. Jarupathirun, F. M. Zahedi, **loc. cit.**

[13] S. Jarupathirun, F. M. Zahedi, **op. cit.,** p. 152.

system[14]. GIS supports marketing managers in developing strategies related to marketing mix - product, pricing, promotion and place[15].

GIS and Product Strategies: Within the context of product-related decisions, GIS can be applied in the areas product diffusion, product life cycle and demand forecasting. GIS can be used to map spatially the diffusion of new products over time and provide marketing experts with insights as to the pattern of adoption of new products and the ability to predict the pattern in the future based on past data. Through GIS a spatial context can be provided to explain the impacts of specific variables such as advertising expenditures and consumer characterization, national economic characteristics on diffusion[16].

GIS can be used to identify product life cycle stage - introduction, growth, maturity, decline - at which a product is in a particular market. Thereby GIS can support marketing expert to identify the appropriate marketing strategy to be adopted in that market[17].

GIS and Pricing Strategies: GIS can be the enabling technology to improve price decision making when there are spatial components to prices. Geography can influence price[18]. For example, you can pay for the same product in a part of a city more than in another part of the same city. Demographic structure of a geographical region, response of customers living in a geographical region to prices, which can differ in various locations due to differences in customer culture such as brand perceptions or customer loyalty, are essential factors for determining pricing strategies. Through GIS, maps that serve to visualize these factors can be produced. These maps may provide marketing experts more insights for pricing strategies than a table with hundreds or thousands of rows representing data about the mentioned factors in the case of absence of GIS[19].

GIS and Place (Distribution) Strategies: Within the context of distribution and location decisions, GIS is used for monitoring material flows in supply chains, route planning, site selection and to measure, monitor as well as to control resource allocation decisions in a distribution network[20].

GIS and Promotional Strategies: Understanding the demographics of customers is an important determinant for the success of a promotional strategy. The main promotional strategies are personal selling, advertising, sales promotion, direct

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[14] H. Turoğlu, **Coğrafi Bilgi Sistemlerinin Temel Esasları**, Çantay Kitapevi, İstanbul, 2008, pp. 308-317; V. Tecim, **Coğrafi Bilgi Sistemleri – Harita Tabanlı Bilgi Yönetimi**, Ankara, 2008, pp. 112-157.

[15] N. K. Viswanathan, "GIS in Marketing", **Geographic Information Systems in Business**, Ed: J. B. Pick, Idea Group Publishing, Hershey, London, 2005, p. 241.

[16] N. K. Viswanathan, **op. cit.**, pp. 241-244

[17] N. K. Viswanathan, **loc. cit**.

[18] R. L. Hess et al., "Geographic information systems as a marketing information system technology", **Decision Support Systems**, 38, 2004, p. 208

[19] N. K. Viswanathan, **op. cit.**, pp. 244-245

[20] N. K. Viswanathan, 2005, **op. cit.**, pp. 249-251.

marketing, public relations and Internet marketing[21]. For this study sales promotions and their relevance to GIS are important. Because of this, the study discusses only this strategy. Sales promotions serve to facilitate product sales through some form of incentives. Sales promotions consist of trade and consumer promotion. Sales promotions targeted at consumers are called consumer sales promotions. Sales promotions targeted at retailers and wholesale are called trade sales promotions[22]. Consumer sales promotions in retail stores are relevant for this study.

Success of sales promotions, especially consumer ones, depends on the ability of marketing experts to target the right customer with the right incentive. Using GIS marketing experts can identify the sensitivity of geographic markets to promotion. Thereby marketing experts can focus on those markets that are sensitive. This reduces the probability of offering promotion where customers would have bought the product even without the promotion. Using GIS enables not only the determination of promotion-sensitive customers but also the determination of store locations where promotional campaigns should be run and the size of the incentive, that is offered to location-specific customers, as well as matching customer characteristics to the nature of the incentive[23].

4. Data Flow Diagram

In section 6, a system is introduced that can be used by a retail store to inform its frequent shoppers with loyalty cards about consumer sales promotions during their shopping in the store as well as to visualize success of the executed promotions for marketing experts with the assistance of maps. System introduction is realized by using data flow diagrams (DFDs). These diagrams can be used in the context of (structured) system analysis by retailers who want to implement the mentioned system. The purpose of the system introduction is to explain the processes supported by the system and data flows among the processes, data storages and the entities of the mentioned system as well as the interaction of the system with its environment. In this way the working principle of the system is clarified. For a better understanding of the mentioned purpose, explanations about the system are supported by DFDs in section 6. Following, DFDs and rules that must be obeyed in the construction of DFDs are explained briefly.

In a data flow diagram entities, data storages, processes and data flows among entities, processes as well as data storages of a system are modelled. Symbols used for the modelling of these main components are demonstrated in Figure 1[24].

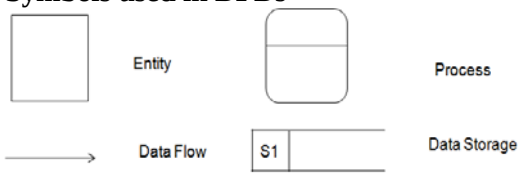
[21] N. K. Viswanathan, 2005, **op. cit.**, p. 245.

[22] **http://en.wikipedia.org/wiki/Sales_promotion**, (23.05.2010).

[23] N. K. Viswanathan, 2005, **op. cit.**, pp. 248-249.

[24] The use of DFDs for structured analysis are discussed by various autors (e.g. DeMarco (1978), Weinberg (1978), Gane/Sarson (1979), McMenamin/Palmer (1984), Yourdon (1989)) in the relevant literature. While modifying and refining structured analysis, these autors proposed different notations for DFDs. In this study the Gane/Sarson notations are used.

Figure 1. Main Symbols used in DFDs



Source: O. Kalıpsız et al., **Sistem Analizi ve Tasarımı – Nesneye Yönelik Modelleme**, Papatya Yayıncılık, İstanbul , 2008, p. 68.

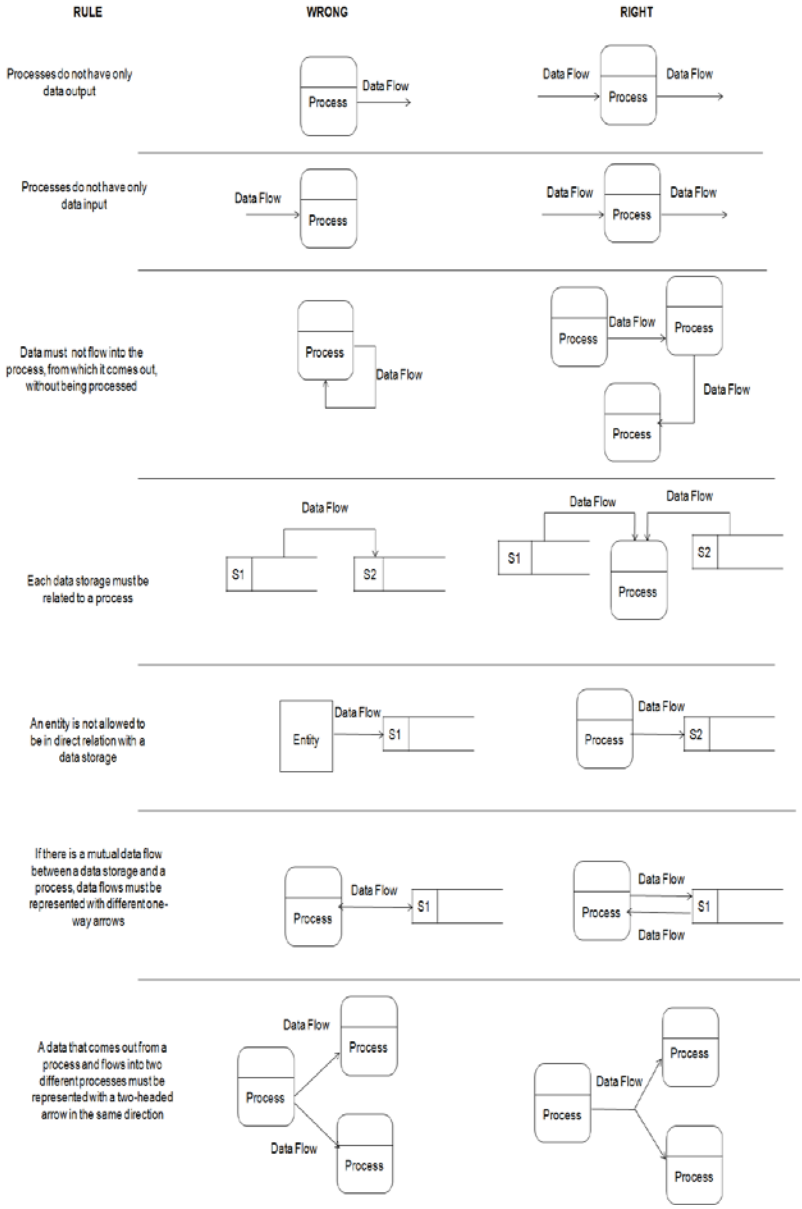
In a DFD the same entity can be used multiply to prevent collision of data flow arrows with one another. Arrow head of a data flow shows the target process or data storage or entity to which the data has to reach. Data storage can be a data file in a database or a physical storage object such as CD, disk etc. Each data storage and process has to be numbered[25]. A data flow name comprises a noun or an adjective and a noun. A process name comprises a verb followed by an object or a noun followed by a verb[26].

[25] O. Kalıpsız et al., **Sistem Analizi ve Tasarımı – Nesneye Yönelik Modelleme**, Papatya Yayıncılık, İstanbul , 2008, pp. 68-69.

[26] H. Balzert, **Lehrbuch der Software-Technik – Software Entwicklung**, 2. Auflage, Spektrum Akademischer Verlag, Heidelberg, Berlin, 2000, p. 144.

The rules in Figure 2 have to be obeyed while modelling systems through DFDs.

Figure 2. Syntactic Rules for DFDs



Source: O. Kalıpsız et al., **op. cit.**, pp. 69-70.

Modelling an extensive system only in one DFD makes it unclear. Hierarchical constructed DFDs are proposed for modelling of extensive systems. On the top level of such a hierarchical structure lies an abstract DFD that models

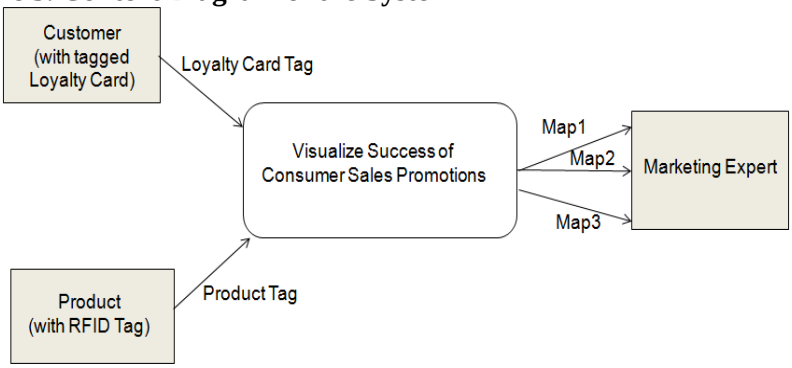
interfaces of a system with its environment. This DFD is called context diagram. Context diagram contains only one process, whose number is 0. This process represents the total system. Context diagram does not contain data storage. It contains at least one entity. The process 0 in a context diagram is divided into its subprocesses in DFD 0 (Diagram 0) that lies direct on the second level of the hierarchy. If necessary, each subprocess in DFD 0 is refined further in a DFD. The refinement is continued until a process cannot be divided anymore. Processes in each diagram are numbered consecutively beginning from 1. To define a process explicitly, the relevant DFD number is used before the process number. For example, the process 4.3.1 denotes the first process in DFD 4.3. Each diagram has also a number, that represents its position in the hierarchical structure. The DFD 4.3 denotes that in this diagram the process 3 of the diagram 4 is refined[27].

5. System for the Visualization of Success of Consumer Sales Promotions through GIS based on RFID-Captured Consumer Behavior

As already mentioned following a system is introduced by using DFDs. This system can be used in a retail store to crate maps through GIS for the visualization of success of executed consumer sales promotions based on RFID-captured consumer behavior.

The context diagram in Figure 3 shows the data flows between the system and the entities in its environment. The context diagram describes the application area of the system and can be annotated as a summary of the DFD 0 in Figure 4.

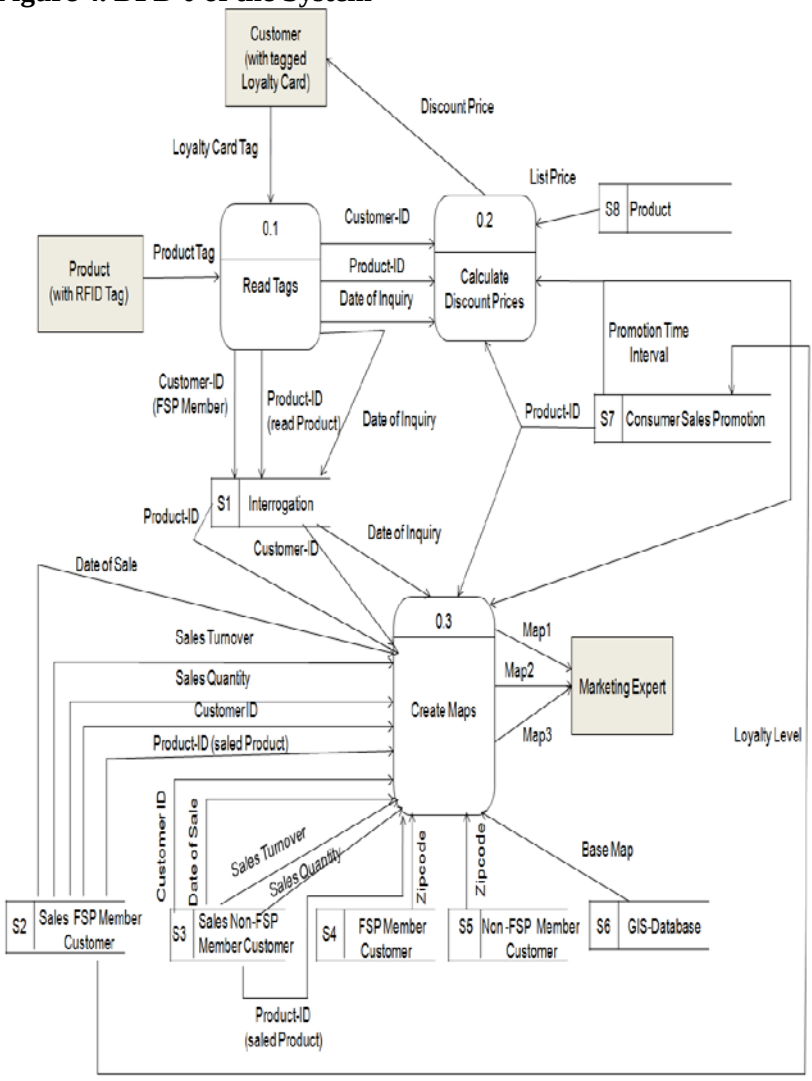
Figure 3. Context Diagram of the System



DFD 0 shows the subprocesses of the system, their interaction with each other and with the environment of the system.

[27] H. Balzert, **op. cit.**, pp. 433-438.

Figure 4. DFD 0 of the System



S: Data Storage

6. Reading RFID Tags

In this study, using a RFID system is proposed to inform FSP member customers about discount products while they are shopping[28]. The study of Inaba

[28] It is assumed that retailers use RFID system not only for informing their customers about discount products but also for various tasks such as inventory management, control of delivery, speeding up payments at paying counter. That is to say RFID system is not purchased and installed just for reading tags of loyalty cards and products.

(2009), which deals with the realization of SCM and CRM by using RFID-captured consumer behavior information, serves as a basis for the proposed RFID-System.

FSP member customer of the retail store scans his/her loyalty card by RFID reader[29]. The reader sends customer ID to the application that calculates discount prices. The reader sends also the product ID of the tagged products on the shelves to the application that calculates discount prices. The application sends back the calculated prices to the computer display which stands beside product shelves. Thereby customers can learn prices of discount products.

Identity numbers (IDs) of FSP member customers, who scan their loyalty cards by RFID-readers, date of inquiries and identity numbers of read products are saved in the file "Interrogation". This is essential to obtain information about the loyal customers that search for the executed sales promotions. Through comparing this information with the relevant sales data, retailer can see whether the discount products, about which FSP member customers got information, were purchased by them or not. This is important to evaluate the success of the executed consumer sales promotions (see section 6.3).

Because the reading process of the system comprises only one process, its refinement in another DFD "DFD 1" is not necessary. Modelling of this process in DFD 0 is adequate for the system analysis.

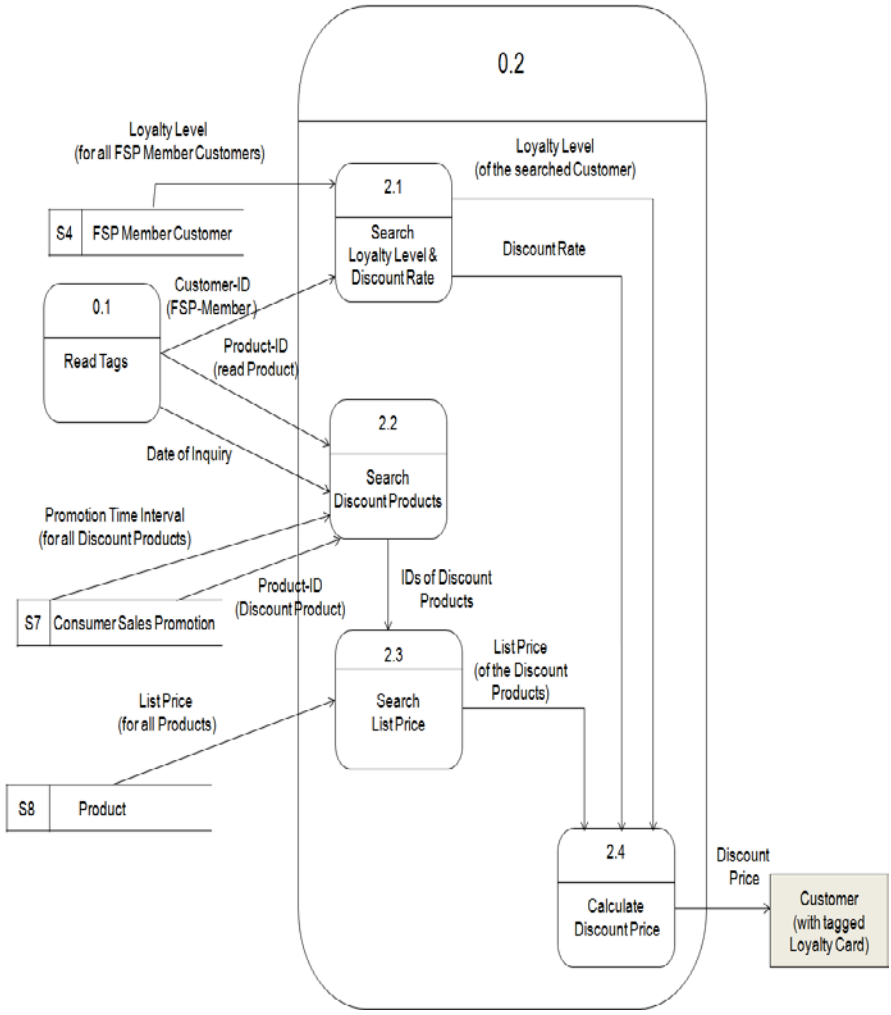
7. Calculating Discount Prices

The application that calculates discount prices of the tagged products on shelves is also an important part of the system[30]. By using transmitted customer and product IDs the application accesses to the customer and product files. Among loyalty levels of FSP member customers the application search for the loyalty level and the corresponding discount rate for the customer whose customer ID is transmitted from the RFID system. For the calculation it is also necessary to determine which product/products among the read products are subject to consumer sales promotion at the date of inquiry. In this context read products and reading (interrogation) dates are compared with product IDs and promotion time interval in the file "Consumer Sales Promotions". The application then searches for the list prices of the discount products, whose product IDs are transmitted from the RFID system, among the list prices of all products in the product file. Based on their list prices, loyalty levels and discount rates discount prices are calculated for discount products. These prices are then transmitted to the computer display which stands beside product shelves. Thereby customer gets the required information about the discount prices.

[29] It is assumed that retailers, that use the proposed system, apply FSP and enable their loyal customers to pay with loyalty cards that are equipped with RFID tags.

[30] In this study only the DFD of calculation process is developed. Development of an algorithm for the application is out of scope of this study.

Figure 5. DFD 2 – Calculation of Discount Prices



8. Creation of Maps

Visualization helps individuals to assimilate and understand new concepts, problems, solutions for these problems better and helps to highlight important information. Humans use visualization to comprehend new knowledge and to make decisions[31]. In this context, visualization of success of executed consumer sales promotions with the assistance of maps, which are produced by GIS[32], helps

[31] S. Jarupathirun, F. M. Zahedi, **op. cit.,** pp. 159-160 and p. 162.

[32] It is assumed that retail stores use GIS not only to visualize the success of consumer sales promotions but also for the marketing activities mentioned in section 4 of this study. That is to say GIS is not purchased and installed just for the visualization of success of consumer sales promotions.

marketing experts to determine which type of loyal customer (e.g. customer with a silver card or customer with a golden card) reacts on the executed promotion, to decide whether the right incentive is applied or not and to decide carrying on the consumer sales promotions as well as initiation of new promotions.

The capabilities of GIS to computerize mapping and to execute spatial database queries such as selection of a particular region according to attribute values (e.g. sales values) enable these systems to visualize success of consumer sales promotions. Through GIS three main aspects can be visualized[33]:

- locational (spatial) distribution of saled discount products about which FSP member customer got information,
- locational (spatial) distribution of sales quantities of discount products that are sold to FSP member customers out of promotion time interval,
- locational (spatial) distribution of sales quantities/turnovers of products that are subject to consumer sales promotions for FSP member customers and sold to non FSP member customers.

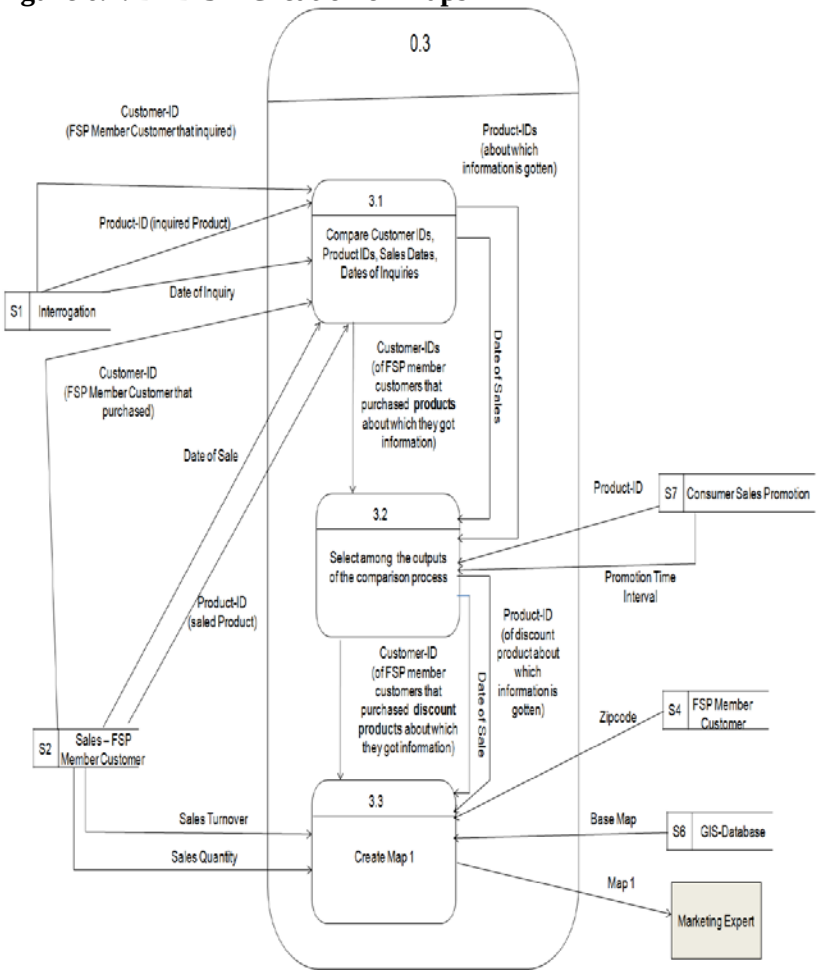
A consumer sales promotion is successful, if customers purchase a product because of the offered promotion. In this context, retailer has to determine whether the realized sales saved in sales file are related to the discount products, about which FSP member customers got information. For this determination customer IDs, product IDs, sales dates of records in sales files are compared with customer IDs, product IDs, dates of inquiry of records in the file "Interrogation". As a result of this comparison FSP member customers, who purchased the products, about which they got information, are determined. Naturally readers read all tagged products on the relevant shelves without considering whether they are discount products or not. This means that in the file "Interrogation" all read products are saved. However, for the map creation those read products that are subject to consumer sales promotions are relevant. To determine these products, among the outputs (customer IDs, Product IDs, dates of sales) of the comparison process those outputs whose product IDs comply with the product IDs and whose sales dates are within the promotion time intervals of the records in the file "Consumer Sales Promotions" have to be selected. Considering the outputs of the selection process, the corresponding sales turnovers/quantities for these outputs in the sales file are determined. Using the turnovers/quantities, zip codes (geocodes[34]) of the determined customers in

[33] Naturally through GIS various maps that can support various marketing decisions can be created. However, the study discusses only those maps that serve to evaluate consumer sales promotions considering the promotional information which FSP member customers gain by using RFID system.

[34] Geocode is "*the element (e.g. a zip code or a coordinate) in a database used to identify the location of a particular record*"
http://www.ordnancesurvey.co.uk/oswebsite/aboutus/reports/misc/glossary.html, (09.08.2010).

customer file and the base map[35] in the GIS database, which shows the domiciles of the customers, a map (denoted as MAP 1 in DFDs) is created. The created map visualizes the locational distribution of sales turnovers/quantities of saled discount products, about which FSP member customers got information. The mentioned mapping enables to visualize locations where the sales of discount products are better. The created map visualize also the districts in which FSP member customers, who show more interest in the consumer sales promotions, reside. This visualization enables marketing experts to see the potential sales locations for future sales and to initiate special promotions for the loyal customers in these locations.

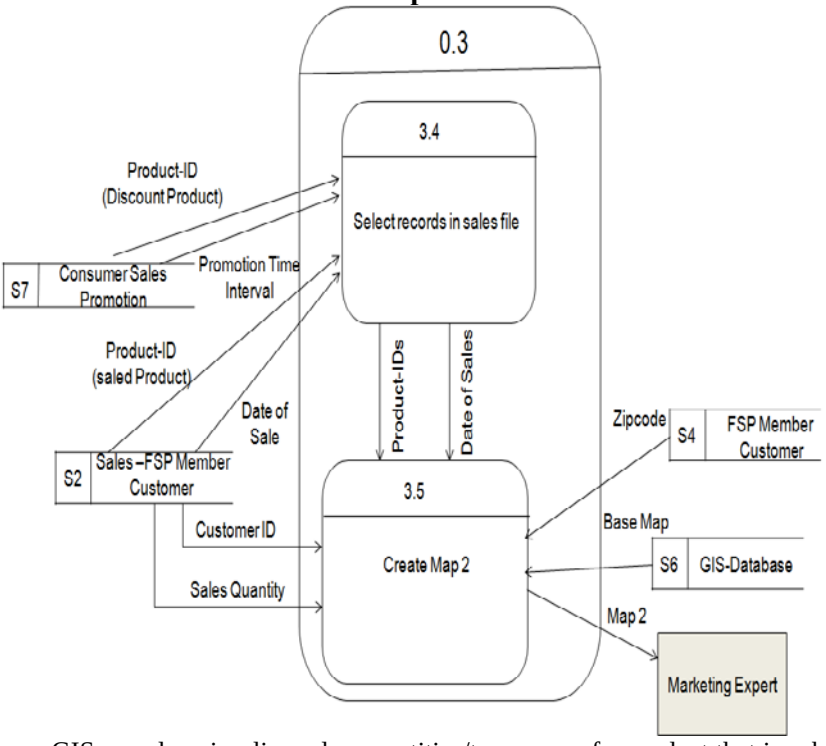
Figure 6.1. DFD 3 – Creation of Maps



[35] *"A map which displays planimetric and/or topographic information and which may be used as a base for a thematic layer is called a base map. Features which may be included on a base map are: roads, rivers, major structures (buildings), contours, etc."* , **http://en.mimi.hu/gis/base_map.html**, (04.08.2010).

Consumer sales promotions are considered succesful, if they cause a booming demand. Therefore it is important to determine whether sales quantities of products that are subject to consumer sales promotions for FSP member customers in promotion time is more than out of promotion time. In this context, in sales files those records whose product IDs comply with product IDs in the file "Consumer Sales Promotion" and whose sales dates are out of/within the promotion time interval of the corresponding product IDs in the file "Consumer Sales Promotion" are selected. Considering selected sales dates and product IDs, corresponding sales quantities of relevant customers are determined. Besides sales quantities, using zip codes of the selected FSP member customers in the customer file and the base map in the GIS database, a map (denoted as MAP 2 in DFDs) is created. This map enables to compare sales quantities of products within and out of promotion time interval. This is important to see whether the promotion has a positive impact on sales and caused a booming demand.

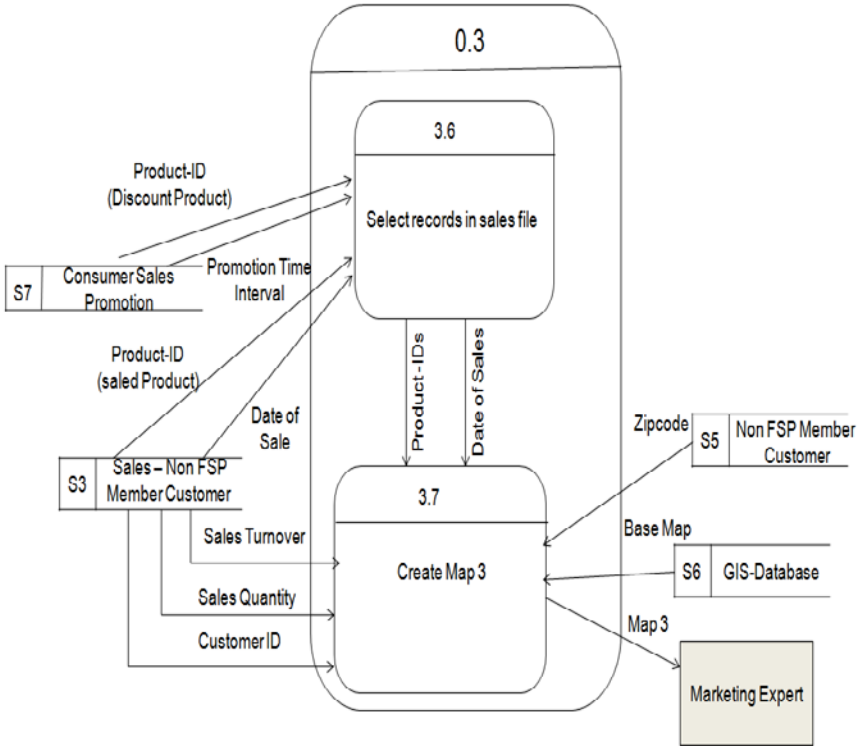
Figure 6.2. DFD 3 – Creation of Maps



GIS can also visualize sales quantities/turnovers of a product that is subject to consumer sales promotions for FSP member customers and sold to non FSP member customers. This visualization requires selecting those records in sales file whose product IDs comply with the product IDs and whose sales dates are within the promotion time intervals of the records in the file "Consumer Sales Promotions". Considering the outputs of the selection process, the corresponding sales turnovers/quantities for these outputs, the zip codes of the selected non FSP member customers in the customer file and using the base map in the GIS database, a map

(denoted as MAP 3 in DFDs) is created. This map is important to compare the sales with and without discount and to see whether the promotion has a positive impact on sales. In other words, it is important to decide whether the right incentive is applied or not.

Figure 6.3. DFD 3 – Creation of Maps



Conclusion

RFID and GIS are the recent technologies whose utilization trends are expected to increase in the future. In this study the collaboration of these recent technologies is discussed. Informing loyal customers about consumer sales promotions that are special to them is an important way of promoting sales for retailers. In the study first the contribution of RFID systems to this informing process was discussed. Then the visualization of success of executed consumer sales promotions with the maps that are created by GIS was discussed. The main characteristic of these maps is their development based on promotional information that loyal customers gain through RFID systems. In other words, they are products of RFID and GIS collaboration. Through the developed DFDs it was visualized, how this collaboration functions. The DFDs can be used within the context of system analysis by IT departments of retailers that want to realize such a collaboration. Application of DFDs enables the extension of the developed DFDs if necessary.

Within the context of a future research the developed model can be extended with appropriate data mining techniques that enable to gain valuable insights about the reasons of failures of executed consumer sales promotions. Thereby marketing managers can introduce new and better promotions.

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