

THE APPLICATION OF DATAWAREHOUSING TO SERVICE DEVELOPMENT

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Abstract: The need to base the development process of new services on future customer needs is inevitable for organisations adopting a market-driven philosophy. A practical problem, however, is the codification of knowledge about future market conditions. This paper proposes a partial solution to this problem by integrating aggregated market data and detailed information on customers needs into a datawarehouse to simulate a new service introduction into the marketplace. We use advanced neural modelling techniques to convert these data into business models, which describe the expected market behaviour resulting from customer's reactions towards new products or services. This way, vital market information is gained for the idea generation phase of new service development. The concept of datawarehousing has been successfully applied by the authors in new service development in the telecommunications industry. This paper concentrates on the application in a fundraising organisation. It is concluded, that continuous service development in dynamic markets becomes feasible by means of integrated datawarehousing and modelling techniques.

Keywords: datawarehouse, service development, business modelling, neural networks, segmentation, fundraising, customer databases.

Introduction

The purpose of 'finding a customer and keeping him' is a widely adopted philosophy within the business community. Market-driven organisations survive by addressing individual customer needs and effectively matching those needs with new products or services (Kotler 1994). By taking customer satisfaction as the ultimate goal, it becomes necessary to involve the customer or end-user as early as possible in the new product development process (Benedetto 1994, Shocker and Srinivasan 1979). Various approaches have been suggested, ranging from market research programmes, e.g. conjoint analysis (Wittink and Cattin 1989) to involvement of focus groups or lead users (Herstatt and Von Hippel 1992, for an overview see Mahajan and Wind 1992).

Concepts on what constitutes a product differentiate between the 'hard', tangible, standardised product attributes which 'rationally' address customer needs, and the augmented, intangible or abstract product attributes, which satisfy the customer in a more 'emotional' way (Levitt 1981). Recent marketing trends, such as the customer relationship

paradigm or one-to-one paradigm (Peppers and Rogers 1993), stress the importance of the intangible aspects of a product (Gupta 1994). These 'intangibles' can be used to differentiate the product from its competitors. With the increasing intangibility of products, making them apparently much more like a service, it is interesting to discuss the new service development process in a more detailed way.

Services are intangible, heterogeneous and perishable. They are also produced and consumed simultaneously, making the close match with dynamic customer needs especially important (Easingwood 1986). The central problem of new service development is the identification of specific customer characteristics and needs. The integration of market knowledge in service development is therefore crucial to achieve the desired service functionality (Rubinstein 1994).

As these customer requirements are diverse and the number of potential customers is high, it becomes almost impossible to identify those needs by traditional market research or lead-user concepts. It may be possible to identify generic needs, but the important individual needs may go unrecognised. On top of that, the intangibility of services may lead to rapid product proliferation and an information overload of organisation members and customers, alike (Easingwood 1986).

In an earlier paper the authors discuss in-depth a datawarehousing approach to support the new service development process in the telecommunication industry (Kappert and Omta, 1997). By applying neural modelling techniques to a set of customer and test market data, significant patterns could be identified, helping marketers and researches to fine-tune the service offering to the intended target markets. Such new modelling techniques offer significant advantages above traditional methods. Especially in the area of new business development, non-linear artificial intelligence techniques can help to track discontinuous market developments. This second case elaborates the concept to be applied in the fundraising industry. In section 2, the datawarehouse principles are outlined and an integrative framework, the business analysis cube, is presented. In section 3, the practical application of a datawarehouse in new service development at a world-wide fundraising organisation is discussed. Finally, section 4 derives conclusions and proposes direction for future research.

Datawarehousing to support the service development process

In many organisations, essential operational business processes are represented in information systems. These systems support day-to-day operations and implicitly reflect strategic key business parameters. For example, administrative systems collect information on customer characteristics and service sales through routine procedures. Marketing systems may collect information on promotional and selling activities with the same customers and prospects. Using this information in a strategic sense may provide insight in declining service lines and windows of opportunity for new service development.

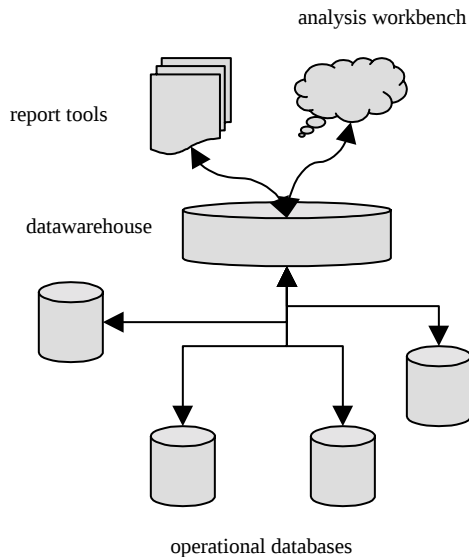


Figure 1. A datawarehousing information architecture

The problem remains that those operational data are fragmented, unstructured and not accumulated. The operational systems have not originally been designed to support strategic management processes, such as new service development. Rather each operational business process often has its own support system, fragmenting business information over a systems archipelago (McFarlan et al. 1983). Different meanings are attached to important business concepts as customer, products and processes.

Another problem is that after their operational use, the data are often deleted. This makes it impossible to gain insight on market or customer trends, especially valuable to new service development. The targeting of new services may also benefit from clear customer or prospect information.

A possible solution to the mentioned problem is the introduction of a datawarehouse (Inmon 1983). Basically, the business datawarehouse provides an integrated view on operational data, along with a historic accumulation of data on the key business parameters (see figure 1). In this way, the datawarehouse should provide a clear, dynamic 'business picture' of the organisation, its products and its markets.

The potential to use such a system for new service development is easily established. The datawarehouse can support multiple phases of the service development process. It may be used in the idea generation phase, where the focus is on 'opportunities'. For example, customer complaint data when adequately registered, may initiate the service development process. Next, the selection of ideas to be pursued can profit from information on market circumstances gathered in the datawarehouse. Screening models (Cooper 1985) can be augmented with hard data on market volume and dynamics, customer characteristics, etc. After selection of the most promising ideas, the design stage can start. Promising prospects, or knowledgeable customers (i.e. lead users), which may contribute to optimisation of the design of the service, are easily identified. After the development of a prototype, testmarketing is

performed on basis of detailed customer information (Flynn and Goldsmith 1993), improving the identification and targeting of promising prospects. Subsequent market response can be recorded and used to adapt the market introduction programme. Finally, regular sales activities can be monitored, giving insight in the progression of the product life cycle. In summary, the datawarehouse may function as a knowledge repository for new service development. The datawarehouse provides information in a convenient way to all involved parties and stimulates organizational learning (McKee 1992).

In order to establish a mutual understanding on business data and as a scheme to integrate diverse data sources we have developed a four dimensional framework, the business analysis cube. The business analysis cube integrates four sorts of information. Each information set is represented by a dimension. The dimensions are interaction, transaction, description and timing (see Figure 2).

The transaction dimension represents information on the (economic) exchange of value between the supplier and the customer(s), for example purchase and pricing information. The interaction dimension contains all (communication) data on events that facilitate the (future) transaction. Interactions take place in order to lower uncertainties on both the customer as well as the supplier side. Examples include promotional campaigns, salesforce activities, customer complaints/inquiries and media exposure. The description dimension contains attributes that identify and describe the customer. Such descriptive characteristics are for example age, income level and educational background. Finally, the time dimension labels the other dimensions with respect to their time-dependency. By using these labels, dynamic processes can be made visible. Time-indexed relationships can also disclose structural arrangements between dimensions that describe cause-effect relationships.

By combining these four dimensions (the 'cube'), relationships between the dimensions are represented. Such relationships can be used to segment markets and to identify product development opportunities. It is important to notice that information regarding the four dimensions is gathered at the individual customer level, in order to make the one-to-one relationship of the organisation and the specific customer possible. The ultimate goal of the business analysis cube is to provide a complete and consistent description of marketing processes. Such a representative model could be used to explain dynamic supplier-customer relationships and simulate system behaviour for forecasting purposes.

Important relationships are represented in modules, generated by report tools. For example, the relationship between interaction and transaction is represented in a report module called Campaign Effectiveness. The historic accumulation of transactions at the individual customer level is contained in the Customer Life Time Value module. At least six modules have been identified up till now, such customer segmentation and loyalty analysis, customer life time value analysis, product portfolio analysis, share of the customer and cross-selling analysis. These modules generate answers to recurring service development questions in a procedural way. For example, the customer life time value analysis can be used to detect important changes in the

transactional behaviour of customers. These behavioural changes can indicate opportunities for new service development.

An analysis workbench contains modelling and datamining tools to identify unexpected, possibly non-linear relationships between the dimensions. The modelling tools effectively reduce the massive amount of data contained in the datawarehouse to the salient patterns reflected in business models. Such business models simulate and forecast to a certain extent the behaviour of the organisation and its markets. Examples include new product models, marketing-mix models, segmentation models and competitor models.

Business models are very specific. The modelling tasks can not be specified in a procedural fashion, like the report modules. Intelligence and pattern search are needed to explore the data. Tools could include combinatorial analysis techniques and neural networks. In the first case study in which the concept was tested, neural networks have been used to investigate the relationship between customers characteristics and the probability of adoption of a new service in the telecommunication industry (Kappert and Omta 1997). In the next section a second case study is described, in which a datawarehouse, report tools and analysis techniques have been used to support a world-wide fundraising organisation in the service development process.

A Case Study - New service development at a fundraiser

The fundraiser in this case study creates general awareness towards environmental issues. It has a world-wide presence and belongs to the top fundraising organisations. Donors are informed on current newspaper issues and sometimes indirectly contacted whenever important events take place. Until recently, donor involvement has been low. The donor was almost anonymous to the fundraiser. Fundamental knowledge on the success or failure of new donor campaigns was not explicitly available, because detailed interaction and transaction data were not gathered.

The fundraiser was conservative regarding the development of new services. Most of the money was raised from the donor base through an annual campaign. The prospecting activities were mass-marketing approaches with subsequent decreasing response rates in a competitive market. Dormant donors, i.e. donors who had not contributed money in the last few years were removed from the donor base in standard operational system procedures. This may have resulted in a massive loss of customer value.

The competitive pressure forces the fundraiser to propose novel ways to establish a firm, personal relationship with its donors in order to secure future gifts. Therefore, the focus of this fundraiser is to target and to develop personal communication messages and services towards its donors to increase their loyalty. With the number of donors roundabout 600.000, it is nearly impossible to do this without the aid of an integrated information system, i.e. a datawarehouse. As donors behaviour changes frequently, it becomes necessary to track this donation history and to respond to its development with adequate, novel communication activities.

By migrating towards a new operational marketing information system, linked to a financial application, data on fundraising activities and resulting donor were systematically gathered at an operational level from that moment on. Next, the development of the datawarehouse structure and the definition of the upload- and download procedures were given attention. The structure of the datawarehouse represents the business analysis cube, combining interaction, transaction and descriptive data in an integrated framework (see figure 2).

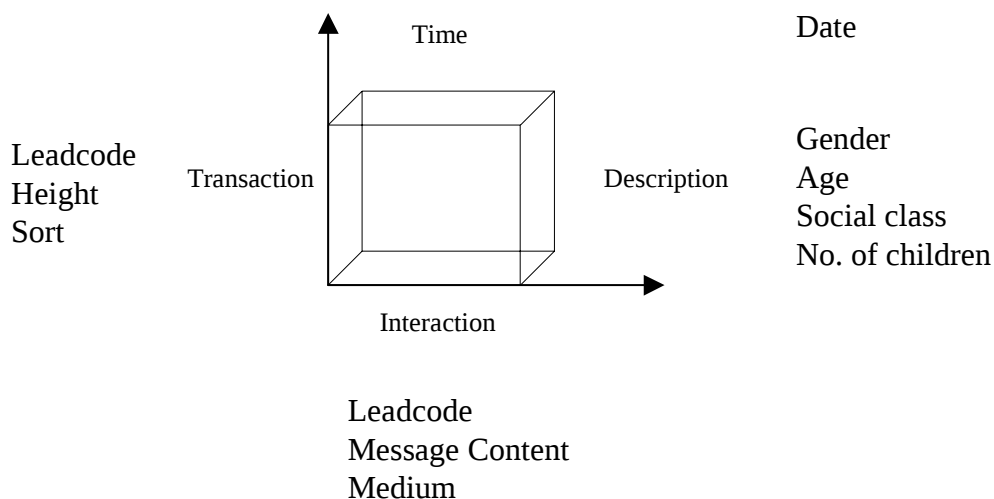


Figure 2. The Fundraiser's Business Analysis Cube (extract)

Monthly (automatic) upload procedures from the financial system and the marketing information system guarantee that the information in the datawarehouse is as accurate as possible. Up till five years of operational data have been gathered, providing a wealth of information to service development activities.

The business analysis cube framework forms the basis of the segmentation of the existing donor base. Dynamic interaction, transaction and description information is combined to value and describe individual donor behaviour. There are different categories for the regularity, height and frequency of the donations. For example, donors who have authorised the fundraiser are different from donors who donate money once in a while. The same applies to the height of the donations. Some thirteen categories have been identified (see figure 3).

These categories are informative for the development of new services and the responsive behaviour of donors when targeted with new services. The categories provide information on the characteristics and size of various donor segments. For example, the high, regular donor category was found to both substantive and unique in its characteristics to justify the development of a new, specifically tailored service to increase their loyalty. In addition, adoption of a new service is dependent upon historic transaction and interaction behavior and descriptive customer characteristics.

	A	B	C	D	E	F	S
DOA	92.2%	1.5%	4.0%	0.4%	0.0%	0.0%	1.9%
DOB	13.4%	70.5%	3.8%	6.6%	0.2%	0.0%	5.5%
DOC	10.0%	14.3%	62.1%	9.4%	0.3%	0.0%	3.8%
DOD	2.6%	10.2%	6.4%	67.8%	3.3%	0.1%	9.6%
DOE	0.6%	2.7%	1.0%	12.9%	72.0%	2.2%	8.7%
DOF	0.2%	1.2%	0.6%	4.2%	18.0%	65.6%	10.1%
GIA	26.2%	12.7%	7.5%	4.2%	0.8%	0.0%	48.6%
GIB	3.0%	48.8%	5.0%	8.5%	0.8%	0.1%	33.8%
GIC	4.5%	30.2%	33.2%	14.3%	2.4%	0.1%	15.2%
GID	1.1%	13.9%	5.6%	29.2%	5.8%	0.9%	43.5%
GIE	0.5%	5.4%	2.0%	18.4%	34.2%	6.9%	32.6%
GIF	0.7%	2.4%	0.9%	6.5%	15.5%	43.6%	30.4%
STE	2.7%	5.9%	0.9%	1.3%	0.3%	0.1%	88.8%

Figure 3. Customer Value Change Module (extract)

The codes on the left side denominate donors with authorisations (label starts with 'D'), donors with irregular gifts (label starts with 'G') and donors who did not donate in the last two years (label 'STE'). The numbers indicate migration in donor categories from one year to another. For example, 30.4% of the highest gift donors (code 'GIF') don't contribute in the next year (code 'STE'): in other words, have gone dormant.

In this way, the new service attributes like message content, medium and timing are tailored to specific segments. In prospecting activities, information regarding prospects for a new service is downloaded to a fulfilment organisation in less than a week after service conceptualisation. The speed of introduction is made possible by the concentration of all the necessary information in the datawarehouse. This gives the fundraiser flexibility to communicate on moments when the message is most likely to be received, for example with additional high media exposure.

For ad-hoc analysis purposes various tools in the analysis workbench are used. The workbench contains multi-dimensional OLAP tools and statistical/artificial intelligence techniques. These techniques simulate and forecast donor behaviour resulting from specific communication messages and new service introductions. On basis of these simulations, the targeting of new services can be enhanced. For example, neural networks have been used to model donor reactions towards a new online information service in a testmarket situation. Neural networks are techniques which construct a mapping, possibly of a non-linear kind, between selected independent variables and a dependent variable by means of network of connected nodes. Independent variables included donation history, gender, age, number of years donor and a geodemographic descriptive variable. The output variable was the adoption of the new service offered in a telemarketing campaign, a binary variable (coded yes or no). The test market had a size of 2000 persons, including 581 adopters/responders, establishing an adoption rate of 29%.. The gains chart shows that we can outperform this average, random approach by using the neural network model to identify the donors with the highest probability to adopt. Response rates of 50% can be reached in

selected subsegments, reducing new service introduction costs to a considerable extent (see figure 4). Additionally, insight may be obtained in the factors driving service adoption.

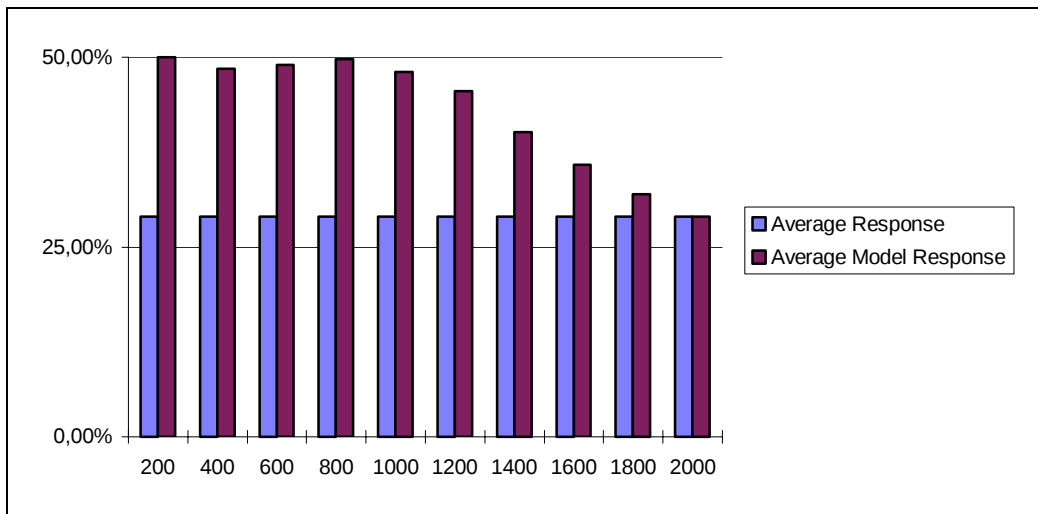


Figure 4. Average Random Response Rate and Average Selective Response Rate (Neural Model)

By such modelling of donor's reactions (represented in the interaction and transaction data) towards offers made by the fundraiser, the targeting of the new services to the existing donor base can be highly selective and efficient. Additionally, the segmentation of the donors is linked to geodemographic segmentation, identifying prospects for new services outside the current donor base.

By using the datawarehouse and analysis techniques an event-driven service development process becomes possible: detailed market information on significant events in the relationship with the donor can trigger the fundraiser to respond in novel ways. This is a major difference compared to the 'old' situation, in which the fundraiser could not adequately respond to environmental changes and competitive pressures which certainly influenced to relationship with its donors. The mass-marketing approach without significant service development has been replaced by continuous service development to address the different needs of a number of fragmented market segments (or even individual donors !). Changing donor needs are monitored and modelled through the datawarehouse and analysis techniques, giving indications and information to new service development.

The new service development and marketing process generates new interaction, transaction and timing data, updating the information and categorisation at the individual donor level. This cyclic process, if performed in a systematic way, makes a learning organisation possible. Gradually, 'experience' is systematically recorded in the datawarehouse.

Conclusions and Future Developments

In today's dynamic markets it is important to develop new services at the highest possible pace. The case presented shows, that, although new service

development is a creative process in nature, datawarehousing generates valuable information on changing customer needs. In addition, the targeting of new services can be enhanced, because vital business and environmental information is represented in an uniform, easy accessible form. Without the specific individual donor information, as generated in the business analysis cube, idea generation and targeting for new services is greatly impaired, resulting in higher development and service launch costs. Therefore, this case study shows, that continuous service development in dynamic markets becomes feasible by means of integrated datawarehousing and modelling techniques.

Besides representing individual donor descriptions, transactions and interactions, we propose that the business analysis cube should integrate regulatory, competitor and cultural information, as well. Rather than forecasting what donor's reactions to new services are, this way a more fundamental understanding why donors accept or reject a new service may be reached. Donor interactions can be recorded electronically, decreasing the time needed to make valuable information available to service development staff. In this way, the rapid development of personalised services can increase the level of involvement of the donor base, possibly resulting in higher or more frequent donations.

References

- Benedetto, C. A. di. (1994). Defining Markets and Users for New Technologies. In: Managing New Technology Development (W. E. Souder and D. J. Sherman, eds.). pp. 73-115. Mc-Graw-Hill, New York.
- Cooper, R. G. (1985). Selecting Winning New Product Projects: Using the NewProd System. *J. of Prod. Inn. Man.*, 2, 32-44.
- Easingwood, Ch. J. (1986). New Product Development for Service Companies. *J. of Prod. Inn. Man.*, 4, 264-275.
- Flynn, L. R. and R. E. Goldsmith (1993). Identifying Innovators in Consumer Service Markets. *The Service Industries Journal*, 13 (3): 97-109.
- Gupta, A. K. (1994). Developing Powerful Technology and Product Concepts. In: Managing New Technology Development. (W. E. Souder and D. J. Sherman, eds.). pp. 45-71. Mc-Graw-Hill, New York.
- Herstatt, C. and E. von Hippel (1992). From Experience: Developing New Product Concepts Via the Lead User Method. *J. of Prod. Inn. Man.*, 9, 213-221.
- Inmon, W. H. (1993). Developing Client/Server Applications. John Wiley & Sons, New York.
- Kappert, C. and S.W.F. Omta (1997). Neural Networks in Technology Management Processes, in: Information Systems Vol. V. (R.H. Sprague ed.). pp. 465-473. IEEE Computer Society Press, Los Alamitos, California.
- Kotler, P. and G. Armstrong (1994). Principles of Marketing. Prentice Hall, Englewood Cliffs, NJ.
- Levitt, Th. (1981). Marketing Intangible Products and Product Intangibles. *Harvard Business Review* May/June.
- Mahajan, V. and J. Wind (1992). New Product Models: Practice, Shortcomings and Desired Improvements. *J. of Prod. Inn. Man.*, 9, 128-139.
- McFarlan, F. W., J. L. McKenney, and Ph. Pyburn (1983). The Information Archipelago: Plotting a Course. *Harvard Business Review*, 61, 145-154.

- McKee, D. (1992). An Organizational Learning Approach to Product Innovation. *J. of Prod. Inn. Man.*, 9, 232-245.
- Peppers, D. and M. Rogers (1993). *The One to One Future*. Currency Doubleday, New York.
- Rubenstein, A. H. (1994). Ideation and Entrepreneurship. In: *Managing New Technology Development*. (W. E. Souder and D. J. Sherman eds.). pp. 15 – 43. McGraw-Hill, New York.
- Shocker, A. D. and V. Srinivasan (1979). Multiattribute Approaches for Product Concept Evaluation and Generation. *J. of Marketing Research*, 16, 159-180.
- Wittink, D. R. and P. Cattin (1989). Commercial Use of Conjoint Analysis: an Update. *J. of Marketing*, 53, 91-96.