Andreas Pinterits

Coordinating Internet Sales with Other Channels

A Performance Measurement Model

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With a foreword by
Univ.-Prof. Dr. Dr. h.c. Hans Robert Hansen

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To my family, Brigitta, Stefan and Stefan jun.

Foreword

The continuing growth of global Internet usage has a remarkable impact on retailing businesses. Customers expect to do business not only through stationary sales channels, but also to order online, pushing companies to introduce e-commerce sales channels. The distribution of goods through newly introduced e-commerce sales channels offers retailers opportunities such as the cost-effective enlargement of their assortment and the attraction of new customers. However, it also implicates a number of problems. In the past, channel conflicts were usually avoided by differentiating the offerings of sales channels. Today, offerings are typically coordinated between a company's e-commerce and other sales channels. In such cases, customers can seamlessly switch between different contact points during their buying process, for example they get the same products for the same price in the different sales channels.

Such coordinated sales channels certainly affect the internal organizational structure of such multichannel retailers. Adequate performance measurement systems are needed to manage the resulting risks (for example channel conflicts) and utilize possible synergy effects. In this book, a design of a performance measurement system for multichannel retailing is presented. It addresses the coordination of distribution channels from a performance measurement's perspective. The author places this book in the context of recent marketing, performance measurement and e-commerce literature. The first part reviews the relevant literature. E-commerce business models for multichannel retailers and their strategic options are discussed. Furthermore, the requirements for modern performance measurement systems are presented. A whole section of the book is devoted to the discussion of success factors for multichannel e-commerce retailers.

The central part of this book is the design of a performance measurement system. The used methods are in the scope of the German "Wirtschaftsinformatik" or design science. A structured approach following the ARIS-Method, introduced by August Wilhelm Scheer, is used to design the performance measurement system.

The system itself is split into a general part and a specialized part. The general part deals with the overall design model of a performance measurement system for a sales and distribution system with two or more channels. In the specialized part, a migration model allowing for the measurement of customer switching behavior during the different phases of the sales process is developed and integrated into the overall model. The practical use is demonstrated by a showcase implementation of the model.

This doctoral thesis is intended to solve real-world problems. On the one hand, it offers a systematic view on the relevant scientific literature. On the other hand, it is a unique aid for marketing, controlling and software-development. I recommend it to everyone involved with performance measurement for multichannel e-commerce businesses.

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Andreas Pinterits

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Chapter 1

Introduction

Since its introduction, the Internet has been growing and gaining importance until today. In the early 1990s some companies began to carry out business over the Internet, electronic commerce was born. In the mid and late 1990s, increasing interest and the strong belief in network effects and economies of scale led to a hype of the New Economy. Exorbitant risk capital for investments into Internet companies, so called "Dotcoms", was available and the sector boomed [HaMT$^+$04]. But the ignorance of basic economic principles finally led to a great number of insolvencies. The so far hyped Internet economy crashed in the year 2000 [ThMa03].

After the crash, e-commerce was addressed more soberly than before. In the meantime the previously emphasized boundaries between Old Economy and New Economy are vanishing. E-commerce is becoming a day-to-day business. The market drives many former old economy companies to engage in some kind of Internet activities. An online appearance in form of a website practically becomes a "must".

Analog to this general development, in retailing there is a trend to establish online retail channels. But while conventional multichannel strategies tried to separate their different channels into market segments, target groups etc., e-commerce multichannel companies pursue another way. Newly established online channels are usually integrated with traditional bricks and mortar business or mail-order business. In a representative German study called "Electronic Commerce Enquête 2005", 48 percent of all questioned companies indicated to be *hybrid suppliers*, thus selling their goods both via traditional and e-commerce channels [SaSt05]. This development is also market-driven. Customers want to be able to switch between channels during the phases of the shopping process [Doub04]. Multichannel customers spend more money on products of a certain retailer than other customers [ScSc04].

For a long time, the main focus of e-commerce literature was put on marketing relevant topics [WiKr01]. Other relevant topics appeared in the course of time. One important issue is performance measurement. The relevance of this topic for e-commerce becomes apparent when one considers the events which led to the crash of the New Economy. The properties of e-commerce sales and distribution channels offer a broad range of new performance measurement tools. Website controlling or the analysis of logfiles allows the calculation of measures which are not available for other forms of retailing. The implications of the operation of multiple coordinated channels, including an e-commerce channel, are yet not so well-elaborated. A shallow view on the topic would suggest a separate treatment of different sales channels by controlling them in a traditional way. However, a more substantial analysis advises that the controlling of well-coordinated channels particularly takes into account the effects of coordination and the specific features of e-commerce channels to deliver satisfactory support for corporate management. Not considering the exchange of services between coordinated channels could lead to wrong assumptions regarding the profitability of the channels. On the basis of these considerations, this work focuses on performance measurement of coordinated retail channels with reference to peculiarities of e-commerce.

“One problem faced by click and mortar firms is that the contributions made by the Internet channel may be intangible and hard to measure” [Tede01] cited in [StAL02].

1.1 Research question

The phenomenon of multichannel retailing, especially in the context of e-commerce channels, is currently under intense discussion in marketing literature. The trend for multichannel integration can be explained by supplier-side and customer-side rationales [KuVe05].

Regarding performance measurement literature, much work is done concerning specialties of e-commerce business models. Underlying information systems create much space for new types of measures. Furthermore they bring along new problems. Only a few authors try to address the operation of multiple channels from a performance measurement viewpoint. Teltzrow introduced a website-controlling framework which tries to indicate the conversion from online stores to offline stores [TeBG04]. Schröder and Schettgen describe multichannel performance measures under the constraint of the availability of detailed customer data of all channels [ScSc04].

Existing literature has not yet provided a comprehensive framework for e-commerce multichannel retailers. This gap shall be filled by the model of a performance measurement system. Such a model has to assist retailers in designing their own performance measurement systems to successfully control the coordination of their distribution channels. Since measures impose requirements on their context, scenarios of their useful appliance are presented. Figure 1.1 shows the integrating position of the model in the identified gap between existing isolated performance measures and other multichannel literature.

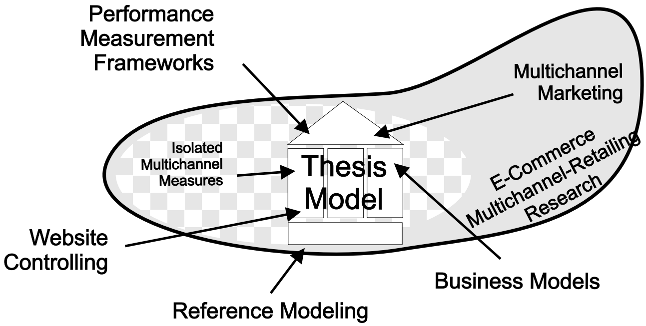

Figure 1.1: Positioning the model

One important function of performance measurement is the comparison of measured values. A separated treatment of different sales channels and comparison of them is suggested. A substantial analysis advises that in order to achieve satisfactory results, controlling of integrated channels particularly should take into account the effects of coordination and the specific features of e-commerce channels. Ignoring adducted support services between integrated channels, for example, would lead to wrong assumptions regarding the profitability of the channels themselves. This applies to measures of identified success factors in various forms. The following examples will clarify this statement:

Financial measures provide easily comparable numbers, though their comparison may lead to wrong assumptions. If the goal of the integration of channels was the maximization of the overall performance of the channels, a logical consequence could be the abandonment of separate views for each channel and an aggregated examination of the financial performance.

Quality measures describe quality standards. A comparison between the quality standards of the different channels would make sense. Unfortunately, the specific measures of different channels themselves will often be incomparable. For such cases a comparable format has to be designed. A conversion of specific measures into a standardized format allows channel comparison beyond the definition of channel-specific quality standards.

Transaction measures, customer satisfaction, and other types of measures should be defined in comparable formats where it is possible. This supports channel coordination in planning and agreement of channel-specific goals.

One aspect of this work is the categorization of the measures into these types. This approach will lead to the proper usage of the different measures in the specified performance measurement system.

The basic question behind this research is how a system that measures the performance of multichannel retailing can be constructed. This will be done in form of a model that describes the requirements and the structure of such a system. The focus lies on the sales and distribution system of multichannel retailers. The performance measurement system therefore does not cover the complete company. It rather functions as part of a performance measurement system, which can be embedded in a company-wide performance measurement system.

The model specifies solutions that enable a proper performance measurement of integrated sales and distribution channels to customers. As a constraint, one of these channels is mainly operated over an information system in an electronic network, and is therefore classified as electronic commerce channel. The described performance measurement system addresses issues of the integration itself. It takes into account several success factors which have been identified as essential for e-commerce. It follows the principles of modern performance measurement. The model will specify the organizational perspective, data perspective, control perspective, function perspective, and output perspective of the performance measurement system.

The model of a performance measurement system will be extended by performance measures specific to e-commerce multichannel retailing. The focus thereby lies on migration models. Migration models allow the measurement of customers' switching behaviour in a multichannel sales and distribution system. They reveal how frequently multiple channels are used for the acquisition of goods. Different ways of measuring such migration models are discussed in the theoretical part of this work. On this basis, migration models are integrated in the model of a performance measurement system.

1.2 Structure of the work

This book is divided into seven chapters. The first four chapters lay out the theoretical foundations for the construction of a performance measurement system. In chapters five to seven, the performance measurement system is modeled, an example implementation is shown, and the findings of this book are discussed. Technical reference to a demonstration implementation is attached in form of an appendix.

In the second chapter, *E-commerce multichannel retailing*, general e-commerce business models, and in particular, e-commerce multichannel business models are examined. The chapter starts with the classification and the design of e-business models in general. In the following subsections multichannel e-commerce and the coordination of distribution channels are discussed in seven areas of strategic business model decisions:

1. Market definition, legal form and partnerships
2. Range of goods and services
3. Pricing
4. Communication
5. Distribution, type of operation
6. Organizational structure
7. Internal processes

The third chapter addresses *performance measurement*. It begins with the description of the evolution of performance measurement systems. Then it continues with a discussion of requirements into modern performance measurement systems. In the next step, four selected performance measurement frameworks are presented and discussed along the previously stated requirements. Afterwards, the focus is shifted to e-commerce multichannel retailing and success factors of e-commerce companies in general are discussed. The chapter concludes with a discussion of selected performance measures for multichannel retailers.

Chapter four, *Methodology - a structured approach for designing the model*, presents the methodological basis of the book. The work is positioned in the field of design science. The ARIS framework, which provides the structure for the modeling of the performance measurement system, is described. Also, the modeling tools which are used are presented.

The fifth chapter, *Performance measurement model for e-commerce multichannel retailing*, represents the core part of the book. It is split into a general model and the discussion of selected specialized performance measures for multichannel retailers. Both parts are structured into the five views of the ARIS framework:

1. Organization view
2. Data view
3. Function view

4. Control view
5. Output view

The model contains the requirements definition of a performance measurement system. The different concepts are displayed by various modeling tools and extensively discussed chapter five.

Chapter six extends the theoretical model by a showcase implementation of an example performance measurement system. Fictional numbers are used to show the use of the performance measurement system, and the calculation of a migration model, which is a promising performance measurement tool for multichannel companies. Nevertheless, the numbers are aligned with a company which was used repeatedly used in existing literature as a case study for multichannel retailing.

The book closes with the discussion of findings and contributions. It points out limitations and indicates starting points for further scientific work in this field of research. The appendix of the book contains parts of the technical implementation of the performance measurement example which is introduced in chapter six.

Chapter 2

E-commerce multichannel retailing

The focus of this book lies on companies characterized as e-commerce multichannel retailers: companies which operate a sales channel in a traditional way, and also have an e-commerce channel [StAL02]. On the e-commerce channel, products or services are sold over information networks like the Internet. Companies which operate both a web-based online channel and a channel with offline stores, also called "*bricks and mortar*", are often referred to as "*bricks and clicks companies*" [GuGa00]. Other terms for this type of business are "*clicks and mortar*", "*surf and turf*", "*cyber-enhanced retailing*", and "*hybrid e-commerce*" [StAL02].

Multichannel retailing refers to the distribution of goods and services over more than one channel. Multichannel retailing in a wider sense comprises a broad range of organizational designs. Distribution channels may be incorporated in one single company or spread over different organizations. Producers may incorporate direct selling over the Internet beside their traditional channels running over distribution partners. In this work, the term is used like in [HaMa07]. Multichannel retailers are retailers which sell their goods over e-commerce as well at at least one additional distribution channel.

In many cases *bricks and clicks companies* evolve from traditional stationary or offline retailers through the introduction of an additional e-commerce channel. Often the decision to establish such a channel cannot be counted as the best economical decision, but is simply demanded by the market [KiSX04]. In recent marketing publications the concept of *multichannel customers* emerges. It is shown that a growing number of customers rely on and therefore demand multiple channels during their purchase decision. For example a study in the tourism business revealed that 65 percent of customers used more than one channel when making travel arrangements in the year 2003 [Doub04]. The trend clearly points upwards. From the customer's viewpoint, a multichannel company does not consist of various more ore less independent channels, but provides different points of contact to one and the same integrated multichannel retailer

[AcBC+05]. So the customer is able to choose where, when, and how to get product information, order a product, or demand a service. A study in a high-technology industry business-to-business context revealed that one can distinguish between multichannel customers and non-multichannel customers. The multichannel customers put more trust in the company, are more loyal and spend more money [KuVe05]. Therefore, the value of a customer interacting with more than one channel is higher than the value of a customer interacting with only a single channel [Kirs05].

The introduction of online channels offers opportunities as well as risks for the companies. It is clear that synergies concerning brand recognition, existing infrastructure and cooperation of channels present a broad potential advantage in competition [Madl04]. A very serious concern for companies which plan to introduce e-commerce channels is channel conflict. In a survey, 50 manufacturers were asked about problems with the management of multiple sales channels. 66 percent of them indicated that channel conflict was the biggest issue in their online sales strategy [Webb02]. Channel conflict describes a situation where employees in one channels perceive that actions from another channel hinders them in reaching their goal. Webb identifies three main sources of this phenomenon [Webb02, StEl92]:

- goal incompatibility,
- domain dissensus, and
- differing perceptions.

Goal incompatibility means that employees from different channels strive for negatively interdependent goals. Such a situation may occur, if for example the most important goal for both channels is profit maximization. Cannibalization effects would in most cases impose that profit increases in channel A causes profit decreases in channel B. Such negative goal interdependence cannot always be avoided. Nevertheless, it should be minimized when defining goals for different channels. Etherington and Tjosvold discuss positive effects of a cooperative context when managing interdependence while dealing with budget conflicts [EhTj98]. Regarding superordinate company goals, one can assume that cooperative objectives in total would support company goals better than negative or non-interdependent goals in different channels. Webb includes internal and external channel partners in his survey. Superordinate goals can only be established for internal partners. External partners therefore have a greater risk for incopatible goals then internal partners.

Domain dissensus occurs if there are missing or overlapping domain definitions. A domain can be defined by its population, territory, the functions performed or the technology deployed

[StEl92]. As discussed in this work, different channels in e-commerce companies often serve the same market. The risk of domain dissensus is therefore rather high in such settings.

Differing perceptions often result from poor communication between individuals. If channels are poorly coordinated and there is a lack of communication between them, channel conflict can arise out of the resulting differences in perception of employees working for different channels. The occurrence of these three phenomena positively affects the likelihood that channel conflict occurs.

2.1 E-commerce business models

Business models in general describe sets of key components or fundamental decisions which define how a company tries to fulfill its goals in respect to its external organizational conditions [HaMT+04]. The term itself is particularly popular in the e-commerce field, but typically the authors primarily focus on a classification of business models and not on a uniform definition of the term itself [HaMT+04, HeKa01].

A well-known definition of business model is introduced by Timmers. He describes a business model as a package of three components: Firstly, it has to contain an architecture for product, service and information flow. This includes the definition of different actors who participate in the business process. Secondly, it has to state potential benefits for the different actors. And thirdly, it has to define a revenue model, which is a description how and from whom revenue can be generated [Timm98].

2.1.1 Classification of e-commerce business models

This section is dedicated to the classification of e-commerce business models. It clarifies the use of the term e-commerce, and what is meant by a sales channel which is operated as an e-commerce channel. Early authors on e-commerce started to classify businesses into different categories and tried to describe their operations in form of business models. Timmers identified eleven different business models and classified them by their level of functional integration and degree of innovation [Timm98]. The model e-shop is described as the least innovative and least functional integrated business model in comparison to other models. In this case, the website is used to promote the company or sell the company's products. E-tailing or multichannel retailing, the topic of the book on hand, would be categorized into this business model. Timmers also describes more innovative and more functional integrating business models — e-procurement,

from/to	*Business*	*Consumer*	*Administration*
Administration	A2B Online competitive bidding for projects	A2C Online government services, e-voting	A2A Online collaborative working, eg. online crime pursuing
Consumer	C2B Online job exchanges	C2C Online auctions	C2A Providing online tax returns
Business	B2B Supply chain management	B2C Online shops, bricks and mortar business	B2A Providing online tax returns

Table 2.1: Actors in e-commerce [WiKl00]

e-mall, e-auction, trust services, info brokerage, value chain service provider, virtual communities, collaboration platforms, and third party marketplace (see Figure 2.1) — most of them evolved through the progression of the Internet and its underlying technology [Timm98].

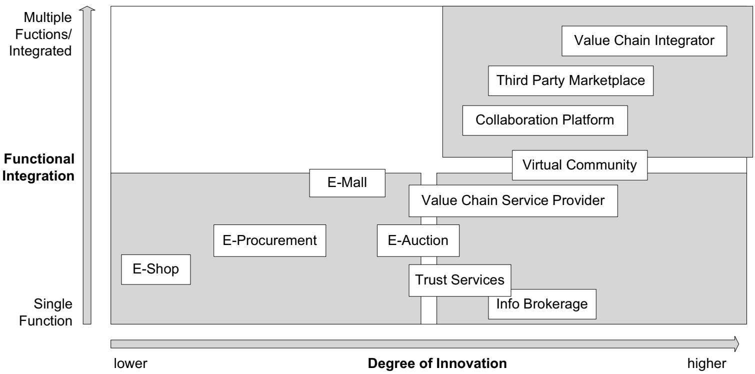

Figure 2.1: Classification of Internet business models [Timm98]

Wirtz and Kleineicken identified three types of actors which may participate in e-commerce business: *Business*, *Consumer* and *Administration* [WiKl00]. Each type of actor may act on the seller's or the buyer's side or on both at the same time, allowing for nine types of e-business fields. Table 2.1 summarizes nine types of actor-to-actor relations and gives examples for their applications.

Regarding types of e-commerce business models, further categorization methods can be found. The 4C-Net-Business model distinguishes between four different types of goods and services, typically delivered by e-commerce companies [WiBe02]:

- Content
- Commerce
- Context
- Connection

Content describes all businesses specializing on the collection, selection, production, packaging, and delivery of content. Depending on the type of content dealt with, the category can be split up into the subtypes *e-information*, handling objective, business-like information, *e-entertainment*, handling hedonic information and games, and *e-education*, handling learning content [WiBe02]. *Commerce* is the type of operation which subsumes business models which transfer non-e-commerce business into e-commerce. Offering non-internet-specific goods and services over electronic networks is classified into the *commerce* field [WiBe02]. Bricks and clicks retailing also belongs into this category. Companies of the *context* type offer search and navigation services in and around the Internet. Search engines and web-catalogs belong into this category. These companies provide essential infrastructure for the Word Wide Web. Without them, users would not be able to explore and search the Internet in the way they are doing now, but only rely on their known web-resources [WiBe02]. The *connection* type provides infrastructure for data and information exchange. This includes *interconnection*, which basically means that providers connect the personal computers of their customers to the Internet by the use of adequate stationary or mobile technology. Further, the category includes *intraconnection*, which means that companies provide information systems, allowing users to get in contact with each other and exchange information [WiBe02]. Examples for intra-connection business models are e-mail providers, customer portals, chatrooms, online communities and so on.

Applied to multichannel retailing, the e-commerce channel is referred to as sales channel, which operates in the *commerce* model of Wirtz' classification. The work focuses on retailers who typically offer their goods to consumers. This is referred to as B2C (business-to-consumer) e-commerce. In difference to many other emerged business models in the e-commerce context, the revenue model of retailing is classified as a transaction based direct model.

All these models can also be distinguished by their type of revenue generation. The part of the business model which describes revenue generation is called the revenue model (cf. [MeNP$^+$05]). It is possible to generate revenue in a direct or indirect way, as well as transaction-dependent or independent revenue generation of different business models [WiKl00]. Direct revenue generation relates to a consumer of a product or service who pays for it directly. Indirect revenue generation describes models in which not consumers or users are charged, but a third party, for example sponsors or advertisers who pay for the operation of the site. The distinction in transaction-dependent and transaction-independent models is connected to whether a payment is related to a specific transaction or is based on another factor, for example a monthly fee [WiKl00]. Bricks and clicks e-commerce represent a direct transaction-dependent revenue model. The revenue comes from consumers and is directly linked to sales-transactions. An indirect business model could are subscriptions for the regular use of specific services or repeated receipt of products. Steinfield identified bricks and clicks as a distinct electronic commerce business model [StAL02].

2.1.2 Design of e-commerce business models

E-commerce companies have to adapt their business model according to their organization's conditions [MaSe05]. Hansen identified a number of factors influencing the strategic decision regarding e-commerce business models. These factors can be categorized into *company-related factors*, *product-related factors*, *business-related factors*, and *infrastructure-related factors* [Hans98]. Accordingly, they influence the business model of bricks and clicks companies. In this case the effects may apply to the e-commerce channel, the coordination of e-commerce channels with other channels, or the overall business model of the company. The influence of an organization's conditions on different aspects of the business model is summarized in Figure 2.2.

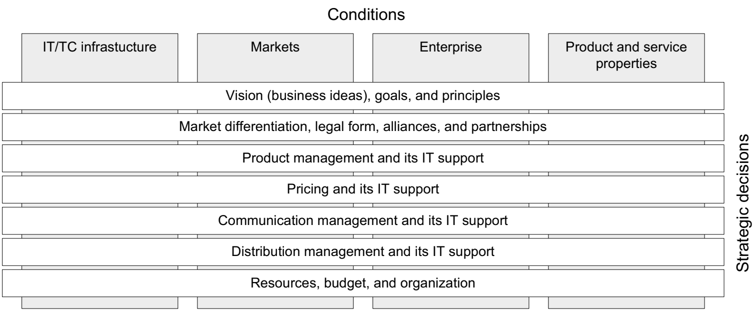

Figure 2.2: Design elements of e-commerce business models and their influencing external organizational conditions [HaMT+04] translated by [MaSe05].

The framework can be used to describe strategic or business model-related decisions in context with their environment. The environment is analyzed in detail by approximately 150 factors in the four stated categories. Strategic decisions are decomposed into about 300 items [MaSe05].

In the case of bricks and clicks companies, the distribution model is partly pre-determined. The distribution channel strategy is multichannel retailing. Channels may be differentiated or not. Channels may be coordinated or not. The decision to differentiate or coordinate in principle can be set individually per channel for most of the decisions regarding the business model. The difference between differentiation and coordination can be illustrated by a decision in the scope of communication policy. An example for a non-differentiated promotion may be conducting a lottery. Stationary customers in the store and online customers at the website are invited to participate. Every participant is put into the same pot. Differentiated lotteries would be autonomous for every channel, eg. online customers are invited to participate, store customers are not. Coordination of channels is a slightly different concept than differentiation. In this example coordination could mean that the lottery is conducted only in the online store. Customers of other channels are invited to visit the online store and participate via the website. Another form of coordination would be the distribution of coupons in the online lottery, where the coupons are intended to be consumed in the offline stores of the company. Differentiation occurs if there is a distinction in the business decisions of the different channels. Coordination means that if the channels interact with each other in their operations. The important difference is not to homogenize sales channels, but to synchronize them, leaving each channel enough flexibility to use its special strengths and knowledge [Sawh01].

2.2 Design of distribution channels

The previous chapter described how to differentiate and coordinate the business models of specific channels. This chapter explores specific parts of channel business models for bricks and clicks companies. The discussed decision areas have been adapted from the business model framework [Hans98]:

- Market definition, legal form and partnerships
- Range of goods and services
- Pricing
- Communication
- Distribution, type of operation
- Organizational structure
- Internal processes

Internal processes are explicitly distinguished as a seperate item. Their importance arises from the great potential source of synergies for multichannel retailing when processes are well designed for different distribution channels. The item “vision” has been elimintated, since a vision has to be established throughout the company and is no channel-specific design element.

2.2.1 Market definition, legal form and partnerships

Multichannel retailers are able to define individual markets for each sales and distribution channel. In principle, markets can be differentiated by region, time, or by object [Meff00, p. 37]. If channels are targeted to serve different markets, the danger of channel conflict can be avoided [Webb02]. In theory, a regional differentiation could be established by targeting the store-based channel on certain urban areas while targeting the online channel on rural areas and cities where no store is available. However, the regional differentiation of online channels is difficult to handle because public websites usually can not be restricted to regional access. A more practical regional differentiaton would be by country. It is possible to establish country-specific websites. Also, delivery terms can be established which prohibit or at least penalize the delivery to certain countries.

Differentation by time is possible in a seasonal business where the online channel offers products which, due to space restrictions are only offered in certain seasons, e.g. at a sports goods retailer. Differentation by object would mean different sortiments of types of products. This could, for example, be achieved by high-quality and low-quality product lines, different products for home use and industrial use, etc.

However, this work focuses on multichannel retailers serving the same market with their different distribution channels. The introduction of an additional channel in such a case could possibly expand the target market [StBA01]. Basically however, if the channels should operate in coordination, they have to serve the same markets or markets which mostly overlap.

Since this work assumes different channels operating under the supervision of one unit, the legal form is also assumed to be consolidated under one single legal entity. Different legal entities would go beyond the scope of one performance measurement system, and are not covered by this work.

Partnerships can be used to fill gaps in distribution channels [StBA01]. If, for example, a multichannel company does not want to establish its own logistic fleet, it may form a partnership for its logistics. Another possibility would be the complete outsourcing of the webshop, if the company does not have and does not want to obtain the necessary know-how to establish its own online store. Like this, the retailer can focus on his core-competencies and rely on the know-how of his partner companies. Partnership can help to establish a new distribution channel, despite the lack of experience in the new business processes or necessary technology.

2.2.2 Range of goods and services

Multichannel retailers may differentiate their channels by the range of offered goods and services. Clearly separated assortments help prevent channel conflict [Webb02]. The differentiation of goods and services could be done over product categories, quality, and packaging. The assortment design decisions which allow differentiation are broadness, depth, personalization, and dynamic of chance of the assortment [HaMa07]. However, the focus of the work at hand lies on companies which offer overlapping ranges of goods. They provide freedom of choice over which channel they buy their desired services and goods to the customers. Wise selection and coordination of overlapping assortments create potential synergies, which are discussed later on.

Not every product is equally suitable for different distribution channels. Customers may have, depending on the product, different requirements regarding the selling-process. Each type of distribution may satisfy these requirements differently. Specific features which aid or obstruct the offer of goods in e-commerce channels are discussed in literature [Hans98]. The suitability of goods should therefore be taken into consideration, regarding the offered range of goods and services in the different channels. At some point, product-specific channel coordination may even permit the generation of additional value for customers, which would not be possible with single channel strategies.

2.2.3 Pricing

In principle, bricks and clicks companies may decide to use the same or different prices for their online and offline branches. In many cases, a consistent pricing-strategy is used for all channels. However, the customer usually has to pay additional fees for some channels. For example shipping costs, which refinance the costly *last mile* of transportation to the customer. From a customer's viewpoint, such additional delivery cost is the price for the convenience of not picking up the goods by themselves, but having it delivered to their home.

The operation of multiple channels offer a wide range of pricing options. Even if the channels operated in a coordinated way and in general share the same prices, additional pricing measures are possible. Special price reductions, bundled pricing, or other actions could promote one channel. Price differentiation may even intensify cooperation of different channels. E-commerce channels offer additional mechanisms for price determination, like online auctions or name-your-own-price-mechanism, which could also be used [Timm98, SpSS04]. Customers typically expect lower prices in single-channel e-commerce settings than bricks and mortar settings [HaSu05]. This drives cyber-enhanced multichannel retails in a sort of dilemma. If they offer cheap prices online, the image of traditional offline stores will suffer due to the price differences. If prices are equal, customers might migrate to cheaper online retailers [BeWi06, p 22].

2.2.4 Communication

Communication strategy should influence the customers' experience of sales channels. Depending on whether the company wants customers to experience multiple channels as integrated or independent, it has several options to design its communication. Basic decisions are the presentation of one shared brand or separate brands, names, company logos, corporate designs, etc. [HaMa07]. In any case, the communication strategy should be coordinated with the other marketing decisions, like the range of goods and services.

2.2.5 Distribution, type of operation

The range of varied interpretations for multichannel retailing ranges from multiple channels, even from the same type of operation, to a strict inclusion of an e-commerce channel in combination with a channel from another type of operation [SK03]. This work is focused on the latter interpretation, dealing with specific properties of the e-commerce channel. The use of e-commerce channels introduces a range of possibilities, especially regarding performance measurement. Typical examples for such settings are traditional bricks and mortar or mail-order companies which where forced to expand their operations by an e-commerce channel.

Lee and Shu propose four models of Internet distribution structures [LeSh05]. The models describe possible evolution paths from a typical three-party situation, where a distributor stands between supplier and customer. The four models are characterized by their labels:

Functional Decomposition In this model, transactions are further carried out by the distributor. Service is expanded by service offerings directly from the supplier of the goods. The service is not a substitute but an expansion of existing service offerings. This model is recommended if it is difficult to sell the product directly over the Internet. Advantages include better information of supplier and customers and a direct contact between those two. Since there is no second transaction channel in this model, channel conflict does not occur [LeSh05].

Cloning Cloning describes the situation when the distributor clones or duplicates his existing functions on the Internet. This is denoted as logical expansion of a distributor's company, since it can utilize its existing processes and knowledge. The firm afterwards operates as multichannel distributor. Experience leveraging, economies of scale, brand name recognition and market expansion are mentioned as the advantages of cloning. Disadvantages are the complexity introduced by channel coordination, new distribution challenges and newly introduced competition and markets. A possible option of this model would be the introduction of a new supplier company as independent legal entity [LeSh05].

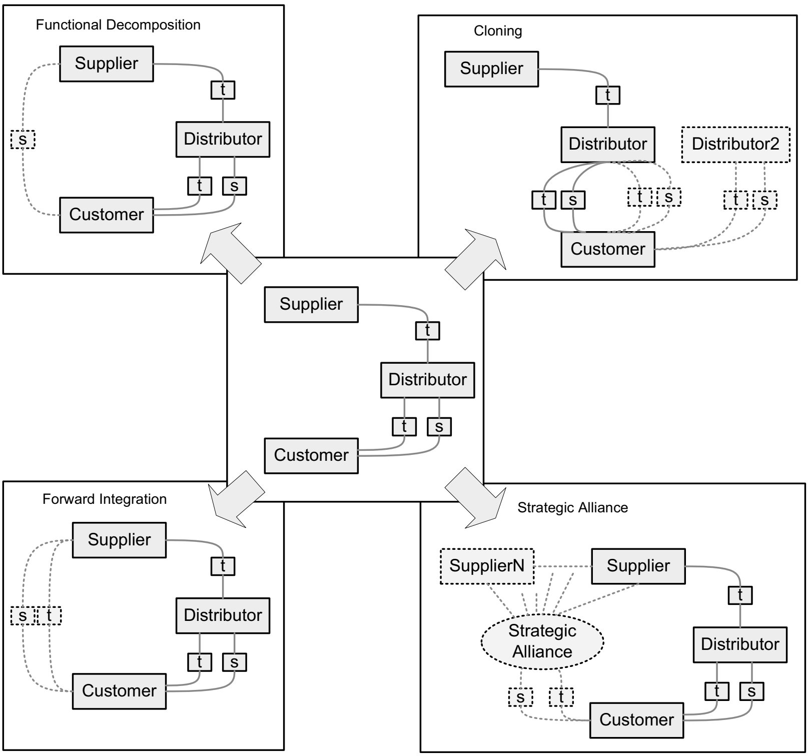

Figure 2.3: Four models of internet-enabled distribution structures [LeSh05]

Forward Integration The model of forward integration describes the situation when the supplier introduces his own direct e-commerce distribution channel. The existing distributor continues his business but is bypassed by the possibility to buy products directly from the supplier. Major advantages of this model are cost savings and better control of distribution. It inherits challenges in the form of initial setup costs and inexperience with distribution functions. A major problem is the occurrence of channel conflicts. Since cannibalization effects may occur, the supplier may also get in conflict with the distributor. This could even result in losing the distributor [LeSh05].

Strategic Alliance Model Strategic Alliance describes the situation which could also be called a kind of "re-dis-intermediation". The supplier forms strategic partnerships with Internet based marketplaces, promoters, other suppliers, etc. This usually displays a new kind of distribution system, which, like in the Forward Integration model, may exist beside the traditional distribution system. This model is recommended for oligopoly markets, where a few players form a strategic partnership. Advantages include cost savings, a greater volume and variety than simple direct selling, and additional advantages of strategic partnerships. As a disadvantage, alliance coordination costs are mentioned [LeSh05].

Figure 2.3 shows a graphic representation of the four described models. Cyber-enhanced retailing in the sense of this work is described by the cloning model. The existing distributor tries to expand his business by the introduction of an e-commerce channel. The already existing functions are cloned and adapted for this new business segment.

2.2.6 Organizational structure

From an organizational viewpoint, multiple channels may be positioned in various forms. The loosest interconnection is distribution across different independent firms, which even may have different owners. Such a structure often occurs when a manufacturer seeks to expand or optimizes his ways of distributions. For example, IBM expanded their business starting in the early 1980s from pure direct selling to 16 indirect channels by the mid 1980s [CeCo90].

Coordination of legal independent distribution channels inherits different challenges than coordination of channels which operate under one legal entity. This work only covers forms of multichannel businesses which operate under one company. Legal and cross-institutional issues are not considered. Even when multiple channels are operated by one company with one single superordinate management instance, the channels may be separated into different departments. The organizational structure of channels depends on the overall organizational structure and, as "structure follows strategy" [Chan62], may be adapted to strategic goals of the multichannel distribution. In organizational structure literature, several forms of differentiation or organizational structures are discussed. Ideal forms of functional and divisional breakdown structures are documented in literature [KaHe96].

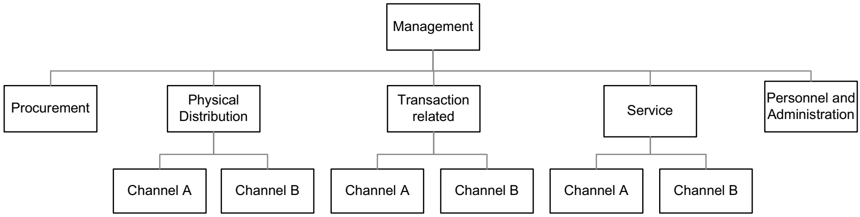

Figure 2.4: Functional breakdown in organizational structure, adapted from [BeSc04]

In a multichannel context, functional breakdown would mean that the different functions of each channel would be split into compartments like Procurement, Logistics, Sales, and Personnel and Administration (cf. [BeSc04]). Overlapping functions of different channels would be organized into the same organizational units. Figure 2.4 shows the organization chart of a simple example structure. In the example sales and logistics are functions of each channel. Nevertheless, they are organized into single departments. Interchannel coordination of the different functions is supported by this structure, while coordination of the different functions of one channel is not.

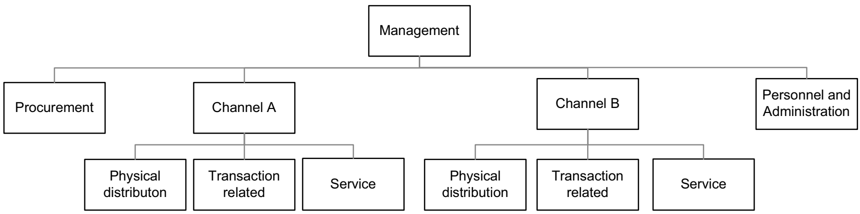

Figure 2.5: Divisional breakdown in organizational structure, adapted from [BeSc04]

A divisional structure would separate each channel into its own unit. Figure 2.5 displays such a divisional structure. The functions logistics and sales are subordinated to each channel unit. Such a design would not provide interchannel coordination support by its organizational structure. To enable coordination, specific positions supporting coordination functions between independent line units, can be established.

Another possibility would be the introduction of other organization forms, breaking single line hierarchic relations, like matrix organizations or linked team structures [KaHe96]. Figure 2.6 displays an example of a matrix organizational structure of a multichannel retailer. The functions physical distribution, service and transaction-related functions are also coordinated by the managers of channel A and channel B.

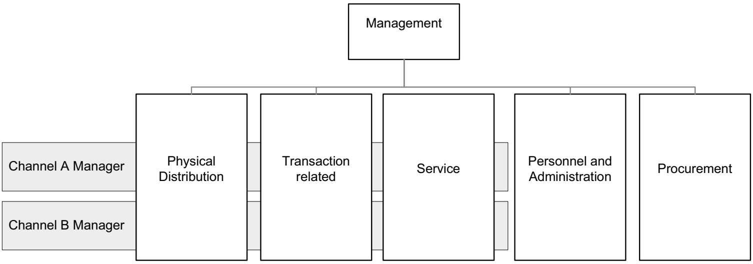

Figure 2.6: Matrix organizational structure, adapted from [BeSc04]

2.2.7 Internal processes

Multichannel retailers have to design their internal processes to suit the channels they operate. Each channel in principle has its own technical features and requirements. It is a strategic decision whether the retailer tries to integrate the processes over different channels or not. Integration offers the chance to establish synergies and easy channel switching for multichannel customers. However, integration may also reduce the flexibility of each channel. Central components of integration of different channels are shared information systems with integrated resource planning and customer relationship management systems.

2.3 Coordination of distribution channels and utilization of synergies

The preceding section describes design criteria for bricks and clicks companies which may lead to different ideal types of multichannel strategies: *focused systems* and *integrated systems*. A third mentioned type, *hybrid systems*, stands for a combination of typical elements of both ideal types [KrWV04, HaMa07]. The following section deals with coordination and synergies of integrated multichannel systems.

In theory, coordination can be both centralized and decentralized. Centralized coordination means that a central unit makes binding decisions. Since this decision unit controls both subunits, it can coordinate the operations of both units, for example sales channels.

Decentralized coordination works without such a decision unit. Decentralized channels need another mechanism to adjust their operations between each other. A decentralized way of coordinating different departments are transfer prices [PfPf04]. Transfer price theory takes a production-oriented view. Departments are described by their production functions and have the goal to maximize their own profit. For every intermediate good or service from another department it has to pay transfer prices. In theory a decentralized company can reach its maximum profit if the transfer prices are set to their optimal value. The problem is to find the optimal value for transfer prices. The optimal transfer price can be calculated by the optimal output for the good. But if the optimal output is known, no transfer price is needed any more, because the optimal allocation is already known. This is known as the "dilemma of pretial control" ("Dilemma der pretialen Lenkung"). If departments are free to determine transfer prices themselves, negotiation skills of their members may influence prices, thus the result would not lead to a global optimum. Since naturally it is not possible to define transfer prices for different mutual services or coordination actions, centralized coordination is assumed in this book. The output of a performance measurement system based on this work will also help to establish coordination decisions at a central point.

Coordination of channels aims at the utilization of synergies. Synergies are a result of cooperation — if one part drops out, the synergy does not exist any more. Shapley showed by his work on "n-person games" that a theoretical value for the contribution of each member of a game exists [Shap53]. It may also be possible to estimate a monetary value for synergy of channel cooperation. However, theory does not provide a solution to spread the value of cooperation between different departments. This makes it practically impossible to calculate a true value for each channel incorporating synergy effects. Synergy effects have to be handled with care by performance measurement systems. If synergy effects have a hidden effect on performance measures, the values may be biased and therefore should not be used to compare different organization units.

When operating a focused design, there is no flow of information and cooperation between the different channels. Therefore the channels act as competitors. Whether inter-company competition is desired or not depends on the specific situation and strategy. There are cases where competition is a valuable tool, in most cases however it will be disturbing the success of bricks and clicks strategies. Theoretical work suggests that coordinated multichannel approaches have numerous advantages. Apart from the ability to attract new customers, to satisfy multichannel customers and the possibility to offer new services, bricks and clicks companies can draw advantage from spillover effects that result in purchases and reduced costs in other channels [StAL02].

Figure 2.7 shows a framework to analyze synergies in bricks and clicks companies. Common capabilities and customers may be established as sources of synergies. *Infrastructure*, which encloses tangible and intangible assets, may be shared by multiple channels. Different channels may share the same business *operations*. Eventually, with the introduction of a new channel, business processes of other channels have to be reengineered to be able to utilize synergies.

Marketing & Sales may be shared to obtain effects in both channels. Common *customers* are also a source of synergy. Positive experience in one channel may lead the customer to switch to the company for other product/channel combinations, too.

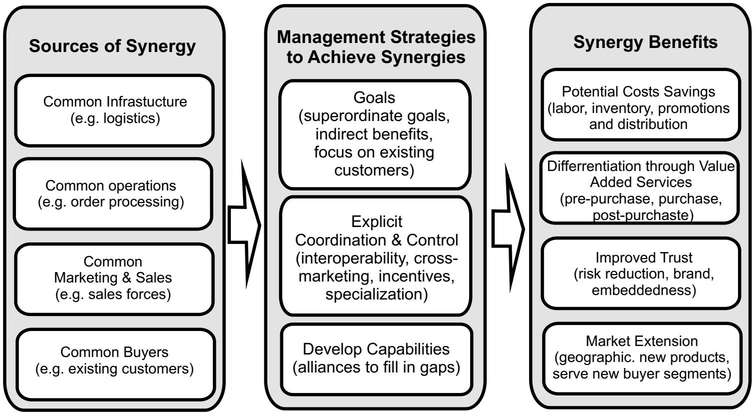

Figure 2.7: Sources, management requirements, and benefits of bricks and clicks synergies [StAL02]

The framework characterizes the important role of management strategies in the utilization of synergy potentials [StAL02]. In order to establish synergies, the full backup of the management is needed. This includes establishing the right *goals*, providing *coordination and control* and developing *capabilities* [Stei04]. At this point, the use of adequate performance measurement systems plays a major role. There are practical cases where the incorporation of indicators of synergy-benefits of one channel into the goals of the management of the other channel have shown success [StAL02].

Other works distinguish between different stages of integration. Distribution channels can be *compatible* with each other, which means that they coexist in harmony [AcBC$^+$05]. This stage primarily aims at improved trust and market extension as benefits. *Integration* in this ontology means that effective cross-channel shopping flows are possible. The activities of the different channels are mutually synchronized and harmonized [AcBC$^+$05]. In this stage, it is also possible to generate value through expanded possibilities of channel integration. *Cross-channel optimization*, the most powerful stage, stands for the utilization of capabilities in one channel, to positively influence the cost structure of other channels [AcBC$^+$05]. The last stage aims at all kinds of benefits described in [StAL02].

The final part of the framework shows different synergy benefits, which are categorized into *cost savings*, *differentiation*, *improved trust*, and *market extension* [StBA01]. The following subsections will explore possible benefits in a similar structure used in the business model analysis in chapter 2.2, adapted from [Hans98, SK03]:

- Vision
- Market definition, legal form and partnerships
- Range of goods and services
- Pricing
- Communication
- Distribution, type of operation
- Organizational structure
- Internal processes

2.3.1 Market definition, legal form and partnerships

To establish synergies, the management of a multichannel retailer has to arrange the right capabilities [Stei04]. Partnerships may be a useful way of establishing capabilities, without investing in their development. A latent danger of partnerships are dependencies on the business partner. On the one hand, the company is not under full control of the process any more. For example, bad quality of the partners' service may have effects on the company's image. On the other hand, dependencies arise from the lock-in effect. Partner-specific investments may explosively raise the switching cost to another partner. However, partnerships also inherit the chance to establish cross-company synergies by a cheap way to establish missing capabilities.

2.3.2 Range of goods and services

A simple way of channel integration is the provision of information about various ranges of goods and services in the other channels. If a specific product is not available through one channel, the channel can at least provide the information, whether the product is available through another channel. This can be the case when its characteristics of a product make it not feasible to sell over a specific channel. Perhaps the product is too bulky to be stored in a local store or is so sense-appealing that it cannot be sucessfully sold in online channels. In such cases, the customer can obtain information and recommendations about the product over one channel and purchase over the other [GuGa00].

In some cases, the range of goods and services can be expanded by the operation of multiple channels. This is the case when the website provides added-value services for customers [GuGa00]. If a product can be enhanced by online services, the company may introduce services for online and offline customers through their online channel. Literature also speaks of the possibility to create *dual channel products and services*, which can only exist when there are at least two different coordinated distribution channels [StBA01].

For selling digitizeable products, the online channel offers the possibility to distribute the product in digital form. This clearly has an impact on the company's multichannel strategy, since the company has to decide whether it offers the same range of goods offline, online in physical form, and online in digital form. In many cases, digitalization is also suitable for new forms of bundled and unbundled goods. This also increases the range of alternatives when selling products which can be distributed in digital and non-digital form. For example, as a form of dual channel product, a music store could offer offline customers, who have already purchased a CD, the possibility to download songs from the same CD for free. So the customers also have the product available in digital form for use in devices like MP3-Players, without having to digitize it themselves. They can also restore the music, in case the CD gets lost, or download it anywhere if they forget to take it with them on holiday. As a benefit for the company with such a system, offline customers would become aware of the online store and be able to build confidence in it, which might draw them to use the webshop and buy music online, too.

2.3.3 Pricing

Pricing allows the utilization of synergies by using different prices in online and offline channels. Promotion activities may, for example, offer discounts on instore goods for customers with online receipts [StAL02]. Such a promotional activity aims at increasing the number of customers in the offline store.

Another pricing strategy which relates to cost synergies rather than to customer maximization, are price incentives aimed to push customers into the more favorable channel. If the company knows the cost of its processes in the different distribution channels, a reasonable strategy is to attract customers to the channel with the lower costs. For example, typical routine transactions may be offloaded to the web. A company could perform such an action if thereby it sees the chance to lower its transaction cost [StAL02]. This trend can be noticed in the banking business where banks try to relocate their daily transactions to the Internet or automated machines, and focus their costly employees on premium and consulting activities.

2.3.4 Communication

Synergies of integrated communication strategies over multiple channels can be achieved by the creation of one common external picture over the different channels, or cross promotion between them. In general, a substantional possibility to obtain synergies in marketing functions is assumed [Madl03]. Different activities in this area may be the creation of additional offline channels and trademarks for promoting the website and creating customer confidence, the promotion of the online shop in local stores and vice-versa, the online maintenance of store brands, integrated promotional campaigns (eg. contests), the usage of the same brand, and a local store locator in the online shop [GuGa00, BaRe01, StBA01, StAL02].

2.3.5 Distribution, type of operation

The design of distribution processes can, as already mentioned, be focused, integrated, or hybrid. The principal idea of integrated distribution is that the customer is able to switch between the distribution channels in every step of the process. Figure 2.8 illustrates this by simple process chains. With an integrated process design, a customer may, for example, get product information from the website, afterwards buy the product in a store, and get product-related services like failure resolvement by the online support system on the website of the company.

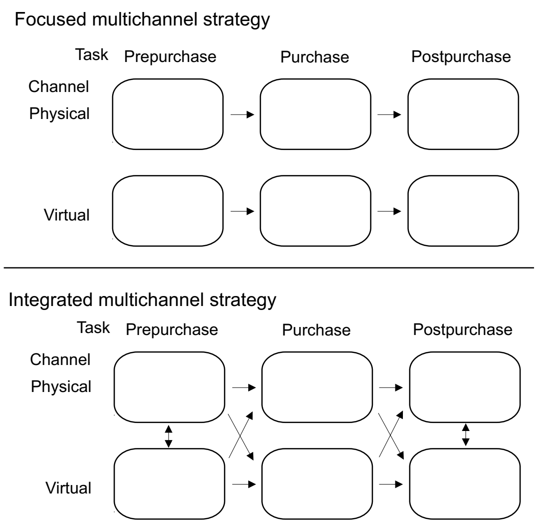

Figure 2.8: Focused and integrated multichannel strategies. Adapted from [StBA02]

To enable such a flow, the processes in each channel have to be made compatible with the processes in the other channel. This can be achieved without taking special requirements of other channels into account. However, to obtain synergetic effects, the adjustment of business processes is feasible [StAL02]. There are several cases in literature where such integrative designs of the business process is documented. These patterns can be distinguished into patterns for the e-commerce channel and patterns for offline stores.

Integrative Patterns for E-Commerce Channels To induce more traffic in local stores, information about the stores can be provided on the website. Often the customer is able to search for the nearest store in his surrounding area. The possibility to check the inventory of local stores online is a common feature. In such cases, customers are able to check the availability of goods or services in the online shop and in the local stores on the website of the company [GuGa00]. A typical scenario would be a customer taking advice from a recommender system in an online shop. Since he does not want to buy online, the system routes the customer to the nearest store, where he can purchase the product [StAL02].

In some cases, online shops and offline stores are even more closely connected. On some e-commerce sites, every customer is assigned to a local store [StAL02]. The customer afterwards is treated as if he was a customer of the local store. So the store is able to operate regional marketing, service and so on. If it is beneficial, the bricks and clicks company may also offer self-pickup as a delivery option. In this case, the customer can purchase a product in the online store, but in order to save delivery cost, he may pick up the goods in the nearest store [StAL02]. This option is also useful for services which cannot be consumed at home, like travels or concert tickets. For such products, an online purchase always results in the consummation of the service at a predefined place.

Another coordinating function of online channels is the provision of additional online services [StAL02]. Customers, having bought a product in a local store, are able to use online after-sales service as well. The Internet allows the implementation of after-sales services, which are not possible in traditional store-based business units. Manufacturers and retailers may provide their customers with direct access to their support databases. Online communities enable customers to exchange information and problem solutions among each other. Such services offer a convenient way of solving product-related problems. The provision of such services may even lead to reduced cost of after-sales services, since the customer is able to solve the problem without engaging an employee in some cases. A coordinated support system for online and offline customers can be seen favorably in any case, since there may be a chance of resolving problems of offline customers without the utilization of service-personnel. The other way around service by call-centers or in-store service may be important for online customers to establish personal contact with the company, which, finally, is important to build trust in the company [TrPF04].

Integrative Patterns for Offline Stores Support of the online distribution process in the pre-purchase and purchase phase in offline stores is connected with the usage of kiosk or handheld devices in the store. For example, in-store kiosks allowing access to items not available in the store, or handhelds providing web-basket functionalities in stores [StAL02].

In the after purchase-phase, a coordinated offline channel could offer services for online customers. A customer is able to return his online purchases in the offline store for example [StAL02].

2.3.6 Organizational structure

An important part of the coordination is the prevention of negative effects like channel conflict. Therefore, for the introduction of new channels, convincing existing channels that new channels work for their benefit, is an important internal measure to actually enable synergies [StAL02]. Depending on the organizational structure, the structure of the new organizational branch has to be designed carefully. As a strategic option, it is possible to outsource great parts of the online store, concentrate on core competencies and nevertheless benefit from synergies [StAL02]. A form of outsourcing may be the formation of alliances which fill important capability gaps [StBA01].

2.3.7 Internal processes

Different channels require different internal processes. To utilize synergies a possible strategy is to make use of the existing infrastructure for the newly established channel as much as possible [StAL02]. This, way existing experience and efficiency can be transferred from one channel to another.

If the established processes are not able to serve multiple channels, and synergies exist, reengineering of business processes is recommended [StAL02]. Beneath these options it is important not to over-integrate the channels. This would destroy their specific flexibility. Leaving space for flexible processes may enable the usage of specific channels' strengths [Sawh01, StBA01]. At the bottom line, the right mix of these options has to be found. Possible alternatives for integrating internal processes are highly dependent on the company and cannot be generalized at this point. A few examples of coordinated internal processes are:

- Same web-interface for customers and employees [GuGa00].
- Shared processes in physical distribution [Madl03].
- Capturing customer data in the store and the web [StAL02].
- Allocation of each web-customer to a specific physical store [StAL02].
- Usage of the expertise of store employees to provide online recommendations [StAL02].
- Usage of online recommender systems to consult local-store customers.
- Single software-application design for virtual and physical channels [StAL02].
- Transfer of work from store employees to online customers [StBA01].
- Usage of shops as local inventory, pickup- or delivery-units [StBA01].

Chapter 3

Performance measurement

Performance measurement is an important function for strategic and operational controlling of a company. It provides a set of tools which allow managers to make better prepared decisions and to transform strategic goals into daily operational actions. The successive chapter uses the following definitions for performance measurement and closely related terms:

- “Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action.”[NeGP95]
- “A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of an action.”[NeGP95]
- “A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions.”[NeGP95]

In the sense of this work, a performance measurement framework is a set of guidelines which describes, the way which a performance measurement system can be designed. Such frameworks usually do not specify in detail which performance measure should be used. They set scopes which types of measures should be integrated and how they should be used to form a satisfactory performance measurement system.

Before the design of a performance measurement system for hybrid multichannel retailing, a well-founded overview over existing performance measurement frameworks and their characteristics is discussed. The goal of such frameworks is to describe the development and usage of financial and non-financial ratios for strategy implementation and controlling. In this section, the most central characteristics of performance measurement systems are elaborated. The characteristics are described in theory and supported by examples from existing frameworks.

The examples are chosen in order to provide an overview over the most popular performance measurement frameworks at the moment.

To compose a useful performance measurement system, measures can be examined by their relations. Such relations can be expressed *logically*, *empirically*, or *hierarchically* [BeWi06]. *Logical relations* between measures can either be founded by their definition or by mathematical equations. The relation between profit margin and fixed cost can be seen as logical, since profit margin is used to cover fixed cost. The relation between return on investment (ROI), earnings and turnover rate can be expressed in a mathematical equation:

$$ROI = Earnings\ as\ percent\ of\ sales * rate$$

Empirical relations are, depending on their randomness, either deterministic or stochastic. Such relations can be observed as typical effects between measures. For example, an increase in customer satisfaction may provoke an increase of customer retention. *Hierarchic relations* are divided into objective-hierarchic and subjective-valued hierarchic relations. Depending on the relations between the different measures, performance measurement systems can be [BeWi06]:

Computational-based in such a way that all used measures stand in a mathematical relation to each other. An example for such system is the Return on Investment (ROI).

Ordered where measures stand in a logical comprehensive relation to each other. It is not necessary that mathematical relations exist, but they can also be empirical relations or known by personal experience.

Goal-oriented which means an enrichment of an ordered system. The measures are structured by goals. An existing goal system is necessary to set up the performance measurement system.

3.1 The evolution of performance measurement systems

The development of performance measurement literature underwent a significant change during the 1990s. Subsequentially it can be split into two phases: traditional and modern performance measurement systems [GhNo96]. Traditional frameworks, proposed during the 1980s, were primarily based on management accounting systems, while modern systems include various other perspectives of organizational performance [GhNo96, KeNe03, LyCr91].

Return On Investment (ROI) is a well-known traditional performance measurement system. It was developed by Du Pont, a multi-national chemicals and health care company [Chan77]. Traditional frameworks usually covered solely financial aspects of organizational performance. Return On Investment splits up one key measure, Return divided by Capital, into the sub-ratios Return on Profit, Capital Turnover, Return, Turnover, etc. The detailed tree of measures and their relation is shown in Figure 3.1. The concept includes the monitoring of all determining factors, which differentiates the concept from simple performance measures. In other words, not only is the return output relevant, but also the detailed way in which the output can be reached.

The calculation of the whole set of measures, and monitoring their development over time, allows a brief but comprising overview over the company's status. Return on Investment can be regarded as the first important performance measurement system. It substantiated most companies' controlling systems until traditional systems were replaced by more recent frameworks, developed after 1990 [Dear69, Chan77, Glei01].

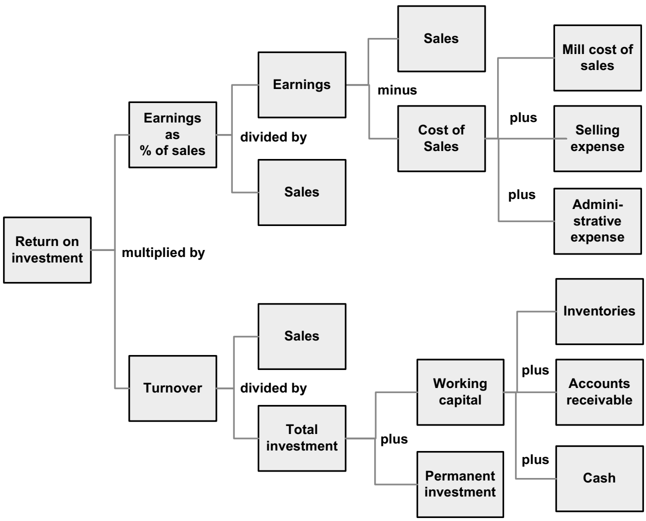

Figure 3.1: Return On Investment framework [Dear69]

Over time, criticism on traditional performance measurement arose from various sides. During the 1970s, managers of American companies tended to risk-aversion and short-term oriented decisions. Hayes and Abernathy traced this behavior back to strong reliance on short-term financial measures at that time [HaAb80]. Richardson and Gordon discussed performance measurement requirements for different phases of the product life-cycle. They argue that evaluation of managers on the basis of cost minimization and productivity is inappropriate for products in early phases, because it inhibits innovations [RiGo80]. Further criticism included the time-lag of financial measures, the missing relation to strategy, the difficulty to quantify some relevant facts into value, the existence of conflicts with continuous improvement concepts and the missing attention to customer requirements and management techniques [GhNo96].

As a consequence, the usage of other dimensions beside financial measures in performance measurement was proposed. Other perspectives like competitiveness, quality, flexibility, resource utilization, innovation, customer orientation, time, continuous improvement, etc. were discussed as desirable targets for performance measurement [BrFJ+91, GhNo96]. The introduction of qualitative measures is stipulated for retailing, too [Witt91]. In 1992 Kaplan and Norton introduced a concept called Balanced Scorecard [KaNo92]. The Balanced Scorecard is regarded as the most popular performance measurement framework at the moment [Glei01]. Its characteristics can be seen as seminal in various ways and will be, among other frameworks, discussed in the following subchapters, dealing with functions and characteristics of performance measurement frameworks.

3.2 Requirements in modern performance measurement frameworks

In this section, modern performance measurement systems will be outlined. This will be done by discussing their basic characteristics. Lynch and Cross describe three basic conclusions, what measures, in their words “yardsticks”, should do [LyCr91]:

- Measures must link operations to strategic goals.
- The system has to integrate financial and non-financial information.
- The real value lies in the ability to focus all business units activities on customer requirements.

These conclusions summarize basic characteristics of modern performance measurement. The first item corresponds to the connection beween strategic and operational planning. Planning is strongly dependent on the performance measurement system.

Items two and three emphasize the necessity of considering different perspectives when measuring business success. The performance measurement system has to include more than financial information. It should cover the whole company and must not overlook any parts. Both latter statements are consistent with the requirements emphasized by criticism on performance measurement systems focused on the financial perspective solely. Adapting and expanding these three statements, the basic requirements in modern performance measurement systems are covered in the following discussion which will be broken down into following requirements:

- Linkage of operations and strategic goals
- Provision of a succinct overview
- Multi-dimensionality and provision of a balanced picture
- Integration of different hierarchical levels

While the underlying requirements are discussed in this chapter, the following chapter will be about examples of modern performance measurement frameworks. Each example addresses these requirements in its own way, which will also be discussed with the example frameworks in the following chapter.

3.2.1 Linking operations and strategic goals

The first item of Lynch and Cross' statements [LyCr91] addresses a central feature of performance measurement systems. Performance measures have to be derived from the companies [Glob85]. Performance measurement includes a planning and feedback process for strategic and operational goals [Glei01]. Planning of goals typically will be done in terms of the used performance measures. The design of the performance measurement system is arranged in such a way that it enables a feedback process. Managers and their subordinates agree on goals for the specific measures. Performance measurement afterwards provides the comparison between target values and achieved values. The system behaves like a cybernetic closed loop, where "corrective" feedback is shown to improve performance significantly [WaLu94].

It is assumed that providing employees with the actual performance numbers in comparison to the agreed goals will lead to an increased effort to reach the goals if there is a gap between targeted and actual performance. This effect can further be fostered by the introduction of incentive systems, where employees can achieve monetary rewards by reaching their agreed goals. An important factor for the functioning of such a system is the appropriate selection of measures for which the goals are defined. The employee must have the ability to influence the achievement of the objectives, otherwise such an incentive system will not show the desired effects.

Setting up a performance measurement system includes the selection and documentation of instruments and measures, respectively. Whereas many publications on performance measurement focus on the kind of measures which should be included in such a system, only few indications on the design process of the system can be found [KeNe03]. Neely et al. show a process-based approach to a performance measurement design [Neel00]. In such models, the need for regular re-evaluation and re-alignment with the strategic goals is explicitly expressed in the framework [WiFa91].

3.2.2 Provision of a succinct overview of the organization's performance

Performance measurement systems should provide a succinct overview of the business unit's performance [KeNe02]. This requirement refers to an adequate selection of performance measures. One can compare a performance measurement system with an airplane cockpit [KaNo92]. Too little information could lead to a crash, but too many measures are also undesirable. Too much information would increase complexity and make the system impracticable and inefficient. The key is to provide necessary information at the right place.

Performance measurement frameworks typically do not provide a specific selection of performance measures, but rather describe the organization. Recommendations of different types of measures are given or the process of the selection-process is outlined. Several reasons therefor can be identified. Firstly, every company has its own information needs. The frameworks are designed in such a way that companies implementing them can identify and satisfy them. Secondly, the discussed frameworks are designed for a broad range of companies and businesses. A specific choice of measures can only be made in context of a certain business and would restrict the application area of the framework.

The model developed in this work differs in this respect because it is designed for a specific type of business. Therefore, assumptions arising from the context can be incorporated into the model. It is possible to make more precise specifications and recommendations than when using universal frameworks.

3.2.3 Multi-dimensionality and provision of a balanced picture

One point of criticism of traditional performance measurement systems is the focus on financial measures, which was already mentioned before. Financial indices are lagging measures and therefore foster past-oriented action, but not future-oriented thinking. Particularly in highly dynamic environments, such an approach is not appropriate. Pure financial measures are also missing reference to strategic and operational planning. Therefore modern performance measurement systems take into account more than one perspective of organizational performance. Different suggested perspectives are operating efficiency, customer satisfaction, employee performance, innovation and change, community and environmental issues [LiSc96].

The claim for a balanced picture is strongly interrelated with the requirement of multiple perspectives. This means that not only more than one perspective should be considered, but the whole set of measures must be weighted in a balanced manner. Therefore all key performance measures get the necessary attention. This can either be done by formula-driven pre-assignment of weights or by subjective judgement in the specific cases [ItLM03, Meye02]. An important argument for the right balance in such a system is intended or unintended manipulation. If an incentive system is linked to the performance measurement system and the weight lies on one specific measure, there is the danger that the system will get played [Meye02]. Employees start to focus on the dominant measure, because their remuneration depends on it. Actions are taken to improve this measure, regardless of the positive effects on the whole performance of the organization. This often leads to a loss of significance of that measure. The result are cosmetic effects which bias the system. For example bonuses which are solely based on financial performance foster short-term profitable decisions at the cost of long-run performance [ItLM03].

3.2.4 Integration of different hierarchical levels

Performance measurement systems have to deal with different hierarchical levels in organizations. Some measures are most interesting for managers or executives, but are not useful for positions dealing with operating tasks. Other measures are suitable for employees handling specific functions, but cannot provide a comprehensive picture for the management. A performance measurement framework has to take this into account and provide the necessary information where it is needed. Therefore, such systems provide a different set of measures at the specific areas and departments. The selection of performance measures should comprise involved people [Glob85], thus, also employees who are judged by these later on. The performance measure in each level has to be under the control of the unit [Glob85]. It makes no sense to evaluate an organizational unit by a measure which cannot be influenced by the unit's performance.

Usually the implemented measures are connected in such a way that low level measures can be aggregated to corresponding measures of higher level. At least the measures of the different levels should be related in a way that every measure is represented in the measure-sets of other levels, too.

Framework	*Authors*	*Reference*
Balanced Scorecard (BSC)	Kaplan and Norton	[KaNo92]
Performance Prism	Neely	[NeAK02]
Performance Pyramid	Cross and Lynch	[CrLy88]
Productivity Measurement and Enhancement System (ProMES)	Kleingeld	[Klei94]

Table 3.1: Selected performance measurement frameworks

The hierarchical design of performance measurement systems can be noticeably observed at the Performance Pyramid Framework. The authors tried to address critics of traditional systems regarding misleading information for strategy implementation, isolated dimensions, lack of internal and external customers and time-lag of bottom line measures [CrLy88].

3.3 State of the art of performance measurement frameworks

To underpin the mentioned requirements in performance measurement frameworks, the discussion is facilitated by selected examples from literature. Table 3.1 lists the chosen frameworks and points to their reference in literature. The assortment of frameworks contemporaneously represents modern performance measurement frameworks at this time [Glei01].

The following section gives an overview over the selected performance measurement frameworks. They are discussed in the light of the requirements from chapter 3.2.

3.3.1 Balanced Scorecard

The Balanced Scorecard framework is referred to as the most important performance measurement concept at the moment [Glei01]. The scorecard is based on four perspectives. Kaplan and Norton recommend the four initial dimensions *financial perspective*, *internal business perspective*, *innovation and learning perspective*, and *customer perspective* [KaNo92]. These factors are regarded as recommendations and may be changed when implementing a Balanced Scorecard in a company. The four dimensions of the original framework are shown in Figure 3.2. The distinction into different perspectives assures that not only financial measures (lagging indicators), but also leading indicators are included into the performance measurement system. For planning and controlling organizational performance the focus lies on the leading indicators. These should also reflect the strategic direction of the company [Glei01]. Soon after the introduction of the concept its implementation in companies was documented and published in a number of cases [KaNo93].

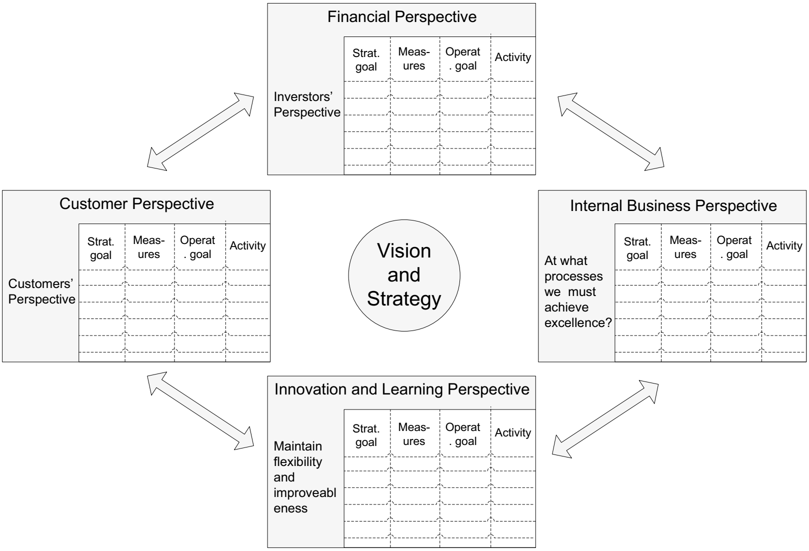

Figure 3.2: Balanced Scorecard [KaNo92]

The requirement of *linkage of operations and strategic goals* is summarized by Kaplan and Norton the following way: "The scorecard puts strategy and vision, not control at the center. It establishes goals but assumes that people will adopt whatever behaviors and take whatever actions are necessary to arrive those goals."[KaNo92] The scorecard ought to be designed to reflect the strategic goals of a business unit in a set of performance measures. The design facilitates the translation of strategic goals into target values of the performance measures included into the scorecard. The target values are communicated via the scorecard. Such values can be understood as target objectives in the sense of management by objectives (MBO). In the end, the responsible employee has to translate the target values into operations, whereby the primarily claimed requirement is satisfied. There are several recommended procedure models for implementation of the Balanced Scorecard [Hü04]. Kaplan and Norton recommend following steps [Glei01, Hü04]:

1. Translating the Vision
2. Communication and Linking
3. Business Planning
4. Feedback and Learning

Finally, the articulation of a connection between the goals via Strategy Maps is described in another publication in order to aid the realization of the strategic goals[KaNo00]. In this way, the measures are linked together across the different perspectives. The relations between the perspectives become clear. Typically linked chains start by leading indicators and end in the financial perspective, where the selected measures show whether a chosen strategy is successful in financial terms or not. Strategy maps also help the management to detect gaps in their strategic planning and performance measurement [KaNo00].

Implementations of the Balanced Scorecard are intended to *provide a succinct overview* over the business unit's performance. Due to the leading thought of customizing, the concept does not define a fixed number of perspectives and measures. It is recommended not to use more than maximal five perspectives and seven measures per perspective, otherwise the system would get too complex [WeSc00, Horv01, Deki03] in [Hü04].

Multi-dimensionality and provision of a balanced picture could be called the basic design features of the concept. The division into different perspectives arose from the necessity of including different dimensions beside the financial performance. The name of the concept, evolved from "Corporate Scorecard" to "Balanced Scorecard" [Glei01], indicates the underlying idea. The four recommended perspectives were chosen to obtain a balanced picture. This implies an equilibrium of financial and operational, internal and external, and leading and lagging indicators [KaNo92, Hü04]. Nevertheless, an overweight in the financial perspective is assumed in practice [Ehrm03].

The *integration of different hierarchical levels* is not explicitly stated in the framework design. The realization of this requirement happens rather implicitly. An integration of different hierarchical levels follows the process models for the introduction of the performance measurement system. Different tasks during the process are designated to different hierarchical levels in the business unit. The concept also allows designing specific scorecards for every hierarchic level. In that case, the integration of the scorecards at different levels has to be granted. The perspectives and strategic goals remain the same at every level. Just the representation by a performance measure may vary at the different stages.

3.3.2 Performance Prism

The Performance Prism framework is a concept which mainly provides a procedure model for the construction of a performance measurement system. The selection of performance measures is actively included into the framework. In the course of the process, relevant stakeholders are identified and the performance measurement system is built around them [KeNe02]. More precisely, the pattern is described by five basic steps where the following perspectives on performance are identified [NeAK02]:

Stakeholder satisfaction Who are the key stakeholders and what do they want?

Strategies Which strategies can satisfy our stakeholders' needs?

Processes What processes do we need to execute these strategies?

Capabilities What capabilities do we need to be able to conduct the processes?

Stakeholder contribution What services do we need from our stakeholders?

The process starts with the identification of important stakeholders. This is one step ahead in comparison to other frameworks, where the upper end often begins with strategy formulation or assuming a pre-given strategy. As a next step, strategies are formulated to satisfy the demand of the already identified stakeholders. The strategies provide the outline for planning the business processes. The realization of the planned processes requires a set of capabilities, which express the resource allocation. Closing the loop, the last step refers to the stakeholders again. They have to provide the necessary resources to build the required capabilities. A graphical representation of the Performance Prism framework is shown in Figure 3.3.

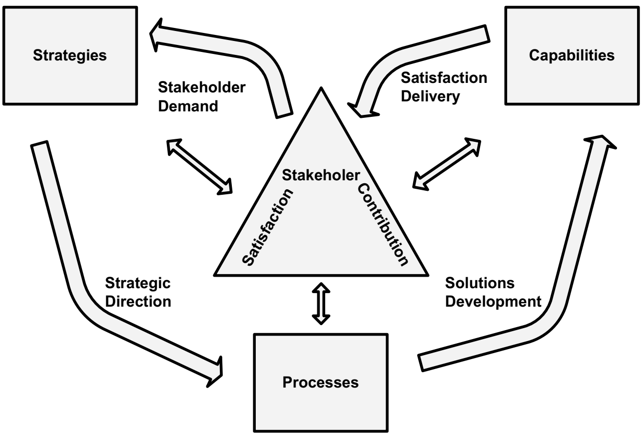

Figure 3.3: Performance Prism framework [NeAK02]

The Performance Prism framework supports the development of a strategy, whereas many other frameworks impose an already existing strategic direction. The aspired *linkage of operations and strategic goals* arises from the endogenous formulation of strategies and planning of processes derived from them.

The framework's design in principle leads to the *provision of a succinct overview*. By selecting only the measures which are necessary to monitor and control the identified processes, as well as capabilities and stakeholder relations, all necessary fields of interest are covered. The selection is complete insofar that the introduction of more measures would only lead to an increased overhead without contribution to the selected goals. There is no maximum number of measures which could be included in the system. Thus the framework offers no prevention of adding too much complexity to the system.

Multi-dimensionality and provision of a balanced picture are reached by the arrangement of the performance measurement system around various stakeholder groups. A stakeholder group *Investors*, would call for finance measures, while the group *Customers* would lead to the incorporation of quality measures for instance. The flexible incorporation of other stakeholder groups allows the integration of factors, which in the design of other frameworks, eg. the Balanced Scorecard, are left out [NeAC01]. If all important stakeholder groups are identified and treated with the right importance, the system also encourages balance between the imposed perspectives.

The Performance Prism framework does not directly address the issue of *integration of different hierarchical levels*. Since the concept leaves broad open space regarding the design of the specific elements, a hierarchical structure may be established in the implementation of the points in detail.

To conclude this chapter it has to be said that the Performance Prism concept did not achieve much attention from theoreticians or practitioners. The framework does not provide a particular design scheme for performance measurement systems, but a process model lying beyond the design of the system. Therefore the Performance Prism framework may also be used in combination with other frameworks, delivering a more specified design of the final structure of measurement instruments. Despite its negligible role, the concept was accomodated in this work, because a deviant approach to other frameworks is possible. No similar ideas, eg. the inclusion of stakeholder groups, was found in other surveyed concepts.

3.3.3 Performance Pyramid

The design of the Performance Pyramid is strictly hierarchical. It maps the information flow in form of objectives, given top-down from management to business units, operating systems and departments and work centers, and a flow of measures bottom-up, thus in the other direction. The authors describe operational measures, which are located on the bottom of the pyramid and function as the foundation of the system. Corrective action and continuous improvement at this level shall allow for good results in higher level measures [CrLy88]. The concept distinguishes between external effectiveness and internal efficiency to address the criticized lack of customer considerations and to cover the required multi-dimensionality. A graphical representation of the concept is given in Figure 3.4.

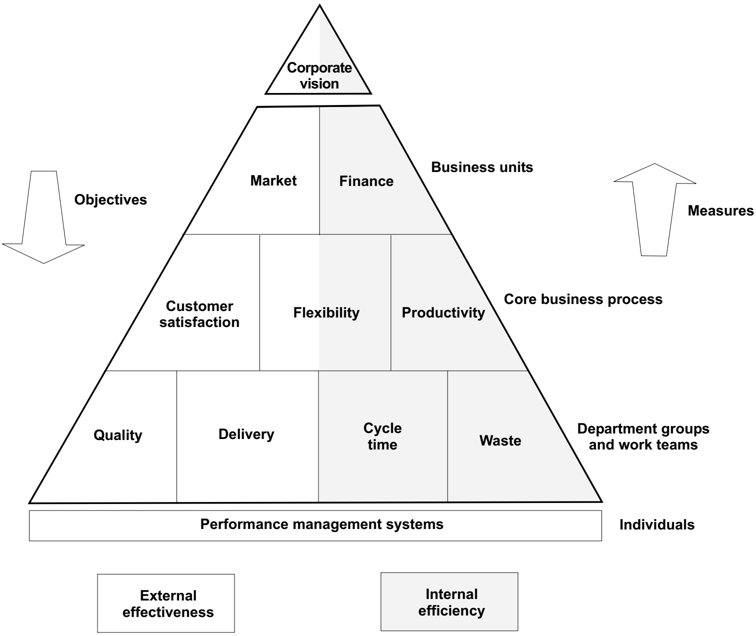

Figure 3.4: Performance Pyramid framework [LyCr91]

Regarding *linkage of operations and strategic goals* the concept includes considerations about the link to goal-setting processes. The framework describes the planning and goal-setting process by a down-flow of objectives and an up-flow of measures between the layers. The objectives of each layer, except the layer of department and work centers must be formulated in a way that they can be broken down into objectives of the layer beneath. The concept includes several loops of comparison, adjustment and evaluation of goals [LyCr91]. Figure 3.5 shows the loops, spanning hierarchical levels. Loop 1 performes a plan-do-check-act cycle for non-financial measures. The other loops include financial measures, too. The loop-model includes dynamic considerations. While Loop 1 is performed almost instantly, Loop 4 has the greatest time-lag and is performed with the lowest frequency [LyCr91]. The goal stipulation should be done in cooperation between the person owning the responsibility for the domain and the controlling and finance department [Glei01].

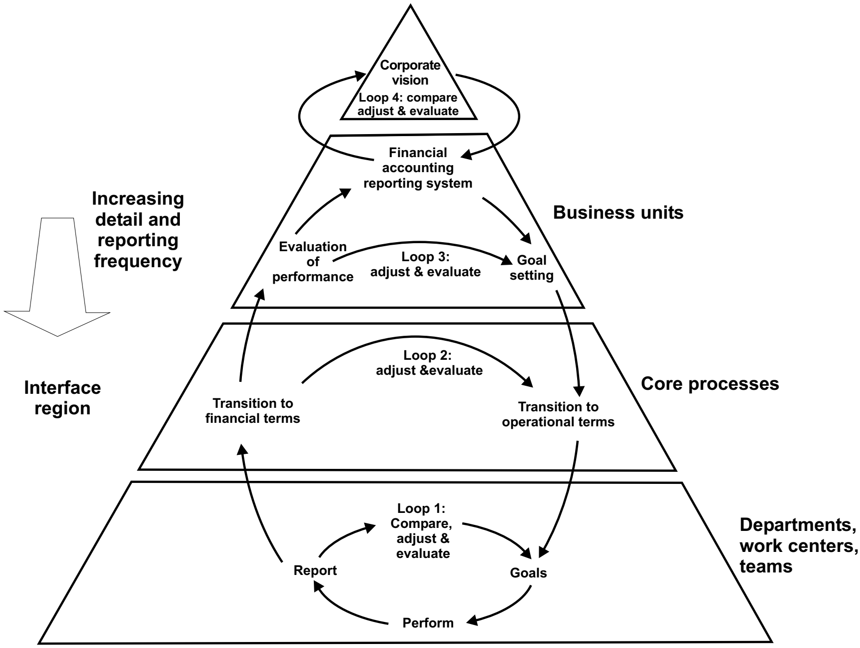

Figure 3.5: Performance loops [LyCr91]

The Performance Pyramid framework introduces *multi-dimensionality* by splitting the framework into external effectiveness and internal efficiency. This approach does not provide such a comprehensive look into different business processes like other frameworks. At least the consideration of non-financial measures is guaranteed by the market viewpoint [LyCr91]. Since the framework outlines the areas of the included measures, a *balanced picture* ought to be reached by the selection of the measures in the concept.

The framework addresses the requirement of *provision of a succinct overview* by only including measures which are comprehensible and influenceable by the person in charge [Glei01]. The framework recommends specific measures for each hierarchic level of the company. Every position should get the "right information at the right time" to fulfill its duties [LyCr91].

The performance pyramid framework is designed strictly hierarchically, thus focusing on the *integration of different hierarchical levels*. It is split into business units, business operating systems, as well as departments and work centers. They are integrated by the development of related measures for each level. Comprehending the dynamic aspects of the framework, the levels take part in different control loops, monitoring and influencing performance at different levers of control.

3.3.4 Productivity Measurement and Enhancement System (ProMES)

The Productivity Measurement and Enhancement System (ProMES) concept was designed in cooperation between the Technical University Einhoven and companies in the service business [Klei94]. Basic design targets were the incorporation of goals, measurement of achievement, and the integration and transformation of feedback [Glei01]. The ProMES framework basically provides (a) a three steps recommendation for the development of measures and (b) the design of the performance measurement feedback cycle. The development of performance measures is done by the following steps [Klei94]:

1. Identification of products
2. Development of indicators for every product
3. Establishment of contingencies for the indicators

The major part of the work is dedicated to the design of the feedback processes. The feedback cycle is split into personnel and organizational components. These are represented by the Human Resource Cycle concept (Figure 3.6) and the High Performance Cycle concept (figure

3.7). The aim of the human resource cycle is the provision of successful personnel management in the long term. The personnel cycle also includes personnel actions like rewards as well as training and development.

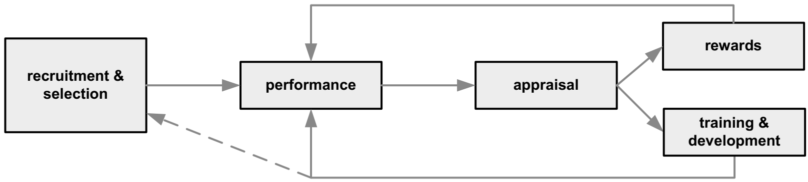

Figure 3.6: Human resource cycle [FoTD84] adapted by [Klei94]

The high performance cycle reflects performance as the achievement of goals. It illustrates the importance of goal setting and feedback in performance measurement [Klei94].

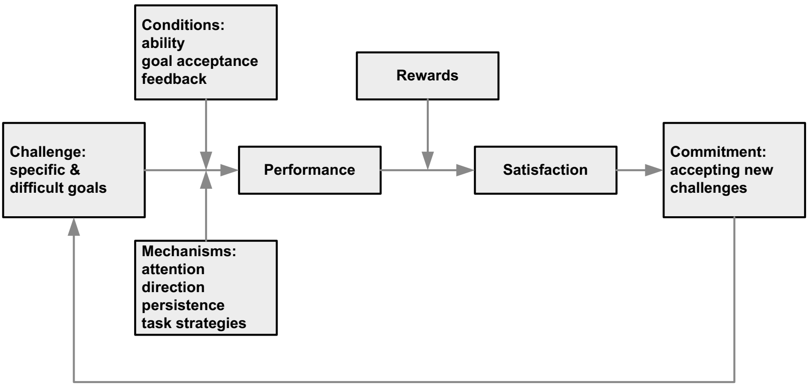

Figure 3.7: High performance cycle [LoSL86] adapted by [Klei94]

ProMES does not directly address the *linkage of operations and strategic goals*, *multi–dimensionality and provision of a balanced picture*, and the *provision of a succinct overview* (cf. [Glei01]). The concept just provides a basic outline for the design of the measurement system itself. The focus lies on the feeback cycle. The *integration of different hierarchical levels* happens again by the introduction of feedback cycles, but is not explicitly covered by the design of the measurement system itself.

3.4 Success of e-commerce companies

When looking at typical recommendations for e-commerce strategies, three different stages can be identified. During the 1980s, the predominant opinion in literature about information systems was that they had to be regarded as strategic weapons that could create competitive advantage. Later on, when e-commerce over the Internet won ground, literature shared the common enthusiasm about e-business. The Internet was seen as a completely different market with its own rules demanding completely new strategies. The main strategic focus often was not on revenues but on future potential. E-commerce companies built up customer stocks on shareholders' capital, not worrying about revenue at that time. After the stock market crash in the year 2000, often called the burst of the Dot-Com-Bubble, the view changed. E-commerce is now seen not as radically different from other channels as before. The valuation of companies which sell over the Internet is also based on its revenue generation now [PiFS04].

A major mistake made by many dot-com companies that failed was a fundamental misunderstanding of some economic laws in conjunction with e-commerce. *Network effects*, *First-mover-wins* and *Winner-takes-all* are principles which to a certain extent are true for e-commerce companies. However, many companies made a mistake by taking them for granted without questioning the prerequisites for these effects [Lieb02]. *Network effects* describe the economic property of a good to increase usefulness for each user of the good, when the number of people using the same good rises. This is true for some products or businesses, but not for all in the e-economy, like often falsely assumed [Lieb02]. *First-mover-wins* and *Winner-takes-all* only take place when economies of scale, network effects and lock-in effects occur, but just these "strategies" led to focus companies solely on growth and customer-gain [WiOS03], disregarding the balance of their strategic goals which would have been claimed by performance measurement principles.

Performance measurement research originated ideas and success factors for e-commerce companies as well. Success factors are designated areas where satisfactory operations ensure successful competitive performance for the organization [Rock79]. At least they have significant influence on success [GeHe05]. Success itself is recognized as the achievement of goals [WiOS03]. Goals can be distinguished into modal and financial goals, whereas modal goals primarily should ensure the achievement of the financial goals [Homb95] cited in [WiOS03].

Table 3.2 gives an outline over factors which were identified as success factors for e-commerce. Empirical evidence has been found that e-commerce companies themselves perceive these success factors as important [PiHM06].. These factors can be understood as superordinated factors. To work with these factors they have to be operationalized into performance measures. The selected factors are firstly listed in tabular form and are discussed in the following pages.

Finance and transaction measures Before modern performance measurement frameworks were introduced, *finance measures* constituted the main part of success measurement. In mod-

Success factor	*References*
Finance and transaction measures	[KaNo92] [Wilk02] [BeWi06]
Customer satisfaction and behavior	[DeMc03] [DeMc04]
System and content quality	[DeMc03] [Niel00] [Palm02]
After-sales-service quality	[BaKW$^+$01] [PaZB85]
Trust and security	[ToDh02] [Shne00]
Strategy	[Part99] [LiCh04]

Table 3.2: Success factors for e-commerce companies. Adapted from [PiHM06].

ern performance measurement, financial measures also play an important role. Finance goals are the ultimate goal of success for most companies. Kaplan Norton therefore included a finance perspective in their framework [KaNo92]. Consequently, a finance perspective can also be found in e-commerce specific adoptions of the Balanced Scorecard [Wilk02]. Wilke categorizes finance measures into three categorizes, super-ordinate success measures, increase of turnover and cost-reductions. However it is not only about the maximization of financial indicators. Ratios, indicating the balance between different accounts, also play an important role. In case of multichannel retailers the proportion between turnover generated by online channels and turnover generated by offline channels is relevant to the company. Beside compliance with the company's strategic position, it is desirable to reach a distribution where operations run efficiently [Wilk02]. There is a huge number of measures for financial performance. A set of examples for financial performance measures is given:

- Turnover [Witt91]
- Profit ratio [BeWi06]
- Cost to sales ratio [BeWi06]
- Profit margin [BeWi06, Wilk02]
- Direct product rentability [Witt91]
- EBIT [BeWi06]
- Cash-flow [Wilk02]
- Return on Investment [Wilk02]
- Liquidity [BeWi06]

The selection of performance measures is chosen exemplary and without further derivation, therefore no claims regarding comprehensiveness and adequacy in an e-commerce context are made.

Transaction measures reflect numbers and size of conducted customer transactions. Customer transactions in e-commerce channels run different types of processes than in traditional channels. Website controlling also delivers other transaction performance measures than in other distribution channels. Transaction measures therefore receive different treatment in different channels. They allow the investigation of the structure of customer transactions. The structure of transactions should be aligned with the underlying business processes. A mismatch would bear negative impacts on cost, customer perception, and finally, the company's performance itself. Transaction measures can be found in e-commerce specific success models [Wilk02]. A set of typical transaction measures is listed below.

- Number of transactions
- Turnover per transaction
- Products per transaction
- Margin per transaction

Customer satisfaction and behavior An important role for the success of e-commerce systems is awarded to *customer satisfaction and behavior*. In the case of e-commerce, customer satisfaction can be split into two dimensions: customer satisfaction with the acquired product, as well as satisfaction with the process and circumstances of buying the product. Since the channel primarily influences the latter, focus lies on the satisfaction of the process of buying. In the case of e-commerce, this concerns the satisfaction with the e-commerce system and the behavior when using the system.

Customer satisfaction is known to have a direct influence on the intention to use an e-commerce system, and in further consequence, on the customers' observable behavior and usage of the system [DeMc03]. Observable customer behavior can be measured by analysis of click-streams in the e-commerce system. It is possible to detect typical paths users of the systems choose to fulfill certain types of tasks or complete transactions. Knowledge about such paths in turn may be used to improve the quality of the e-commerce system, which itself is closely related to customer satisfaction. In general, an influence of system quality, information quality, and service quality is evident in user satisfaction, and the intention to use is evident in user behavior [DeMc03] Figure 3.8 shows the empirical verified Model of Information Systems Success.

Thus, the e-commerce system itself may be a reason of using or not using the e-commerce channel of a company. In a multichannel context, this may mean that the customer ends up using the stationary channel or not buying the product at all. Consequently, if the customer desires a

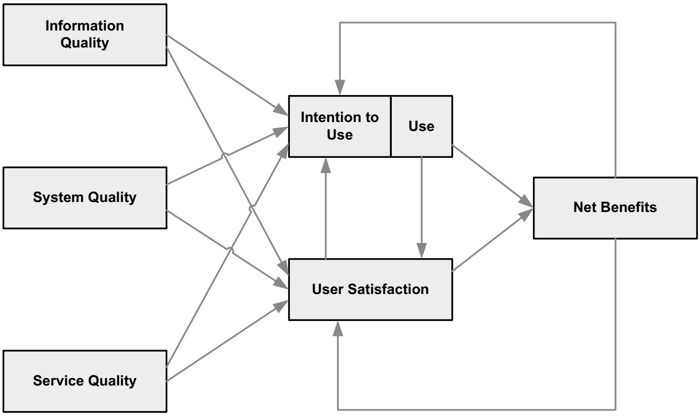

Figure 3.8: DeLone and McLean Model of Information Systems Success [DeMc03, DeMc04]

multichannel setting it may also be a reason to switch to another (multichannel) company where he can find a suitable system.

Suggested performance measures for *customer satisfaction and behavior* are:

- Customer satisfaction [DeMc04]
- Conversion from visitors to one-time customers [TeBe03]
- Conversion from one-time customers to regular customers [TeBe03]
- Customer complaints

System and content quality The Model of Information Systems Success reveals that *system quality* and *content quality* (in their terms information quality) are positively influencing customer intention and satisfaction [DeMc03]. Navigation, response time, credibility and content are essential design principles for web design [Niel00]. Based on these principals, five factors – low download delay, comfortable navigation, high interactivity, high responsiveness and high content quality – were identified as positive influences toward the success of a website [Palm02]. While the download delay may be measured automatically, the other items relay on user juries. Besides these subjective impressions from users, other objectively measureable factors describing the quality of a website can be measured [PiTP06]. The W3C (World Wide Web Consortium, http://www.w3c.org) provides tools measuring compliance of a website with web and accessibility standards which are also quality criteria [KiLH^{+}02].

Suggested performance measures for system quality are:

- Number of visitors returning [RaBa00]
- Speed (response time) [RaBa00, PiTP06]
- Navigation (arrangement, site map, search function) [RaBa00, Palm02, PiTP06]
- Interactivity [Palm02]
- Responsiveness [Palm02]
- Compliance with web standards [PiTP06]
- Accessibility [PiTP06]
- Availability time
- Complaints about the website
- Number of broken links [RaBa00]

Content quality refers to the information presented on the e-commerce website. The content of a website can be classified by a number of attributes which follow three underlying factors: Entertainment and Design aspects, Information and Individualization [TrPi05]. Suggested performance measures for content quality are:

- Effectiveness of content [RaBa00]
- Amount of information
- Variety of information
- Correctness of information
- Timeliness of information
- Incoming requests because of missing information

When measuring the influence of *system and content quality* on the success of a website, the success of a website also has to be operationalized. Exploring the success of an e-commerce channel, the success of the website may also serve as performance measure. Success of a website can be measured by [Palm02]:

- User satisfaction
- Likelihood of return
- Frequency of use

After-sales service quality While system and content quality refers to the quality of the transaction, *service quality* in the sense of this work relates to the quality of after-sales service like support and warranty. The term “service quality” has to be used with caution, since in information systems, service quality often refers to software services, which would fall into the category “system quality” in this work. In this work, the term is used to describe the quality of product-related services which occur in the after-sales phase. The e-commerce channel enables a new kind of after-sales services like online databases and online communities, where people can help one another, as well as other interactive ways which allow customers to help themselves. The few companies already using this high potential of online after-sales services have experienced improvements in financial performance, online revenue, procurement and customer acquisition [BaKW$^+$01]. Suggested performance measures for after-sales service quality are:

- Perceived service quality [PaZB85]
- Positively handled requests
- Customers’ participation in online communities
- Fraction of online service requests by total service requests [RaBa00]

Trust and security In the context of e-commerce, *trust and security* suddenly get a completely new significance. The loss of personal contact makes trust a central factor in the customer’s buying decision. The customer usually has to give away personal information, including highly sensitive information like credit-card numbers, to complete the transaction. The customer is vulnerable to experience two types of trust violations, namely the loss of money and the loss of privacy [FrKH00]. Empirical findings revealed that a lack of perceived web security may overshadow other factors which otherwise would positively influence the decision to buy a product online [SaPP$^+$01]. Therefore Internet vendor trust and concerns about online payment are two major factors in the objectives that influence online purchase [ToDh02].

A single company may not have the power to change the customers’ trust in the web, but it has to foster trust in the own company or brand, as well as the security of the customers’ privacy and money when doing transactions. The construct of trust is complex enough to fill dozens of doctoral dissertations in sociology, political science and information systems [Shne00]. Consequently, it is not easily ascertainable and measureable. As a starting point for the design of e-commerce, two principles are suggested: firstly, the company should ensure trust by disclosure of patterns of past performance, provision of references, certifications, and easily findable, comprehensible and enforceable policies. Secondly, responsibility should be clarified by guarantees and the support of dispute resolution [Shne00]. Trust also stands in relation with system and content quality of the e-commerce system. Trust may further be transferable between the traditional and the e-commerce channels in multichannel settings. One suggested way to build trust among customers is a reputation management system [Kese03]. Suggested performance measures for trust and security are:

- Customers' trust in the company/brand
- Users' trust in the security of the website
- Customers' concerns about online payment
- Provided references and certifications
- Utilization of the reputation management system [Kese03]
- Used technical security standards
- Registered fraughts
- Transaction abortions at payment stage
- Transaction abortions because of security problems
- Transfer of trust between channels

Strategy In strategy literature two fundamental factors determining profitability are identified: *Industry structure*, determining the profitability of the average competitor, and sustainable *competitive advantage*, allowing a company to outperform the others [Port01]. Usually, a company is not able to change the industry structure itself, therefore the primary goal of strategy is to establish competitive advantage. This can be achieved by sustaining price or cost advantages (maximizing return), or by strategic positioning (delivering a unique type of value) [Port01]. The Internet, as often wrongly assumed, does not change these fundamentals. But it allows companies to achieve advantages, eg. by operational effectiveness. However, due to the nature of the Internet, competitive advantages are more difficult to sustain than in the past [Port01].

Strategy builds the top of the Berger & Partner success factor framework. In their study, strategy was among the three most significant success factors out of eight industries [Part99]. In the framework strategic orientation is linked with clear top management responsibility and the formation of business units with profit/loss responsibility. Figure 3.9 shows the full framework, including other identified success factors.

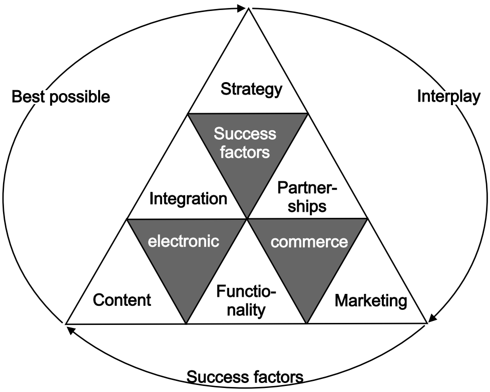

Figure 3.9: Roland Berger & Partners' success factors in electronic commerce [Part99]

Strategies can be described by their content or by their process. The content description can be split into four content dimensions: strategic target, strategic thrust, strategic posture, and strategic mode [LiCh04]. The process can be described by strategic simultaneity, strategic directionality, and strategic rhythm [LiCh04].

To design a successful strategy implies the recognition of economic, politic, social and technical developments [HoKU96]. There are many concepts trying to describe what a successful strategy may be, recommendations how it can be found, and tools helping to develop consistent strategies [EsKu96]. Moreover, the development of a successful strategy to compete with other companies depends on skill and fortune. Usually, companies with exceptionally good performance do not imitate well-known strategies, but establish their own strategies, breaking old habits and introducing new ideas to their markets. The process of strategy planning can roughly be outlined by three steps [HoKU96]:

1. Analysis
2. Conception
3. Implementation and Review

Since strategy development is so complex and dependent on the environment, no adequate measures for success can be given. A successful strategy is reflected by the economical success of the company. A feasible strategy is convertible into strategic and operational planning and must be carried by the whole company to take effect.

3.5 Performance measures for e-commerce multichannel retailers

This chapter discusses performance measures dedicated to e-commerce multichannel distribution. Companies which extend their traditional business with e-commerce activities need measures for their interoperability. A number of different perspectives are being discussed in this area [StHW$^+$02]. These include the general assessment of net-enablement of organizations [Whee02, ZaGe02], the usability, design and performance metrics for websites [Palm02], evaluation of website usability by heuristic methods [AgVe02], consumer values on websites [ToDh02], or the application of the technology acceptance model to online consumer behavior [Kouf02].

In the remaining book, the discussion focuses on a specific part of multichannel customer behavior: *channel migration*. Multichannel retailers in the sense of this work do not have direct control over their customers' channel migration. While the company may influence channel choice by various measures (eg. price differentiation), the ultimate channel decision remains with the customer. Understanding customer migration between channels is critical for multichannel retailers [SuTh04]. Figure 3.10 illustrates possible migration paths of customers in integrated multichannel environments. Various factors influence customers in their channel choice [SuTh04]:

- Price
- Convenience
- Experimental value
- Product

The *price* plays a role for the selection of a channel when different prices are charged in different channels. Such differences may occur as a result of strategic price differentiation. This may be used to influence customers' channel decisions, for example. Hidden or explicit transport costs also have an influence on the price and therefore may be an argument for switching

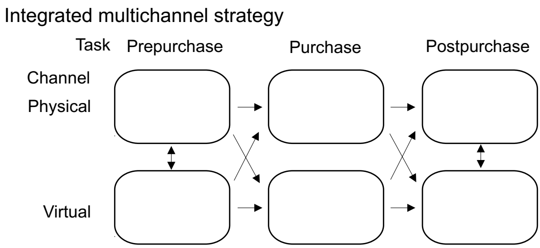

Figure 3.10: Integrated multichannel strategies. Adapted from [StBA02]

channels. Further, the absolute value of the price may be an influential factor. The rationale behind this assumption can be simply explained: the higher the price, the greater the perceived risk. Customers will try to reduce their risks by buying from traditional offline stores [ScGo02]. *Convenience* is considered an obvious factor. It is a reasonable decision to switch to the channel one finds most convenient, given that the other factors for this channel are satisfactory. *Experiential value* is the next influencing factor on the customers' decision. Shopping often inherits hedonic aspects. If visiting one channel is considered more fun than the other channel, the preference will lie on the channel with the better shopping experience. Actually, entertainment elements can be used to strengthen customer loyality to the website [TrPD04]. Finally the *product* itself can have a strong influence on channel choice. There are two mentionable factors in this context: firstly, a customer may be used to buying different kinds of goods in certain ways. Analogous to convenience, such habits influence human behavior. Secondly, there is the relation to the product itself. Every product has different attributes, which make it either applicable to be sold over a specific channel or not. For example, the most promising goods to be sold over e-commerce channels are digitizeable and standardizeable products [HaMa07].

Without the knowledge of how their customers migrate between different channels, companies do not know how well coordinated their channels operate. Further, they do not know whether one channel generates benefits in another channel. Consequently, the flow of customers and their migration between the different channels is a central question for performance measurement in this field. Acutal customer behavior can be represented by channel migration models. A migration model shows the fractions of persons in one state, staying in the same state or switching to other states. Applied to a multichannel distribution system, every state represents a sales channel or an acquisition phase in a sales channel. A migration model for multichannel retailing represents the fractions of customers staying in the same channels and those switching between channels.

The underlying idea of migration models is to describe the structure of channel usage of customers. This can be used for customer-related success measurement. A useful application of a migration matrix is the estimation of the cost of services between sales channels [ScSc04]. Such an estimation requires the assessment of process costs in the sense of activity-based costing. The cost of activities which were run through in one channel can be transfered into the channel where the transaction finally occured. The complete acquisition of customer-contacts, which would allow the exact calculation of cost for each customer, will rarely be available. Therefore the estimation of transition matrices and an overall evaluation of transfered services based on activity costs can be used.

The knowledge of the channel migration structure can also be used for customer-related calculation of the profit-margin. In this form of multi-level fixed cost absorption, the calculation scheme is split into channel related revenue and cost in each channel [ScSc04]. To obtain the correct result, the proportional fixed cost of the channels have to be distributed according to the switching behavior of the customer.

3.5.1 Basic channel migration models

Multichannel customers' behavior can be represented by transition models [PfCa00]. Channel migration is measured by the transition from an acquisition in one channel to the next acquisition in the same or another channel. One approach to model customer migration between different channels are Markov chain models [PfCa00]. A Markov chain model can be used to estimate migration to another channel from one point in time within a given number of periods in time [SuTh04]. Table 3.3 shows a simple transition model for a two-channel retailer.

		Future Channel	
		Retail	*Internet*
Current Channel	*Retail*	a	1-a
	Internet	1-b	b

Table 3.3: Transition model for a two-channel distributor [SuTh04].

If the states of the model itself are not observeable, the model is called hidden Markov chain. A hidden Markov chain model can be determined by counting the occurrence of *outputs*, which are associated with a certain state, and estimation of the model parameters by an adequate statistical method. In the case of a multichannel migration model, the occurrence of a transaction in a certain channel is an output which indicates that one customer switched to that channel. Hidden Markov chains are typically used to estimate the parameters of migration models [MiLB05].

An important property of this methodology is the *Markov property*, which says that the future state of the entity is only a function of its current state. In other words, the model does not take any information of previous behavior into account, but only the channel the customer is currently using. The migration is described by a *t-step transition matrix*. Such a matrix shows the probability of a customer to switch from one channel to another channel in exactly t periods of time [PfCa00]. Table 3.3 shows the simple transition model between a store retail channel and an Internet channel. In this model, a denotes the rate of loyal customers of the retail channel and b the rate of loyal customers of the Internet channel. Consequently, $1 - a$ and $1 - b$ are the rates of customers who switch from their previous channel to the other channel.

The model can be expanded by a third state of a non-buyer or buyer at another company. This would allow for a distinction between customers who switch between the two channels and customers who do not buy goods from the company any more. A representation of the expanded model is shown in figure 3.11. The model is represented as a graph according to the graph theory cf. [Dies05]. Every state is represented by a vertex and possible migrations are represented by directed edges. Another application of graphs representing Markov chain models can be found in [PfCa00]. The usage of different channels during the flow in the pre-sales, sales and after-sales phase is not covered by this model.

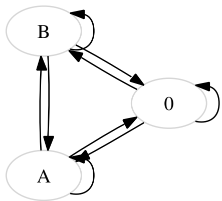

Figure 3.11: Graphical representation of the Markov chain model of two channel migration

$$P = \begin{pmatrix} A & p_{aa} & p_{ab} & p_{a0} \\ B & p_{ba} & p_{bb} & p_{b0} \\ 0 & p_{0a} & p_{0b} & p_{00} \end{pmatrix}$$

P is the one-step transition matrix for the expanded migration model with channel A, B and the state 0 for a non-customer. The *t-step model* can easily be calculated by multiplying P t-times by itself. The (i, j) element of matrix P^t is the probability of a transition from channel i to channel j in t periods of time [PfCa00].

Markov models can be estimated by the use of empirical data. For the estimation of a channel, migration model customer contacts in each channel has to be measured. But the measurement and observation of the combination of customer contacts in each channel is not easily possible. It is necessary to record each customer contact which occurs during the pre-sales, sales and after-sales phases to obtain a complete migration path for a transaction.

The models discussed so far treat all customers equally. They do not distinguish customer groups according to their channel switching behavior. Since there may exist different customer groups with different migration structures, the identification of such groups and the incorporation into the model would improve the explanatory power of the model.

3.5.2 Migration models considering customer groups

Colombo and Morrison introduced a model for brand-switching behavior. In contrast to the model shown before, they distinguish between two customer groups, *hard-core loyal customers* and *potential switchers* [CoMo89]. This model can also be adapted for customer switching behavior in multichannel companies [GeDS07]. This basically implicates the introduction of a parameter λ, which describes the proportion of customers who are completely loyal and do not even consider switching channels. The probability that a customer who last time used channel i will next use channel j is described by following equations [CoMo89]:

$$p_{ii} = \lambda_i + (1 - \lambda_i)\Pi_i \tag{3.1}$$

$$p_{ij} = (1 - \lambda_i)\Pi_j, i \neq j \tag{3.2}$$

The probability of staying in the same channel is expressed by equation 3.1. p_{ii} is the portion of hard-core loyal customers (λ_i) added to the portion of potential switchers $(1 - \lambda)$ which stay in channel i (Π_i). Equation 3.2 applies to all cases where a transition from one channel to another channel takes place. p_{ij} is the probability of beeing a potential switcher $(1 - \lambda)$ and switch to channel j (Π_j).

Distinguishing these two groups of strictly loyal and non-loyal customers may lead to relevant insights which bear managerial implications. Applying this model to the data of a large European home shopping company, it was found that for this company, the incumbent channel was still the dominant channel [GeDS07]. The level of non-hardcore loyal customers indicates how many customers may easily be moved to another channel by marketing measures. The study also revealed that the level of loyalty in this company was decreasing, which supports the thesis of increasing portion of multichannel customers [GeDS07]. Such a model is also able to reveal the ability of a channel to attract floating customers, since loyal customers are treated separately. The model is able to reveal situations where channels are in danger of running dry, because they are not able to attract floating customers earlier than other models. However, one must also mention criticism. This model does not allow various degrees of channel loyalty but only extreme forms, which may be too simplified to reflect actual customer behavior. A more complete model should also incorporate measurement of underlying commitment of customers to estimate loyalty (λ_i) [GeDS07].

The migration models introduced so far rely on the availability of suitable data. Such models can be estimated by the use of empirical data of the channel usage of customers. Surveyed customer contacts in different channels can be used to assess the switching behavior. The migration matrix is estimated by statistical means. A maximum likelihood estimation can be used to estimate channel migration on the basis of measured customer interactions, which represent the output of the different states in a hidden Markov chain model.

While, usually, companies know a lot about their online and their catalog customers, most retailers can identify less than ten percent of their shoppers at the stores [Craw05]. The requirements in customer-specific transaction data and its surveys will be discussed in chapter 5.2.2. An approach which relies on the analysis of webserver log files is introduced in the following subsection.

3.5.3 Web-based estimation of channel migration

Methods for measuring multichannel customer behavior based on web usage data are not widely spread. Nevertheless, there are proposed methods for this task [TeGü03, TeBe03]. The customer lifecycle concept traces website users through different phases of their behavior on a webshop [CuSt00]. The described phases range from *reach*, *acquisition*, *abandonment* or *conversion*, *attrition* or *retention*, to *churn* or the "highest level" *loyalty*. Figure 3.12 shows a graphical representation of the possible stages. *Reach* denotes the ratio of the population who are potential site users. *Acquisition* describes the ratio of the reached population who actually visit the webshop. As a further measure, *conversion* denotes the ratio of visitors who can be gained as customers. Customers who repeatedly return are measured by *retention*. The highest level a customer can reach is *loyalty*, which means an intellectual or emotional binding to the company. While these demonitated measures describe successful events, there is also a set describing unsucessful interaction with customers. *Abandonment* is the number of visitors who commence but do not complete their transaction. *Attrition* is the portion of customers who do not return at all, and *churn* denotes the portion of new and retained customers who were lost by the end of a defined period.

The orignal customer lifecycle model is restricted to the online channel only. However, the concept has been enriched for the usage in multichannel business as proposed in [TeBe03]. By the introduction of a set of multichannel metrics, the performance measurement system is

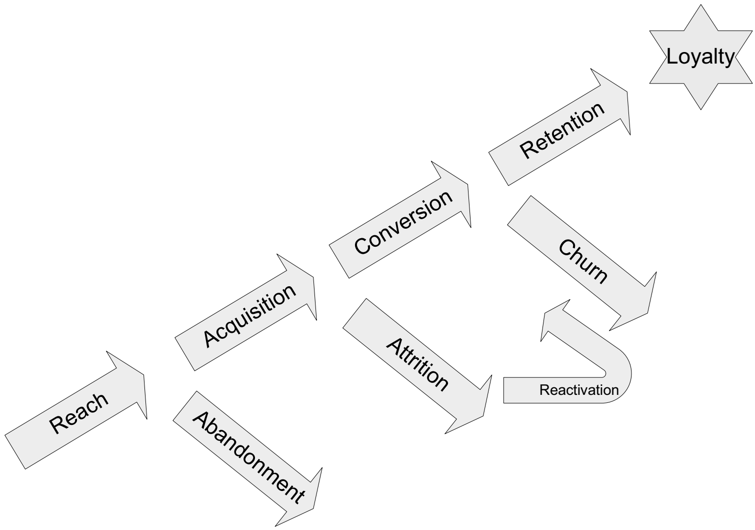

Figure 3.12: Customer-lifecycle[CuSt00]

adapted to deliver relevant information for coordinated multichannel business. The proposed measures are [TeBe03]:

- Offline payers
- Payment migration
- Deliveries to stores
- Delivery migration
- Returns to stores
- Customer store-distance correlation
- Store locator visits
- Store locator exits
- Multichannel clusters

The used measures are related to multichannel-specific behavior of online customers. *Offline payers* are customers who prefer to pay in-store, even when the order was submitted over the online channel. *Deliveries to stores* refers to the number of transactions which was ordered in the online channel but where the goods were picked up in local stores. Compatible with both these measures, *payment migration* and *delivery migration* measure the portion of customers who switch from in-store payment to online payment methods or store pickup to direct delivery, thus pure online purchasement. *Return to stores* measures the usage of after-sales services of the store channel for goods purchased over the online channel.

Customer store-distance correlation is the correlation between online customers in a specific area and the distance to the next store. This measure can be used to judge how strongly customer behavior is related to the distance between a customer and the next available store.

The last set of measures *store locator visits*, *store locator exits*, and *multichannel clusters* describe customer behavior regarding online inquiries about the store-based channel of the company. As a basic value, the number of visits including offline store information is counted. Out of these, visits which end on the store information page can be identified. They are regarded as more strongly related to the offline concept than other visits including a similar page. Even more strongly related are clusters of visits which include hits on pages containing information about offline stores.

The data requirements for the calculation of these measures consist of marketing data regarding the potential website users and their residence. Session and cookie logfiles are needed for the webshop-related measures. Further transaction data for the subsequent offline transactions and the possibility to match them with online transactions is needed [TeGü03].

The measures were tested with a big multichannel company with a webstore and multiple offline stores in different areas. The authors were able to successfully cluster visitors of the webshop into customers who were solely interested in the online shop, and customers which were combining the offered options of both types of sales channels [TeGü03]. In the course of the survey, a relation between customer behavior and distance from the customer to the next offline store could also be revealed [TeGü03]. This behavior is consistent with convenience as the proposed influencing factor for customers' channel choice [SuTh04].

Another approach allows for a more detailed measurement of customer behavior in the webshop. While the customer lifecycle model looks at complete visits or transactions, the usage of micro-conversion-rates allows analyzing conversions which take place during one visit on the website. Lee et al. proposed a model where micro-conversion-rates measure the conversion between the following four general shopping steps on a website [LePS+01]:

1. Products impression
2. Clickthrough

3. Basket placement
4. Purchase

The necessary data for the calculations can also be obtained from webserver logfiles. Every page is categorized into one of these four concepts. Micro-conversions arise when a user switches from one concept to another.

For measuring multichannel behavior, a model including customer life-cycle [CuSt00] and micro-conversion-rates [LePS^{+}01] was proposed. It works with an extended customer life-cycle model, which is displayed in figure 3.13. Therefore, a webshop is clustered into seven concepts and the conversion between these concepts is surveyed [TeBe03, TeBG04]:

1. Acquisition
2. Information catalog
3. Information product
4. Service
5. Transaction
6. Purchase information
7. Offline information

The concept extends the number of conversion metrics of the original model, but is still not able to cover the whole spectrum of conversions of multichannel customers, since the focus lies on web activities while it does not cover activities in other channels.

The measurement is based on the analysis of sessions. A session can be seen as a bag, a set of sequence of pageviews on the website, or respectively a concept of the webshop. It is possible to distinguish different kinds of conversions between these concepts. The *dichotomized-concept conversion* takes into account whether a concept was visited during a session or not. The *weighted-concept conversion* also counts the number of page impressions of each concept. Comparison of the results of the both different conversions can reveal weak points in the design or the navigational structure of a webshop [TeBe03].

The conversion rates can be defined as follows: $s[c], c = 1..7$ represents a feature vector of the overall set of sessions S. It indicates the number of page impressions on the respective concept

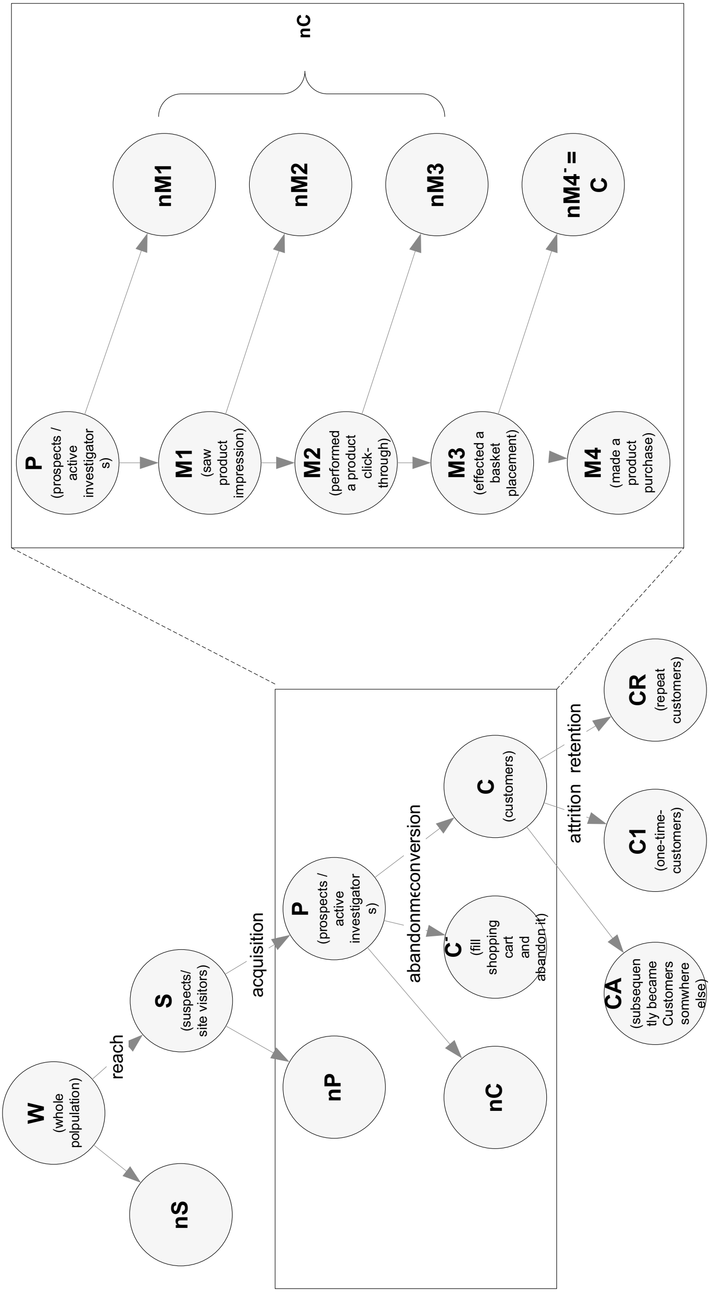

Figure 3.13: Expanded customer-lifecycle [TeBe03]

c. For the *weighted* conversion $s_w[c] \in N_0$, for the *dichotomized* conversion $s_d[c] \in 0, 1$. In addition to the concepts 1-7, concept $c = 0$ denotes a visit to any concept [TeBe03]. The *dichotomized-conversion rates* are generally defined as shown in equation 3.3. If it is assumed that concept c_j can only be visited after c_i, the equation can be simplified to equation 3.4. The *weighted-converison rates* are defined in equation 3.5 [TeBe03, TeBG04].

$$c_j\ to\ c_j^d = \frac{\sum_s AND(s_d[c_j], s_d[c_i])}{\sum_s s_d[c_j]} \tag{3.3}$$

$$c_j\ to\ c_j^d = \frac{S_{i\&j}}{S_i} = \frac{S_j}{S_i} \tag{3.4}$$

$$c_j\ to\ c_j^w = \frac{\sum_s s_w[c_j]}{\sum_s s_w[c_i]} \tag{3.5}$$

Conversions of interest for success measurement are sessions that visit the offline concept, eg. the store locator, or even better, the set of sessions which exits via the offline concept [TeBe03]. The complete set of conversions can be used to gain insight into the users' behavior on the webshop. Different groups of users could be identified by their website usage.

Chapter 4

Methodology - a structured approach for designing the model

The model of a performance measurement system is created along the guidelines of design science. Its purpose is to serve as a reference for the implementation of performance measurement systems. Even if the whole model cannot be adapted in the specific settings of a company, the integrated fundamental ideas may be used for the implementation of other systems. Parts of the model can be used as a template for specific problems.

The application of this method presumes the understanding of a performance measurement system as an information system. An information system consists of related persons and machines, which create and use information and communicate with each other [HaNe05, p. 84]. Since a functioning performance measurement system relies on the same elements and is usually featured by a computer-aided information system, this analogy can necessarily be accepted. Similar approaches, like a reference model for supply chain performance measurement, can be found in literature [Erdm03].

4.1 Design science

The work is positioned in the scope of design science and its German equivalent reference modeling ("Referenzmodellierung"), which is typically used as methodical framework in the German "Wirtschaftsinformatik" [FeLo02]. Hevner et al. outline basic criteria for work in the design science paradigm. They state seven research guidelines [HeMP04]:

1. Design as artifact,
2. Problem relevance,

3. Design evaluation,
4. Research contributions,
5. Research rigor,
6. Design as a search process, and
7. Communication of research.

The difference between behavioral science, which in most cases is associated with information systems research, and design science is summarized by following statement: "The goal of behavioral-science research is truth. The goal of design-science is utility." [HeMP04]. In the center of design science is the creation of IT-artifacts. Simon set up four indications for distinguishing between artificial and natural things [Simo96]:

1. Artifacts are made by humans.
2. Artifacts may imitate natural things, but usually lack some aspects.
3. Artifacts can be described in form of functions, goals, and adoption.
4. Artifacts are usually discussed in terms of imperatives and descriptives.

IT-artifacts occur as constructs, models, methods and instantiations [HeMP04]. Hence, the original task of design science is the creation of constructs, models, methods, and instantiations for information systems. Models can either aim at illustrating existing systems or at constructing new systems [Broc03]. Design science uses both approaches. The goal is the extraction and conservation of knowledge in form of such artifacts. The focus lies on reusability. The models should be applicable and adaptable for the implementation in other information systems.

Since reference models describe parts of the real world, in an epistemological sense, design science assumes the existence of a real world (realism) [BeNK04]. Every model is influenced by its creator. Design science therefore works in the sense of constructivism. It has to rely on languages to formulate the models and the exchange between subjects. Reference models can be created empirically by observation of real world information systems and by "apriory knowledge", without an underlying real world archetype. Therefore, design science can draw insights by induction and deduction [BeNK04]. Induction takes place when knowledge is generated by generalization of statements which are true for observed cases. Deduction takes place when knowledge is generated by the logical combination of other known statements using rules of logic.

4.2 The ARIS framework

In this work, the design of the model follows a structured approach. Under the recommendations of ARIS, the model will contain the organization view, data view, control view, function view, and output view of the performance measurement system [Sche98a].

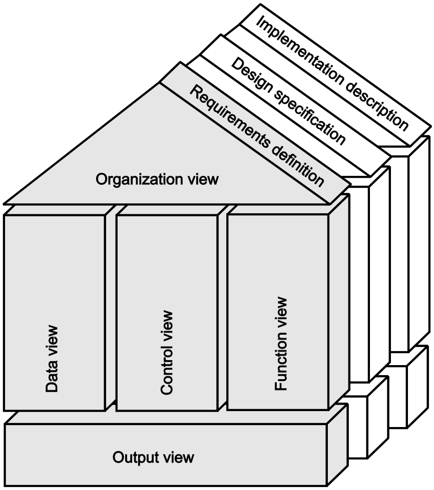

Figure 4.1: Structure of the ARIS modeling framework [Sche98a, Sche98b]

Figure 4.1 shows the structure of the ARIS framework. The design of an information system is split into two dimensions. The first dimension is the descriptive level, while the second dimension deals with different views on the specified information system. There are three descriptive levels:

- Requirements definition
- Design specification
- Implementation description

4.2.1 Three levels of modeling an information system

The *requirements definition* describes the business process and the way it should be carried out by the information system. The focus of this step is the precise and clear definition of business processes [Sche98a]. Abstract definitions and diagrams are used. The concepts have to be clearly understandable from a business administration perspective and formalized to a degree that allows a consistent design and implementation of the system [Sche98a]. The requirements definition is independent from any implementation platform. It describes *what* has to be implemented, but does not anticipate *how* this is done.

The *design specification* is the transformation of the requirements definitions into specific information technology interfaces [Sche98b]. The focus of the model now moves from understandability to specific considerations of information technology. The design specification already considers performance aspects and information technological design limits. For example the design specification of the data model will avoid redundancy and keep cardinalities as low as possible.

The *implementation description* is the documentation of the implementation as it is carried out on the basis of the design specifications. It contains the detailed technical description of the implemented information system. Whereas the two previous levels describe a desired future state, the implementation description refers to the existing system. It is also possible to add necessary modifications to the original design.

4.2.2 Five views on the information system

As stated above, the ARIS model also differentiates between various views on the information system. As displayed in figure 4.1, these views are:

- Organization view
- Data view
- Function view
- Control view
- Outcome view

One part of the model is the description of the underlying organizational structure. This is illustrated in the *organization view*. Usually, the structural organization of a company is represented by an organization chart. The organigram shows the breakdown into different organizational units of the company and their hierarchical relations. On the basis of the organizational structure, tasks which have to be performed by the information system can be assigned to specific positions. The description of the organization is also the basis for the assignment of roles in the information system. At the level of design specification and implementation description, the organizational view typically contains the specification of network topologies and the description of network protocols [Sche98b].

Another fundamental perspective on the information system is given by the *data view*. On the requirements definition level, the data view describes the underlying data which is necessary to operate the system. The data model describes the type of data needed and how it is structured. For this step, Entity Relationship Models are often used in ARIS models [Sche98b, pp. 30ff]. They describe entities, attributes and relationships.

In the design specification, the data structure is conveyed by a relational model. This model basically defines the tables for entities which are stored in the relational database system. Since relational database systems do not distinguish between entities and relations, relations must also be converted into tables [Sche98b]. The implementation description contains detailed technical information about the used database management systems and the set up databases.

The *function view* points out what has to be done by the information system. The requirements definition shows the business processes which have to be handled. Complex functions are broken down into subfunctions. The functions are subdivided until the smallest units represent single job cycles, and it does not make sense to split them further [Sche98b]. Process chains stipulate the chronological sequence of functions. The design specification is module-oriented. The necessary functions are organized into software modules. Anatomic transactions, which may not be interrupted during their execution, are defined. Business processes of requirements definition need not necessarily be mutually allocated to a single module, but may be supported by several modules of the design specification.

The *control view* brings together the items of the organization view, function view, and the data view. In the requirements definition, firstly, functions are mapped to organizational units. An activity distribution chart shows the assignment of roles like outcome responsibility, participation, decision making etc. for business processes to specific units or persons. While the function view and the data view represent static descriptions, the control view covers the dynamic processes of the information system. The event control and data flow model describes the interplay of data and functions in the flow of time. This is usually modeled by event-driven process chains (EPC) [Sche98b, pp. 46-52]. The control view also shows the assignment from data to organizational units. An extended process chain model combines the data flow between information objects and functions, function event control and the access and authorization of organizational units [Sche98b].

The *outcome view* describes all inputs and outputs of the information system. Since this work does not model an information system in the natural sense of the word, the outcome view will primarily be used to illustrate how the results and values of the modeled information system has to be treated. Possible traps in the usage of such an information system, which, essentially is able to picture complex conditions in form of a few numbers, will also be discussed.

4.2.3 Integration of object-oriented modeling and ARIS

In software engineering, there has been a tremendous move from process-oriented to object-oriented programming languages. Many existing languages were equipped with object-oriented extensions. Also new object-oriented languages, like Java, were introduced. With the diffusion of object-oriented concepts in software engineering, object-oriented modeling tools evolved. The most important properties of object-oriented modeling are defined as follows [Sche98b, p. 52]:

- Object formation
- Class formation
- Inheritance
- Polymorphism
- Dynamic linking

The difference between objects and classes is important, but the usage of these terms is often mixed up. Objects represent items from the real world. They are described by a set of properties and methods. In information systems, properties are implemented as variables or fields where object-related data is stored. Methods are object-related functions. Therefore, a method describes specific functions which can be applied to the object. Classes describe groups of similar objects and their relation to other groups of objects. Every object in an information system is an instance of a class. The class definition describes which attributes of an object are stored. The class definition also describes functions which can be applied for its instances. The instance of a class describes an actual real-world item and contains values for the available attributes. One aim of object-oriented modeling is to keep the model easily understandable, since it is possible to associate objects in the information system with the real world. Another goal is to encapsulate data and functions, since data in an object can effectively be protected from access by other objects.

Inheritance describes the possibility to transfer attributes and methods from a superordinate class to a subordinate class. This mechanism allows the specialization of general classes into specialized classes, where all attributes and functions of the general class are available in the specialized class, too. For example, a general class *vehicle* could be specialized into the classes *car*, *truck*, and *motorcycle*. Cars, trucks and motorcycles all share attributes of vehicles, like weight and speed, and functions like *accelerate* and *break*. The specialization classes allow objects of the subclasses to be defined and used more specifically. For example, trucks would have an attribute size of shipping space and functions for loading and unloading freight. Polymorphism means that a specialized class can also specify a different function for a function which is also available in the superordinate class. In the vehicle example this could be used to describe different reactions of the same function. While for other vehicles breaking is implemented as a simple function of speed and weight, for trucks there could be a more sophisticated method to calculate actual deceleration which also takes into account different types of breaking-systems of the truck. The function may be called with the same input parameters but would lead to another output result. Dynamic linking describes a more technical property of information system which is subject to the object-oriented paradigm. It means that different parts of the system are kept separately and are not merged until runtime.

The object-oriented model often takes different perspectives from the ARIS views, and therefore do not exclusively fit into one single ARIS perspective. The Unified Modeling Language (UML) is widely accepted as a standard for modeling object-oriented software [DoPa06]. Class diagrams show classes, their attributes and methods, and relations between classes. They combine elements of the data view and the function view. Scheer delivers an approach to integrate object-oriented concepts into ARIS by the integration of object-diagrams into the *control view* of an information system model [Sche98b, pp. 52-55]. This approach is coherent because the control view ought to contain a combined view on data and functions. There are other approaches which try to integrate business process modeling with UML. Business Process Models in form of event-driven process chains (EPC) can be converted into UML use case diagrams, UML activity diagrams, UML class diagrams and UML application architectures [NüFZ98]. The object-oriented event-driven process chain (oEPC) is another approach to integrate the object-oriented modeling paradigm into business process modeling [NüFZ98, ScNZ97]

4.3 Used modeling tools

Modeling information systems makes use of formalization tools, such as different types of diagrams. These diagrams are used to describe different aspects of an information system. The ARIS guidelines for business process engineering recommend a set of modeling instruments for different views and levels [Sche98b, pp. 4-83]. The Unified Modeling Language (UML) is a set of methods which emerged during the 1990s through the combination of former competing object-oriented software engineering methods [DoPa06].

The following performance measurement model makes use of different tools and diagrams. They serve as a formal description of the created performance measurement system. This section provides short descriptions of the modeling tools which are used for the model.

Use case diagram

Use case diagrams are a tool in the frame of the UML modeling language. UML is often presented as use case driven, which is not necessarily true for the practical usage of UML [DoPa06]. The major advantage of use cases is not necessarily seen in the explanatory power of use case diagrams themselves, but in the textual description of use cases [Fowl04, pp. 99-105].

“A use case is a set of scenarios tied together by a common user goal” [Fowl04, p. 99]. Use cases reflect an external view on the information system. They define important *actors* and how they anticipate the essential functionality of the system. Therefore, they are able to serve as easily understandable descriptions of the goals of the information system.

Entity relationship diagram (ERD)

Entity relationship diagrams (ERDs) are the recommended choice of the requirements definition of the data view of ARIS models [Sche98b]. An employment analysis in the year 2004 showed that UML and ERD are usually both employed for data modeling. However, the focus often lies on ERD modeling. The UML diagrams are usually rated secondarily [WiSe06].

ERD was introduced by Peter Chen in the year 1976 [Chen76]. The entity relationship model was introduced along with of three major data models discussed at that time. An entity relationship model is based on different entities and their relations to other entities. It describes different entity sets, their attributes, and relationship sets between them. Relationship sets may take different forms. Chen described one-by-one (1:1) relations, where each entity of a specific entity set can have a relation to exactly one entity of the other entity set. Think about a marriage as a relation between two persons. Each woman can only be married to one man, and each man can only be married one woman. A one-to-many (1:n) relation is the case when one entity may have more relations to entities of another set, but entities of the other set may just have one relation to an entity of the first set. Think about relations as hierarchically organized company structures. Every employee works for one department. But every department employs several employees. Finally, the many-to-many (n:m) relation describes cases where each entity may have multiple relations to other entities of the related entity. For example in a project-oriented organizational structure, each employee could work on several projects and each project could employ several employees.

Class diagram

Class diagrams are the most frequently used diagrams of the UML modeling language [DoPa06]. They allow defining an object-oriented model of the static aspects of the information system. The definition of classes offers the possibility to encapsulate data and corresponding methods in order to describe objects in the information system.

Class diagrams allow the definition of different types of relations between classes. Solid arrows denote associations. Associations are typically implemented as attributes of the object in question. As in entity relationship modeling, associations can be tagged with the regarding multiplicity. [1] means that there has to be exactly one participating related object on this side of the relation. [0..1] also allows the assignment of no corresponding object. [*] means that there may be more objects participating on the other side of the relation. On the implementation level this would mean that the object in question would hold references to a whole set or array of objects of the related class.

Class diagrams also allow the definition of aggregation and composition of classes as empty and filled rhombi respectively as the starting points of solid lines to the associated class. The powerful object-oriented mechanism of classification and generalization is drawn as an empty triangle at the “general” end of a solid line. These are only basic features which are actually used in the following chapters of this book. A detailed and comprehensive description of the UML class diagram standard can be obtained in [Fowl04].

Function tree diagram

Each process in the information system is modeled as a function. Function trees are used to give an overview of these functions. They can be used for the requirements definition of the function view in an ARIS model [Sche98b]. Complex functions are broken down into subfunctions. The result is a hierarchical structure of functions and subfunctions.

Business process modeling notation

Business process modeling notation (BPMN) was introduced by Stephen A. White from IBM Corporation as a standard notation for business process modeling [Whit]. BPMN was released in 2004 and represents the effort of the Business Process Management Initiative (BPMI). The most important BPMN tool used in this work is the business process diagram (BPD), which is a graphical notation of business process operations [Whit]. BPMN with its broad support of a large segment of the business process modeling community is intended to reduce the fragmentation of process modeling tools. It consolidates different ideas of other notations into one single standard notation. Other notations which were reviewed as foundation of these standards are UML Activity Diagrams, UML EDOC Business Processes, IDEF, ebXML, BPSS, Activity-Decision Flow (ADF) Diagram, RosettaNet, LOVeM, and Event-Process Chains (EPCs) [Whit].

A business process diagram consists of *flow objects*, *connecting objects*, *swimlanes*, and *artifacts*. Flow objects are events (circle shape), activities (rectangle) and gateways (diamond). These objects are linked via connecting objects (sequence, message, and association). Swimlanes consist of pools and lanes. A pool can be a set of several lanes. Pools and lanes represent participants in the process. To illustrate the point, pools can be used to model companies, lanes are used to model their sales channels. Processes are drawn in lanes, indicating where the process takes place. Artifacts allow connections to data objects, group processes and additional annotations to the model.

The possibilities of connecting activities to lanes representing organizational units, as well as to data objects, allow an integrative view on the dynamics of an information system. BPDs are used in this work to integrate the organizational view, data view and function view in the control view of the ARIS model.

Chapter 5

Performance measurement model for e-commerce multichannel retailing

In this chapter the insights of the preceding chapters are used to create a prototype of a performance measurement system. The model is designed in the form of a requirements definition in the scope of the ARIS methodology, which was presented in chapter 4.2. The model is split into two parts: the *general model* and the requirements engineering of *selected performance measures*.

The idea of the *general model* is to plot the abstract design of an information system which is capable of fulfilling the needs of a multichannel retailing company with an e-commerce channel. The general model does not include concrete specified performance measures. It rather mages a suggestions for the overall design of such a model. It incorporates previously identified success factors and treats them as perspectives for performance measurement. For this attribute the general model can be compared with other popular performance measurement frameworks like the balanced scorecard, which also provides the structure and recommends different scopes [KaNo92, KaNo93].

The approach of this work differs from other performance measurement frameworks in the following points: the general model focuses on issues and facilities of the coordination of sales and distribution channels. Moreover, one channel is appointed as electronic commerce channel. The comparability of measures in such a context is discussed in the output section. The discussion remains on the level of success factors and does not involve single specific measures. Another fundamental feature of the general model is the treatment of performance measurement as an information system. A formalized model of this information system is established. The differences to other frameworks are for the greater part a result of the focus on multichannel retailing and its coordination problems. While other frameworks try to cover performance measurement systems for the whole company, this model focuses on multichannel retailers and contains specific features which are not applicable for other types of companies.

The *selected performance measures* expand the general model by a small assortment of specific measures. One goal of this chapter is to show how specific measures may be fitted into the general model. The other goal is to construct and describe performance measures which are peculiarly interesting for hybrid e-commerce companies. The goal is not to describe a complete recommended set of measures for multichannel retailers, as every company has its own requirements regarding performance measurement. The selection of adequate measures has to be done by the company itself at the stage of establishing a performance measurement system. This can be argued with the recommendation to derive performance measures from company objectives cf. [Glob85], which are unique for every company. In terms of management information systems, the performance measurement system has to be customized, just like business-oriented standard software.

5.1 General model of the performance measurement system

As stated above, the general model covers the overall structure of the information system which works as a performance measurement system. The model is split into the five ARIS views which are recommended for modeling information systems which reproduce business processes (Chapter 4.2).

Two use cases which describe the use of the performance measurement system are: *planning target values* and *measurement and review of the actual performance of the company*.

Figure 5.1 is a use case diagram for the information system as a planning instrument. Three main actors who interact with the performance measurement system are identified. The *chief executive officer* of the multichannel retailer establishes business goals. The system allows the describtion of goals on a textual basis. To serve their purpose and ensure the company's value creation, these objectives have to be translated into quantifyable goals and actions [KaNo93].

The transformation of business goals into target values follows in the next step. In this example the *Head of Sales and Distribution* is responsible. He has to establish target values for each performance measure. The target values have to be deducted from the given goals. The planning process includes several feedback and feedforward loops. The target values have to be negotiated with the chief executive officer. The top level target values need to be broken down into target values for each underlying scorecard. These values have to be negotiated with the responsible employees. In this example, a *channel manager* is displayed as responsible for a

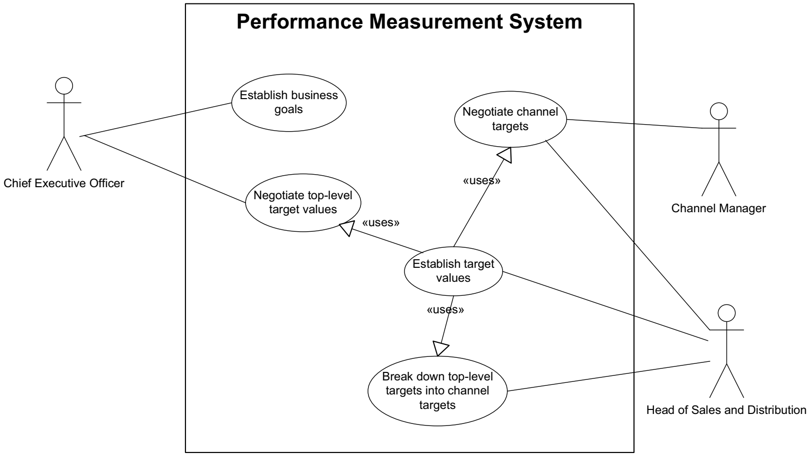

Figure 5.1: Use case diagram for planning processes

channel-specific scorecard. The planning process can loop several times from the top management to the responsible employees.

The performance measurement system aids this process by storing target values in the course of the planning process. Therefore, a simple revision management is reasonable, in which the progression of planned values can be retraced. The system also includes the status of a target value, for example if it is just a proposed value or if it is already agreed. The system provides help to break down and aggregate target values of measures if the corresponding functions are defined. For example, the system can show the effects of changes of target values in the underlying scorecard on the value in the aggregated scorecard.

Figure 5.2 shows a use case diagram for the information system as a measurement instrument. Employees in the responsible positions have to feed the system with the actual values for measures in their responsibility. In this case, the actor *channel manager* represents the employees of a specific sales channel. The *Head of sales and Distribution* has to register the measures in his field and, consequently is also responsible for the aggregation of the measures of underlying scorecards to the overall sales and distribution scorecards. Employees are able to assess their own performance by comparing the target values with the actual achieved values. The system can also be used as a reporting tool where employees report their performance back to the corresponding line manager. Since actual measured values are important feedback for the *chief executive officer*, the reported values are used to revise business goals, adapt target values and, thus, close the feedback loop to the planning process.

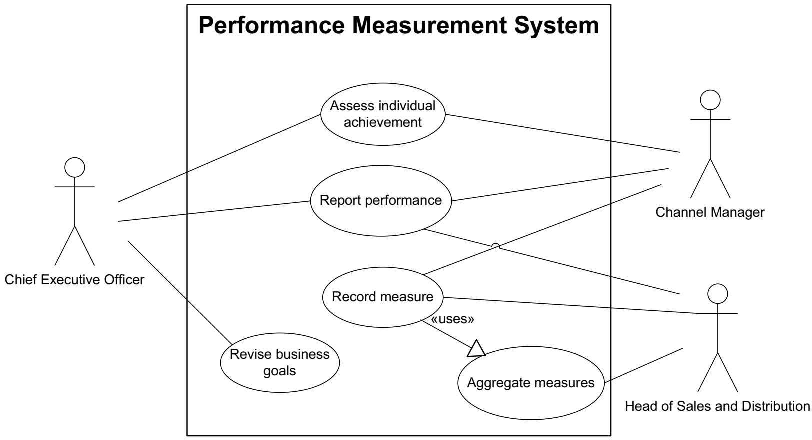

Figure 5.2: Use case diagram for measurement processes

5.1.1 Organization view

The constructed model is designed according to the principal modern design characteristics of performance measurement systems (cf. chapter 3.2). It is divided into different hierarchical company levels, where each level possesses its own set of ratios. This occurs analogously to the Balanced Scorecard framework [KaNo92, KaNo93]. The different levels are linked together. Inferior ratios have to match superior ratios by either direct relation or the same underlying strategic goal. Direct relations stand for the possibility of aggregating or disaggregating measures to related measures in a higher or lower level scorecard.

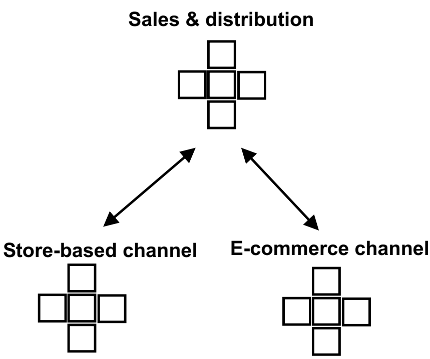

Figure 5.3: Two-level hierarchic structure of the model

Figure 5.3 displays the structure of the performance measurement model. It consists of two hierarchically ordered levels. The upper level describes the whole sales and distribution unit of the company. The lower level is split into different sales channels. In a simple case, only a store-based channel and an e-commerce channel is modeled. Companies may implement much more complex channel configurations. In such cases, the hierarchic structure stays the same and every additional channel is added as its own entity on the second level. An additional layer representing groups of sales channels could be added if complex channel structures exists. For example, the channels could be grouped into local stores, super stores, and e-commerce channels. The group entities are operated by the aggregated measures of the underlying channels. The comments in the remaining book will refer to the two-level structure. Nevertheless, the model itself is designed in such a manner that the introduction of a third layer is possible in the customizing process without marking far-reaching changes to the model itself.

For every unit, in the sense of this model, as set of measured, like in a Balanced Scorecard [KaNo92] is designed. These sets will be refered to as scorecards. According to the hierarchical construction of the measured units, there is a scorecard for every channel as well as a scorecard for the whole sales and distribution function of the company. The scorecards, therefore, are also in hierarchic relationships to each other.

The model must be embedded in the actual company organization. Depending on the organizational structure, this can be done by assigning scorecards to the company's organizational units, or may inherit a complex mapping from specific organizational positions to the system to specific performance measures in the system.

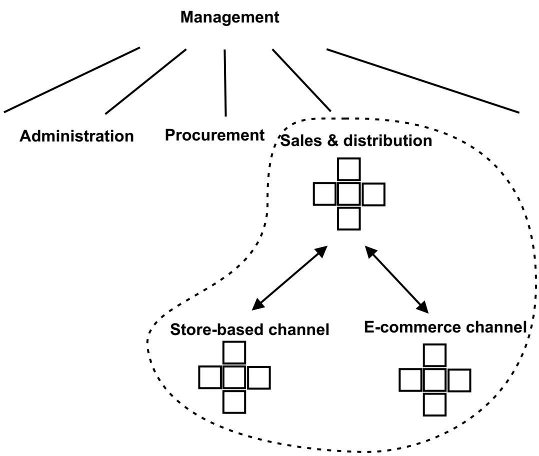

Figure 5.4: model into company organization. Case 1: Functional structure

If the company is divided into different functional units, simple direct relations occur. Figure 5.4 shows such a case. The company is structured by functional aspects like administration, procurement and sales and distribution. The performance measurement system, which is described in this work, is directly related to the sales and distribution branch of the company. The relevant area is highlighted by a dotted line in figure 5.4. The sales and distribution branch in this case is subdivided further into the specific sales channels. This is equivalent to the general structure of the model. Of course, such a company will have a performance measurement system for the whole company and not only for its sales and distribution branch. Since the other scorecards should be oriented toward the strategic goals, the content of the scorecards will also bear relations with each other. For the major part the model which is created in this book could be expanded into a model for performance measurement in the whole company. However, this work restricts its outline to the sales and distribution branch. Therefore relations to other parts of a company-wide performance measurement will not be explicitly described by the model.

Figure 5.5 outlines a more complex situation. If the company's organization is structured in another way, for example divisional units, the measures of the sales and distribution performance measurement model have to be mapped to specific organizational positions. Eventually, it is necessary to map one single measure on the model to several different units in the organization.

5.1.2 Data view

The Data view represents the performance measurement system and its performance measures. It contains the necessary structures in order to store the target values and actual values of every measure at different points in time. Afterwards the calculated values are stored in the structures of the core model. First, all presented structures are modeled in an object-oriented manner and presented in the form of UML class diagrams. Since classes cannot directly be translated into a relational model, a relational model in form of an Entity Relationship diagram (ERD) will be presented. This approach was chosen because object-oriented mechanisms allow a simple and powerful classification for performance measures. The author of this book thinks that adding the object-oriented form makes the data model easier to comprehend than a solely representation of the Entitiy Relationship Diagram. The concept may be easily understandable for the reader when it is presented in the object-oriented form. Nevertheless, since the applications which are needed for business operations in companies typically rely on the usage of database systems, an adequate description of an entity relationship model is included.

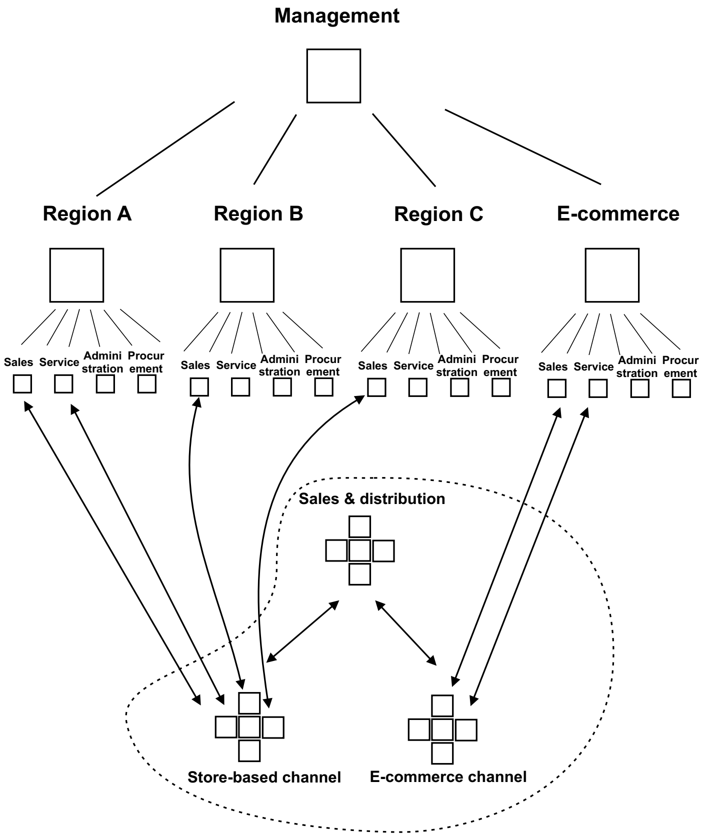

Figure 5.5: Integration of the model into company organization. Case 2: Divisional structure

Object model

The data structure of the general model is used to store the basic elements of the performance measurement system. On the highest level *scorecards*, *success factors channels*, *strategic goals*, and *measures* can be identified. The relation between these classes are illustrated by the class diagram in 5.6.

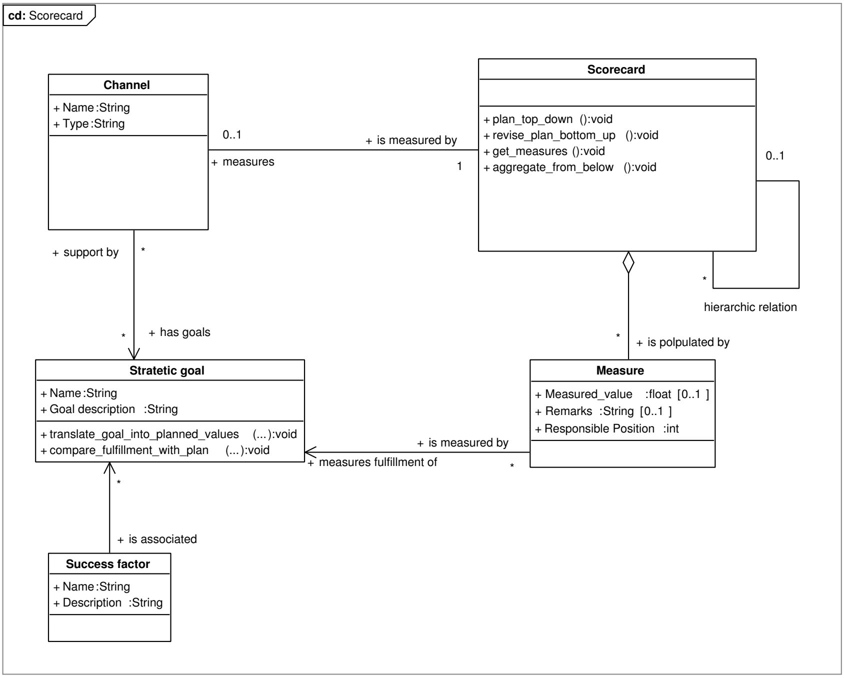

Figure 5.6: Data model for definition of channel-specific scorecards

Channel The channel class represents the different sales channels of the company's sales and distribution organization. Every object in this class represents one distinctive sales channel. The most important attributes of channels are their name and the description of their type. Channels are static components of the performance measurement model. They are determined by the company's business model, and more precisely by the distribution channel model.

Success factor Success factors are important areas of measurement which are described in the theoretical part of this work (cf. chapter 3.4). Success factors are static parts of the model, which preliminarily are stipulated in the customization process, when the performance measurement system is introduced. Success factors represent the company's performance areas, which should be monitored by the system. The decision for specific success factors is a strategic decision in the frame of performance measurement.

Strategic goal A required characteristic of performance measurement systems is the linkage of performance measures and strategic goals [LyCr91]. This model meets this requirement by the introduction of a class strategic goal and its relation to measures. Every strategic goal is described by an instance of this class. In the consequence it is possible, and in the course of this model mandatory, to link every measure to a strategic goal. Strategic goals are only required if they are associated with at least one success factor. Otherwise they do not refer to goals which should be measured, and therefore are not handled by the measurement system described by the model.

Measure Performance measures are the core of a performance measurement system. The class measure keeps track of target values and actual values in a scorecard. Since the actual value can be stored in just one entry, it is a simple attribute of the class. A measure can hold a complete set of target values, which are generated in the planning process. Therefore all revisions of target values are objects of a seperate class. Every measure has to be associated with a strategic goal. A measure also can include remarks which may be used to explain or justify a certain target or measured value.

Scorecard A scorecard in this model represents a set of measures which is used to measure the performance of a certain channel or of the whole sales and distribution branch of a company. Every channel has its own scorecard, but not every scorecard necessarily has an assigned channel. Since scorecards stand in hierarchical relations to each other, this relations are also expressed by the association *hierarchic relation* where the tree structure of the performance measurement model can be reproduced in the information system. The association with superior or inferior scorecards is also important for the possibility for aggregation of measured values or the disaggregation of target values in the planning and measurement process.

The classes *Scorecard*, *Success factor*, *Channel*, and *Strategic goal* primarily describe the organization of a performance measurement system around the actual measures. Their definition allows the storage of different parts of the performance measurement system and their relation. And the relation of performance measures to each other. To use the system for planning and measurement, target values and actual measured values have to be recorded for specific points in time or periods in time. Figure 5.7 shows a more detailed class diagram of the class measure.

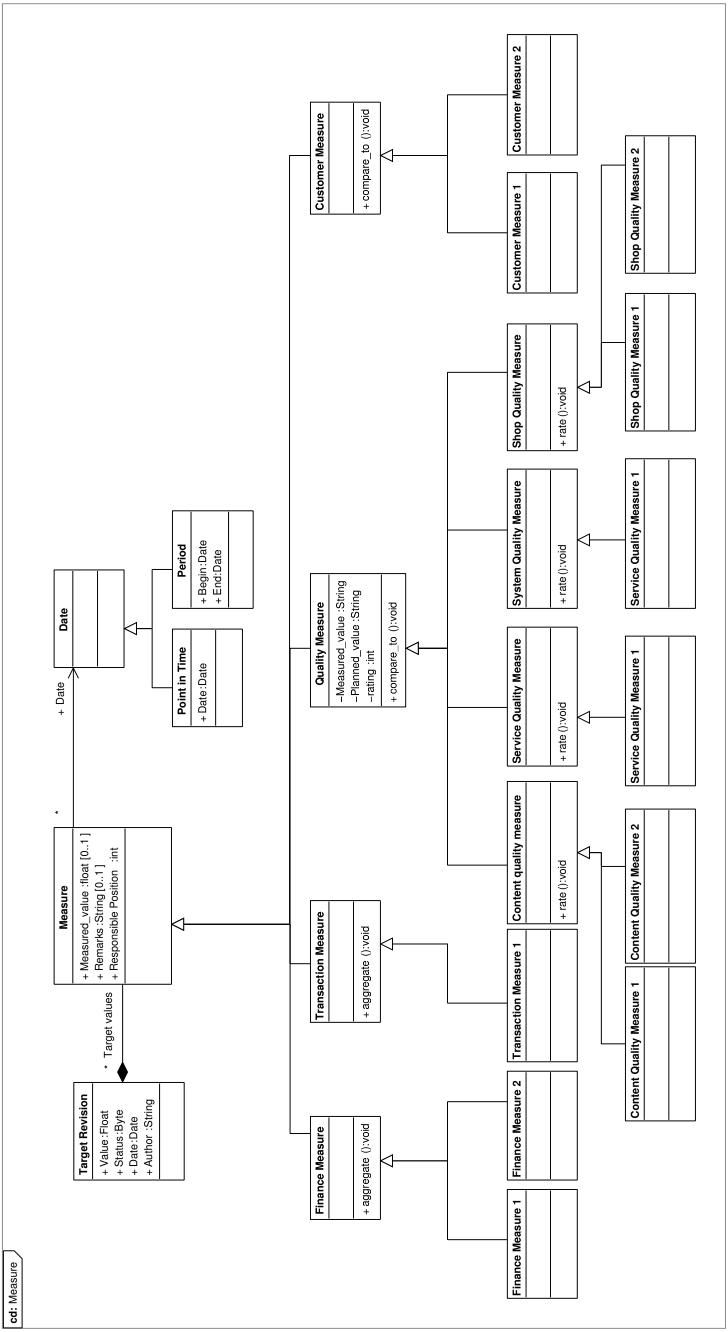

Figure 5.7: Measure class in detail

Each measure is related to a specific date. The date may be either a specific point in time or a period in time, depending on the type of measure.

Date The distinction between point in time and period in time is achieved by two subclasses which can handle these different time formats. A point in time just needs one date entry, while a period is delimited by its beginning and its ending date.

Subclasses of measure The class diagram in figure 5.7 shows a number of subclasses for measure. This specialization allows the distinction into several types of performance measures. Each type of measure may allow different operations. This property will be discussed in the following views of the model. Each type of measure can also have different data requirements which can be modeled into a particular class. Measures with no special data requirements and functions are derived from the generic subclasses *Finance measure*, *Transaction measure*, *Quality measure*, and *Customer measure*. These generalized measures are predefined by the model and come along with certain features and limitations which will be discussed in the *output view of the model*.

Target revisions To enable the revision management of the target values in the planning and negotiating process, every measure may contain a whole set of target value revisions. Every revision is tagged with its date, and the author. The status of a revision is used to indicate whether it is a proposed value or an agreed target value.

Entity relationship model

Object oriented modeling in form of class diagrams allows certain features which are not existent in relational data models. Since the performance measurement system typically will make heavy use of database systems, also a relational data model is represented. Figure 5.8 shows the Entity Relationship Diagram (ERD). The relational model naturally cannot be an one-to-one representation of the class model. However, the goal is to realize the underlying data structure as far as possible. One advantage of the relationship model is a focus on efficient storage of the incurred data. Another advantage is that it is easily possible to transform the relational model into real table definitions for relational database management systems.

Channel (<u>Channel-Id</u>, Name, Distribution-Type, Channel-Manager)

The entity type *channel* describes channels as entities. Every channel gets a unique number as reference. It can be described by its name and by the distribution type of the channel. Also the channel manager can be enlisted.

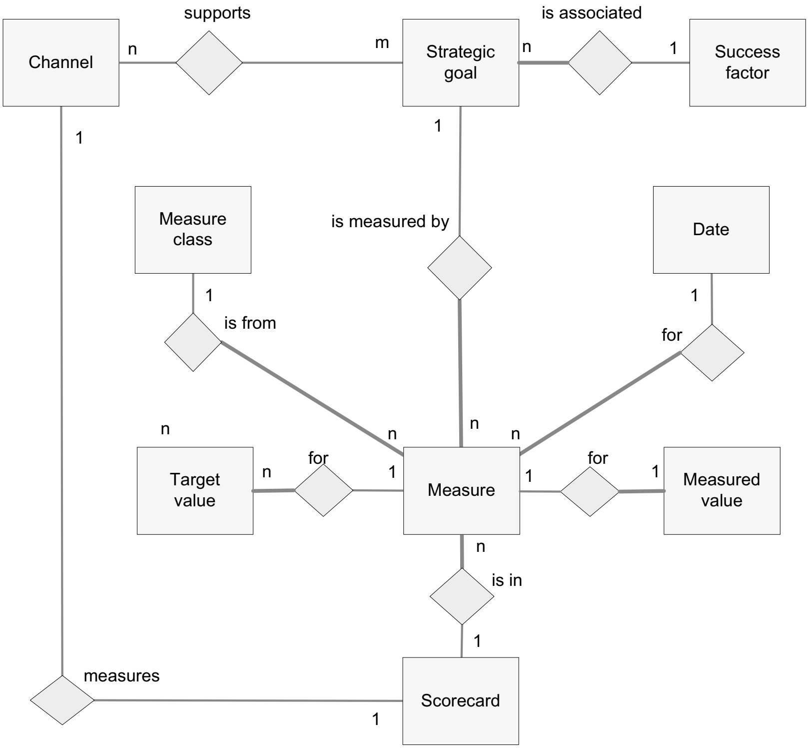

Figure 5.8: Entity relationship diagram for performance measurement

Success factor (Factor-Id, Name, Description)

Success factors describe important fields of measurement for the company. Every factor is beyond its name also annotated by a textual description of the success factor and why it is regarded as important. The channel descriptions are accessible for all users of the system and therefore act as an instrument to assist the communication of important company goals to the employees. This work discusses the factors *finance and transaction measures*, *customer satisfaction and behavior*, *system and content quality*, *after-sales-service quality*, and *trust and security*. These are also recommended as basic configuration for the performance measurement system. The multichannel retailer is able to revise these factors and define their own factors in the course of the customizing process.

Strategic goal (Goal-Id, Name, Description)

The entity type *Strategic goal* includes the name and description of goals. Every goal is assigned to a success factor. A n-to-m relation between *Channel* and *Strategic goal* is used to express which goals should be supported by which channels. In practice, this relation will be almost complete. There may be channel-specific goals which are not applicable to all channels. A strategic goal, which is not associated with any channel, applies to the overall sales and distribution function and, therefore, is only measured in the top level scorecard.

Scorecard (Scorecard-Id)

Every scorecard is a set of measures which is either associated with a single channel or the whole sales and distribution system. Scorecards stay in hierarchical relationships with each other. In the entity relationship model, this is achieved by a one-to-n relation with itself.

Measure class (Class-Id, Name, Description,
Aggregation-function, Breakdown-function, Comparison-function)

Since the Entity Relationship model does not support specialization and generalization in the same way as object-oriented modeling does the different specializations of the class *Measure* have to be resolved in another way. The specialization of the different types of measures lies in providing different methods for aggregation, breakdown and comparison of measures in different related scorecards. Since it would make no sense to introduce different entity types to specify different functions for different types of measures, an entity type *Measure* class is used to describe the different types of measures. The entities are described by name, a brief description and their functions how to aggregate, break down and compare measures of this class. If a type of measure has specific data requirements which should be included in the system, additional independent entity types have to be created. The relational model does not provide a mechanism wich encapsulates these data requirements into a separated, measure-specific space, the way the class model does.

Date (Date-Id, Begin-Date, End-Date, Period-Flag)

The relation *Date* represents the underlying timetable for the planning and measurement system. Since performance measures either relate to a specific point in time or a specific period of time, the relation can handle both types. In contrast to the class model, where this difference is modeled by two specialization classes of date, the entity date in the entity relationship model takes both types. The type is indicated by the flag *Period-Flag*. For points in time the attribute *Begin-Date* is sufficient. For periods in time a *Begin-Date* and an *End-Date* have to be stored.

Measure (Measure-Id)

Every measure handled by the system is registered as an entity in the entity type *Measure*. The relations to other entities determine the most important attributes of every measure. Thus, one must specify in which measurement class the measure is taken. Further, it has to be assigned to a specific scorecard and a specific date. The date determines which date the target values are planned for and to which date or period the measurement of an actual value is applied. Further, every measure has to be assigned to a strategic goal. This ensures that no measure is planned or taken without an underlying strategic planning.

Target Value (Measure-Id, Revision-Id, Value, Status, Date,
Author, Remarks)

Target values are stored in dependency of entities of *Measure*. The primary key is composed of *Measure-Id*, the primary key of *Measure* and *Revision-Id*. Every measure can take several revisions of target values. Storing multiple revisions makes sense since the target values may change several times during the different phases of the planning process. Also, the date and author of every revision are stored.

Measured Value (MeasureID, Value, Remarks)

Measured values are stored in dependency of entities of *Measure*, too. Just one value for each measure is stored. Therefore the primary key is *Measure-Id*, the same as in *Measure*.

5.1.3 Function view

The function view is split into three major parts which describe three different stages in the goal-setting and measurement process. The first part consists of functions which are necessary in the course of customizing the system for a specific company. These are basically the functions needed to establish the performance measurement system and its prerequisites.

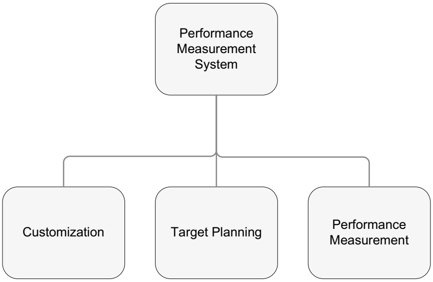

Figure 5.9: Function tree of the overall system

The second part refers to all the functions which are related to the planning process and the establishment of goals with the system. They are outlined in the use cases in figure 5.1. The third part focuses on the measurement system and its usage is described by the use cases in figure 5.2. Figure 5.9 displays this categorization as a function tree.

The description of the functions of the information system in this requirements definition gives an overview of the necessary business processes. Detailed descriptions of how these functions should be implemented are omitted.

Customization

The customization branch describes the functions which are performed in the phase when the information system is set up for the first time. During this phase, the foundations of a working performance measurement system have to be laid out.

In the primary steps of setting up the performance measurement system, channels have to be entered, success factors defined, scorecards established, and measurement classes have to be created. These functions are, on one hand necessary to prepare the system for its usage as a planning and measurement system. On the other hand these functions require the users to think about factors or basic variables of the system, which possibly are not available before the establishment of the performance measurement system. Since such a system can be modeled to require a certain type of information before accepting any other information, it is able to enforce users to strictly fulfill the recommended process of setting up such a system. For example, the performance management system requires the definition of strategic goals in order to enter performance measures. This way the users cannot bypass the recommendation of linking performance measures to strategic goals. Figure 5.10 shows a detailed function tree for the customization phase.

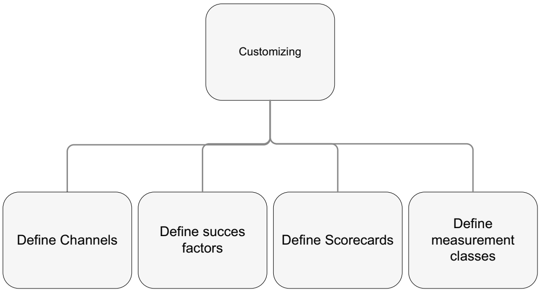

Figure 5.10: Function tree of the customization branch

Define channels is a function of the customization process. It provides the possibility to create, edit and delete channels in the performance measurement system according to the multichannel strategy of the company. The function *Define success factors* provides the possibility to create, edit and delete success factors, while *Define Scorecards* also allows maintaining scorecards and assigning them to previously defined channels.

The function *Define measurement classes* is used to create and maintain different types of measures. The set of measurement classes defines the set of available performance measures in the system. The system provides a basic set of measurement classes which are discussed in the output view of this chapter. The creation of measurement classes inherits more complexity than the other functions in the customization branch. It is possible to define whether a specific type of measure can be aggregated from measures of underlying scorecards, broken down into measures of underlying scorecards, and wheter if it is possible to compare the values to other values of measures of the same type in other scorecards. If functions for these tasks are available, they can also be implemented and assigned to the measurement class.

Planning

Figure 5.11 shows a more detailed function tree for the planning functionality of the system. These functions provide the possibility to use the system for the creation of strategic goals and establish target values for the different positions of the multichannel retailer. An important part of these functions is the support of the negotiation process (through which each target is discussed and agreed between users) on different hierarchical levels of the company's organization.

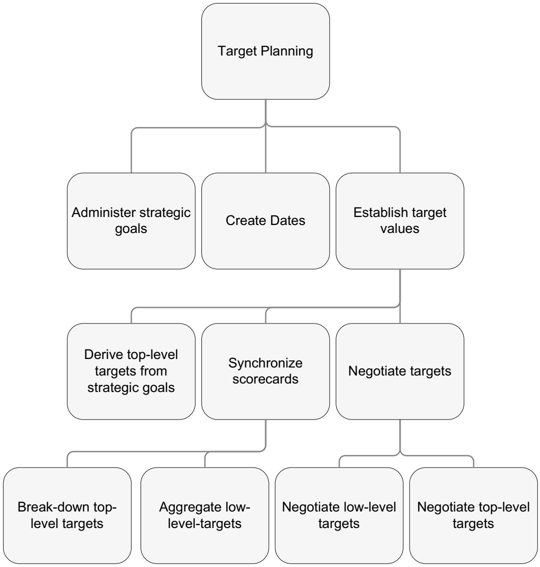

Figure 5.11: Function tree of the planning branch

The function *Administer strategic goals* aids the creation and revision of strategic goals. The goals are derived from success factors and provide the basis for the establishment of target values in the later course of the planning process. *Create dates* allows the definition of points in time and periods of time for which the planning and measurement will be done.

The function *Establish target values* is split into several subfunctions: *Derive top level targets from strategic goals* is used to create initial values for the top level targets, which should be directly derived from strategic goals. The branch *Synchronize scorecards* provides subfunctions which aid the aggregation of target measures of a low level scorecard into the top level scorecard and vice versa the breakdown of planned values. Depending on the abilities of the *Measure* class the aggregation and break-down can be done by the performance measurement system itself, or the relevant values have to be entered manually by the user. The branch *Negotiate targets* assisting the negotiation process of targets. The process typically involves users on different hierarchical levels of the organization. The negotiation functions are defined for every level of scorecards. In the case of two levels, negotiation can happen for the top level targets as well as for the targets in the low level scorecards of each channel.

Measurement

The branch *measurement* defines functions which are used to obtain, communicate and evalute the achieved performance. The function tree in figure 5.12 displays an overview of the functionality.

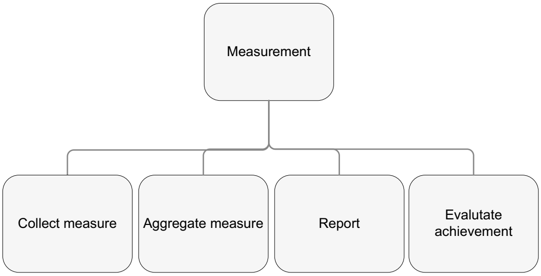

Figure 5.12: Function tree of the measurement branch

Collect measure is used to insert the actual measures into the performance measurement system. In general cases, when the information system does not know how to calculate the value, it is entered manually. If the needed functionality is provided by the *Measure* class and the information system owns all necessary data, the calculation is provided by the system.

Aggregate measure uses the same mechanism as the aggregation function of the target planning branch to aggregate low level measures to the measures in the top level scorecards. *Report* and *Evaluate achievement* are functions which are used for self-assessment and performance assessment of underlying employees or channels.

5.1.4 Control view

The control view combines the elements of the *organizational view*, the *data view* and the *function view*. While the other views describe a static description of the model's elements, this section presents a dynamic view of their interplay. The control view of the performance measurement model is split into the three main branches of the function view (see figure 5.9), *customizing*, *planning*, and *measurement*.

Figure 5.13 displays the sequence of customizing, planning and measuring. Before the performance measurement system can be used it has to be customized for the specific company. After the system was is up, it can be used for planning and measurement cycles, where performance measures' target values are firstly planned, and then actual values are measured. The measured

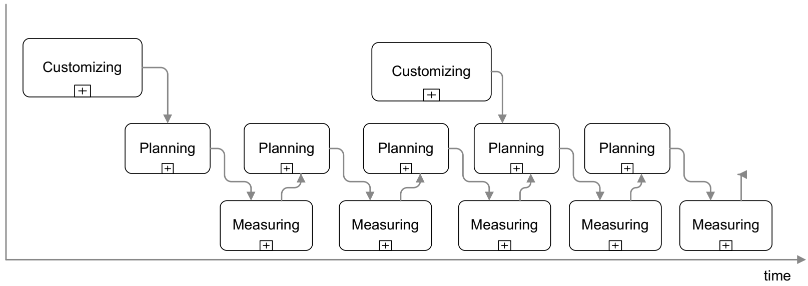

Figure 5.13: Sequence of customizing, planning and measurement processes

performance is used as feedback information for the ongoing planning process for the next period. The system is revised in regular intervals. Therefore, customizing processes are re-run to keep the system up to date and to further enhance it.

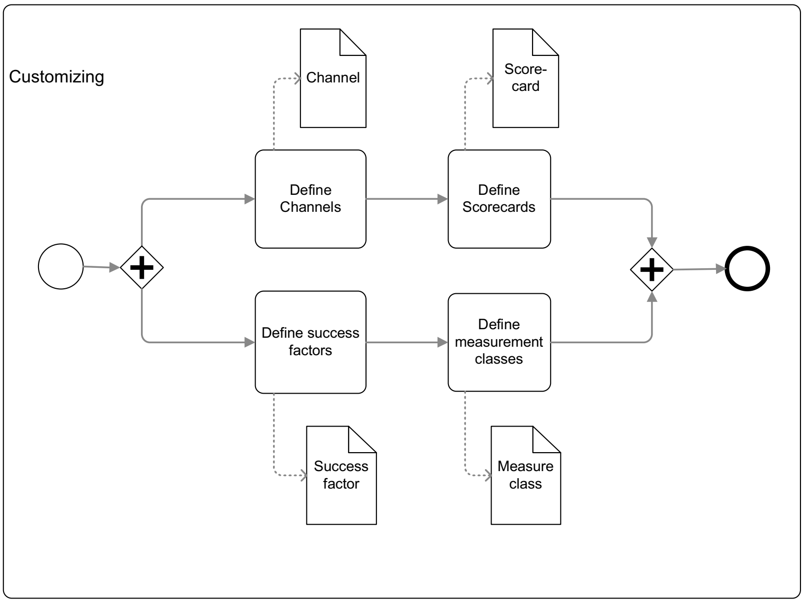

Figure 5.14: Business process diagram for the customizing process

Figure 5.14 displays a business process diagram for the *customizing process*. The essential character of this process is the definition of all basic parameters for the system. Specific channels have to be defined and stored in the database. After this step, scorecards can be defined. Usually, there will be a scorecard for each channel and one superior scorecard for the whole sales and distribution system of the performance measurement company. Scorecards are stored as entities of *Scorecard*. Since the introduction of a performance measurement system will not necessarily change the multichannel business model of the company these processes are rather descriptive than creative. The output is a suitable description of the channel structure of the company which can be used for performance measurement.

In addition to the definition of channels and scorecards, the basic success factors of the company are defined. As stated above, this book discusses suitable success factors for multichannel retailers. However, an essential part of establishing an adequate performance measurement system is thinking and defining a set of success factors which are seen relevant for the success of the company. This has to happen in the customizing phase. The later processes rely on a satisfactory definition of success factors. Success factors are stored as entities of the entity type *Success factor*.

Another important function conducted at the customizing phase is the definition of measurement classes. The output is stored as entities of *Measure class*. In an object-oriented system, the different types of measures would be defined in form of specializations of the measure class. Chapter 5.2 of this work will discuss suitable types of performance measures and the possibility of their system-aided measurement. The definition of relevant measures can be seen as a central element of the customizing phase. It equals the selection of suitable performance measures for the performance measurement system. The selection is an ongoing topic of discussion in performance measurement literature and finally determines the success or failure of the performance measurement system.

Organizational elements are not included in the model. Since this process is conducted just once at the introduction of the performance measurement system, it will typically not be as standardized as the other processes, but will rather possess the character of a project. External consultants are often involved in the process of setting up such systems. The organizational unit which performs this task therefore is not bound to the usual organization structure of the company. Any attempt to assign specific positions would therefore be ambiguous.

The customizing phase ends when a proper set of *Channels*, *Scorecards*, *Success factors* and *Measure classes* are defined and stored as appropriate entities or objects in the system. The output can be seen as static data in the system, while all other information represents the dynamic or operational data of the performance measurement system.

The *target planning process* is characterized by the dynamics of projecting and negotiating target values on the distribution system's different hierarchic levels. Figure 5.15 shows a business process diagram model for the target planning process. Since the optimal assignment of functions in such planning systems differs from company to company [LoVa76], the mapping

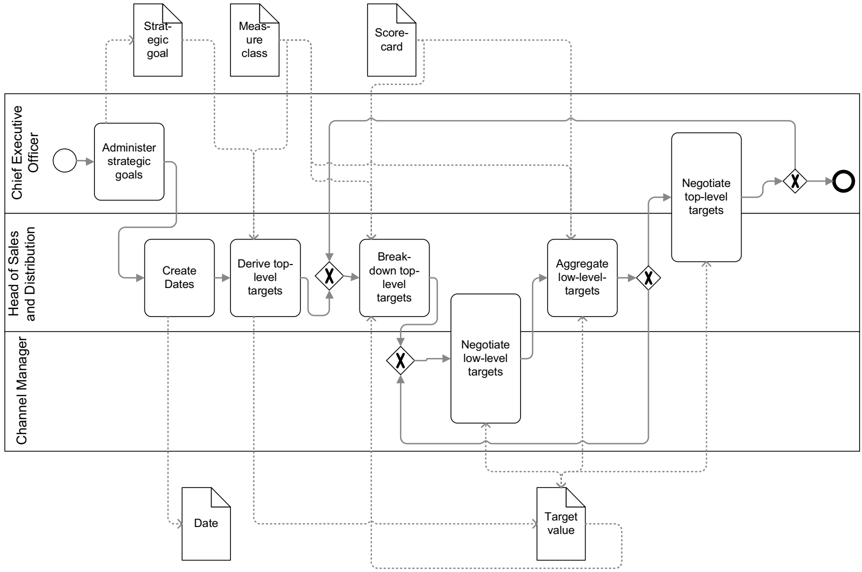

Figure 5.15: Business process diagram for the target planning process

of organizational units represents a proposal for a balanced mix of top-down and bottom-up planning cycles.

As a first step, strategic goals for the future operation of a company must be defined. This happens on the basis of the overall company strategy and the defined success factors of the sales and distribution system. This function is typically conducted on the management level of the company.

Strategic goals have to be operationalized as target values for certain target dates. As a first step, target dates in the system are defined. They represent the timetable for the performance measurement system. Afterwards, top level targets can be derived from the strategic goals. These targets on the top level scorecard of the system have to be broken down into targets of the underlying scorecards. The projected target values need to be negotiated and adjusted with the responsible positions. Since changes of these values will have consequences for the higher levels, the target values have to be aggregated again and negotiated with the top level management. Depending on the negotiation's outcome this process can loop several times until the whole target planning is agreed on with all the involved positions in the company.

Major output in the form of data entries are:

- A timetable in *Dates* and
- agreed *Target values* for all *Measures* in all defined *Scorecards*.

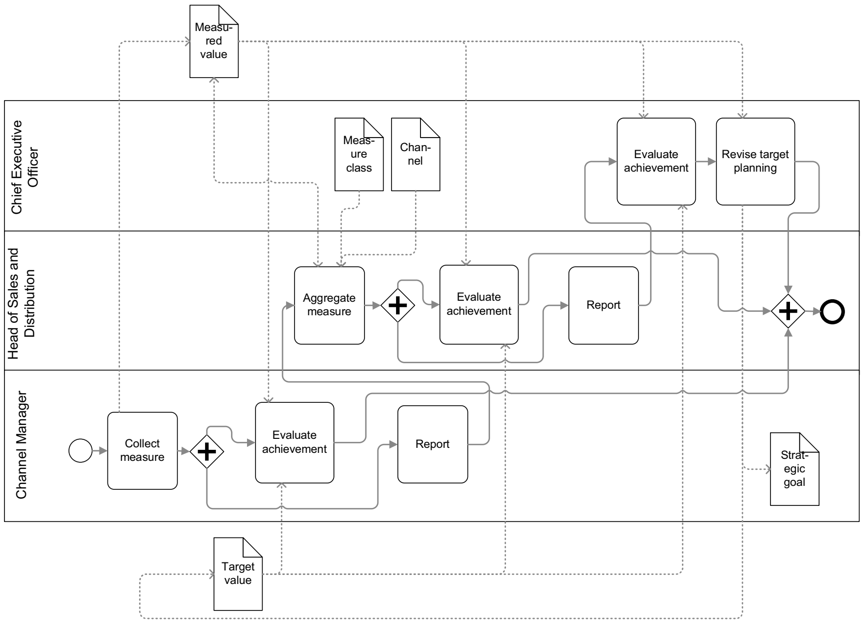

Figure 5.16: Business process diagram for the measurement process

Finally, the *measurement process* is conducted to evaluate the performance of the sales and distribution channels. Figure 5.16 shows the business process diagram for the measurement process. It starts with the collection of values for measures of the low level scorecards. These values are stored in the database as measured value entities. After recording the values, they can be aggregated to values in the top level scorecard for the whole sales and distribution system.

After the values are stored in the system, employees can use them to assess their own performance. The values are associated with the target values which were planned in the previously conducted planning process. If the according comparison functions are defined for the measurement classes, the system is able to compare the results with the planned values, as well as the values of other dates or other benchmarks. The performance is reported to the responsible line manager. Management can use the actual recorded numbers to evaluate the performance of their staff members, allocate bonuses if the performance measurement system is linked to an incentive system. Top management uses the actual performance values to revise the strategic goals, which are used for further target-planning. So the actual performance is used to influence planned performance, and the performance measurement loop is closed.

5.1.5 Output view

The output view of this model is not, as one would assume, used to describe how user interaction takes place with the performance measurement system. It rather focuses on the discussion of the content, more precisely, on different types of measures and how they should be interpreted. The discussion spans over different types of measures which are used with this system. As described in the previous subchapters, these types represent classes of *Measures* which are stored in the system.

This approach takes a customer-centered view. In terms of marketing, a customer-centered view discourages managers to think in sales channels and encourages them to think like customers of one whole company with different points of contact insted [ScGo02]. Therefore, it gives more weight to the performance optimization of the whole sales and distribution system than the optimization of single channels and the comparison of different channels against each other.

The recommended classes are derived from the discussion of success in chapter 3.4. They are categorized as follows:

- Finance measures
- Transaction measures
- Customer satisfaction and behavior
- System and content quality
- After-sales service quality
- Trust and security

Since this performance measurement system takes place in the planning process, the category of strategic planning was omitted. The discussion of the instruments' performance is not included in the instrument itself at this stage.

Finance measures

Finance measures are, in principal, measurable and comparable for each channel. However, the interpretation of finance measures has to be done very carefully. Synergetic effects between the sales channels, as discussed in the previous chapters of this book, may distort these values in such a way that a simple channel comparison can draw a misleading image.

This argument can be explained by a simple example. Assuming a multichannel retailer operates two sales channels, a store-based channel and an online channel. Both channels offer the same range of products and are very well coordinated, so that customers can freely switch channels between different phases of the purchasing process. Since the selection of products requires solid guidance, most customers prefer to come to the store-based channel, to be advised by the sales person, but commonly do not immediately buy the products. The company's online channel allows comfortable option of ordering of the products from home, so the greater part of these customers decide to order the products from home, since they do not want to travel to the retail-store a second time. Thus, the store-based channel generates traffic and revenue in the online channel. However, this service is usually not reflected by finance measures. Customers with such switching behavior induce cost on the one channel but generate revenue in another channel. To filter out this effect one would need detailed knowledge about the customer's path through the distribution channels and the originated cost by these processes. Value which is created by synergetic effects themselves cannot be measured at all. Without comprehensive knowledge of mutual services between coordinated channels and their cost, financial results of the different channels should not be compared to each other.

Finance measures are measured in uniform scale, in terms of money. Therefore the performance of different channels can easily be aggregated to represent the financial performance of the whole sales and distribution system of all channels. The aggregated numbers can be computed by simple additions or weighted averages. The performance measurement system provides functions which aggregate finance performance measures from low level scorecards to top level scorecards. The comparison of values between different channels is blocked by the system. Nevertheless, the comparison of values from other periods or benchmarks is supported and can be done automatically by the system.

In retailing, different ratios like the cost to sales ratios of channels plays a role, too [BeWi06]. These are typically used to compare different units with each other. Cost of sales ratios affected by customer migration in the different phases of the sales process. Therefore, such ratios may also be biased when they are measured by multichannel retailers.

Specialized performance measures for multichannel retailers allow the estimation of customer migration between channels. Such measures are discussed in the succeeding sections of this book. They may allow a unbiased comparision of channels by such measures.

Transaction measures

Transaction measures refers to complete transactions in form of recorded purchasing events. A customer who buys a number of products during one visit in a sales channel originates one transaction. Since the definition of transaction stays the same for all types of distribution channels, the numbers can easily be aggregated and broken down from one scorecard to another scorecard. The aggregated numbers can be computed by simple additions or weighted averages. Also, the comparison of transaction measures like number of transactions, turnover per transaction, products per transaction and so on, inherits no pitfalls and can be aided by the system using simple number comparisons.

Customer satisfaction and behavior

A generally aknowledged way of measuring customer satisfaction is to make an inquiry with the customer himself after the consumption of the product [GiVe06]. The questionnaire should be standardized in such a way that the same questions can be used for customers who use different channels. The inclusion of questions about the channels the customer uses during the different stages of their purchase would be reasonable. Such an inquiry could also provide the information for a comparison of customer satisfaction in different channels.

If the measurement instruments for customer satisfaction are standardized, they can be aggregated and compared by statistical functions. The right function depends on the used measurement instrument and the used scales. Since the aggregation of customer satisfaction measures may depend on complex statistical methods, the function is not easily reversible. The system therefore does not assist breaking down targeted success measures. Planning has to be done manually by the user.

In terms of customer behavior, multichannel retailers are especially interested in their customers' behavior regarding channel choice and use of channel-specific features. Measures which are able to capture or estimate customer behavior are discussed in the following specialized parts of the model.

System and content quality

Quality of e-commerce channels can be differentiated into the quality of the e-commerce system and the quality of the content. Quality is difficult to describe in terms of numbers, and its evaluation has to be channel-specific. A reduction to numbers which allow comparisons between different channels would result in a loss of most important channel-specific information. Therefore, quality should be measured channel-specifically and cannot automatically be aggregated into top level measures or broken down into lower level measures. Specific target levels of quality can and should be very well-defined on the company's management levels. However, the necessity of interpretation of quality levels makes quality goals very channel-specific. The system therefore does not supply aggregation, break-down and interchannel comparison of system and content quality. The comparison of different points in time or periods in the same scorecard is possible, presuming that the corresponding quality levels are defined in the measurement class.

Quality of after-sales service

In contrast to the other quality measures, the quality of after-sales services can be standardized across different sales channels. The used methods may range from complex constructs like perceived service quality [PaZB85] to simple transaction measures, like the counting of positively handled requests. All standardized measures can be automatically aggregated and compared by the system. Simple measures, which require no irreversible functions for aggregation, can also be broken down.

Trust and Security

Trust and Security are important success factors, particularly for e-commerce channels. Coordination of channels also targets improved trust, or the transfer of trust from one channel to another channel cf. [AcBC^{+}05]. Whether transfer of trust takes place, and how strong this transfer happens, depends among other factors on the multichannel business model. While it is not clear how strong the transfer from one channel to another channel actually turns out, aggregation of trust levels and breaking down of trust levels are not recommended.

Trust levels, if they are measured in a standardized manner, are comparable between channels and between different points in time. Measurement of changes in the alignment of trust levels for different channels can give interesting hints on the transfer of trust between the operated sales and distribution channels of the company.

It is known that security features influence trust. Security is very unique for the different sales channels. While perceived security can be seen as important success factor for an e-commerce channel, its importance for the success of typical store-based distribution channels is questionable. Therefore, the measurement of security and the evaluation of trust, or other performance measures, is only recommended within e-commerce channels. Aggregation, break down and channel comparison are not applicable for these measures.

Summary

Table 5.1 summarizes the capabilities of the proposed measurement classes for the system. This declaration should only be treated as a general guideline. The power of the included mechanism of providing class-dependent functions for aggregation, break down and comparison lies in the individual treatment of each measure. If a measure can be standardized in such a way that an automatical aggregation and break down is possible, the corresponding functions can be implemented in the system.

The table shows the availability and the feasibility of aggregation, break down, and comparison functions in a standard setting of the performance measurement system. Comparisons between different dates or other benchmarks, which reproduce the same performance measure for some similar business unit, are practically always possible. The table uses symbols to indicate whether a function is available or not. [+] means the function is available and feasible. [-] means the function is either technically not availables, or is in standard form not feasible or misleading. [*] means that the availability strongly depends on the concrete occurrence of an individual measure.

Success factor	*Aggregation*	*Break-down*	*Channel comparison*
Finance measures	+	+	-
Transaction measures	+	+	+
Customer satisfaction	+	-	+
Customer behavior	-	-	-
System and content quality	-	-	-
After-sales-service quality	+	*	+
Trust	-	-	+
Security	-	-	-

Table 5.1: Summary of the proposed measurement classes

As mentioned before, this table has to be interpreted with caution. The provided class specialization mechanism makes it possible to implement unbiased comparison, break down, and aggregation, if such functions are available. Every company has to decide for itself, for which classes an interchannel comparison is feasible or not. The general model of this work recommends the treatment of the discussed types of measures as indicated in the table above. A more detailed discussion of performance measures, suitable for multichannel retailers, follows in the next section. In the specialized model, a set of migration models will be specified for the performance measurement system. Eventually, the implementation of the following measures will make it possible to break through the presented barriers of the system.

5.2 Selected performance measures for e-commerce multichannel retailers

After the requirements definition of the general performance measurement system, this section will introduce measures which allow judging the behavior of multichannel customers. For this purpose, a much more detailed model of customer processes in multichannel retailing will be presented. On top of this model, relevant measures for the performance measurement system are designed. The design is intended to fit seamlessly into the general system and is modeled in the same scope of the ARIS framework.

Figure 5.17 shows the process model of the purchasing process in three phases. The originator is the customer. He is in complete control of the sequence of process execution. The customer decides to use company processes in the phases pre-sales, sales and after-sales. He is able to loop through the processes in different channels. He may also switch between the channels of the company and other companies/competitors.

An advantage of multichannel business models is the possibility for customers to freely switch between channels. Therefore, multichannel companies typically do not force their customers into specific process sequences. The process in the model begins with the start-event “potential customer”. The model allows for several cycles through pre-sales processes. If the customer does not buy the product during his visit, he may reconsider his decision and loop through the pre-sales phase again with another chance of purchasing the product. Between these cycles, the channel or even the company may be switched. If the customer finally decides not to buy the product, or buys it elsewhere, the process ends at the non-customer end-event. If a customer decides to buy, they run through the purchase process in a specific channel. After a successful purchase, the customer may run through after-sales processes a number of times, every time in a different channel as well. The completed process ends in the end-event *customer*.

In this model, the four processes in the pre-sales phase and sales phase, which takes place in the distribution channels of the multichannel retailer, are marked as subprocesses. Detailed views for these are available. The design of all subprocesses is company-specific. The following

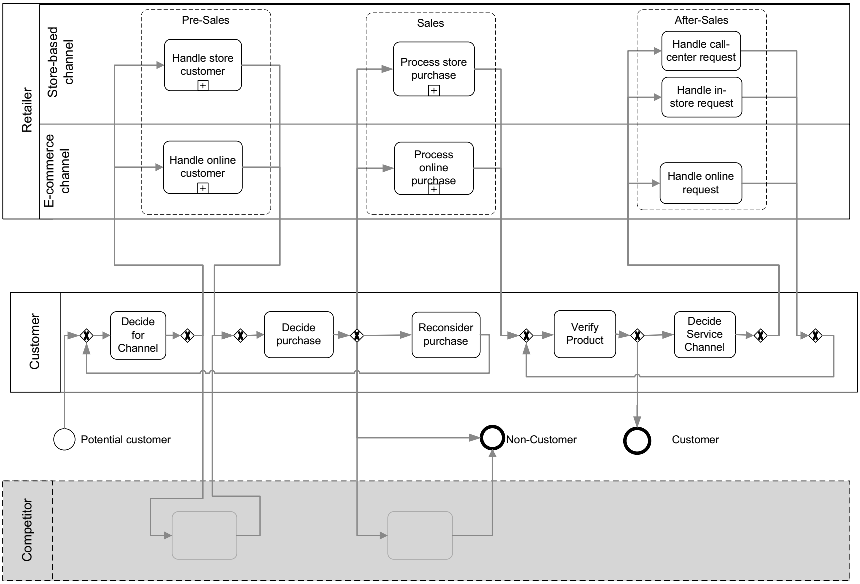

Figure 5.17: Overview of pre-sales, sales and after-sales phase in the distribution process

models represent examples for these subprocesses. They do not reflect these processes for every multichannel retailer, but the idea is to give a general impression of how these processes may be organized.

Figure 5.18 shows the detailed processes which may occur when a customer uses the store-based distribution channel in the pre-sales phases. The customer may browse through the shop and in addition ask an employee questions about the range of offered goods and services. He may also look at a product or ask product-specific questions. The shop employees have to handle all kinds of questions which may come up. Once again the customer controls the process and there is no predetermined sequence of processes. The model describes the possibility of looping back to another cycle of catalog or product inquiry.

The following purchasing process is illustrated by figure 5.19. In this process, a predefined sequence must be followed. Merely the collection of customer data is optional.

The pre-sales process in the online channel is like the pre-sales process in the store-based channel built around the retrieval of catalog information and product-related information. Each page of an online-store can be categorized into one of the following concepts: Acquisition (home), catalog information, product information, service, transaction, purchase and offline [TeGP03]. The pre-sales process in this model allows looping through acquisition, catalog information,

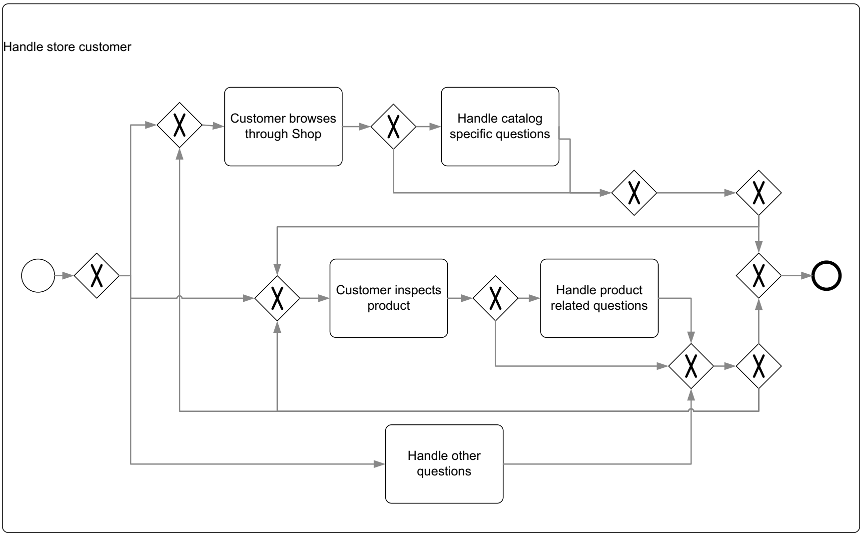

Figure 5.18: Detailed view of the store customer subprocess

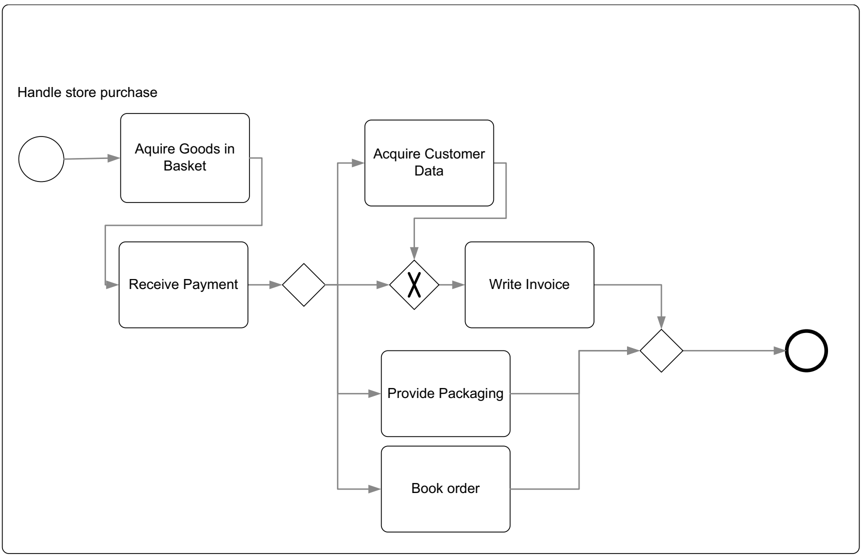

Figure 5.19: Detailed view of the store purchasing subprocess

product information, offline and parts of the transaction sections. Users typically enter the website at the acquisition area, from which they proceed to other parts of the store. Direct access to products is possible if other sites or ads directly link to the specific page. During the visit on the site, the customer may put products into his virtual shopping basket, which often is a necessity to purchase a good online.

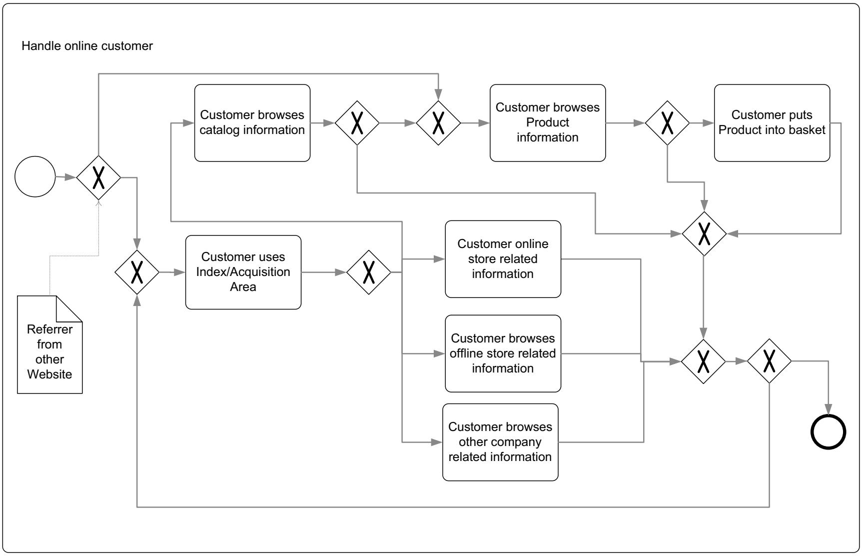

Figure 5.20: Detailed view of the online customer subprocess

The online purchase process follows a predefined sequence, too. It takes place on the transaction and purchase related pages of the website. The process is illustrated in figure 5.21.

When applying this process model of distribution via different channels, several challenges for performance measurement become apparent. Since the company is not in control of the sequence without taking specific measures it even does not know the sequence in which their customers "consumed" the processes. It does not know exactly, whether a customer who bought a product, merely informed himself once in one channel, or several times in different channels. It does not know if the customers got product-related information in a store and afterwards bought the product at some competing company. Figure 5.24 reduces the overview model to the perspective of a multichannel retailer, who does not explicitly measure the conversion between its different channels.

The requirements definition in the remaining chapter aims at measuring customer behavior in the scope of this model of two distribution channels. Therefore, measures which were discussed in chapter 3.5 are adapted to the general performance measurement system. The following

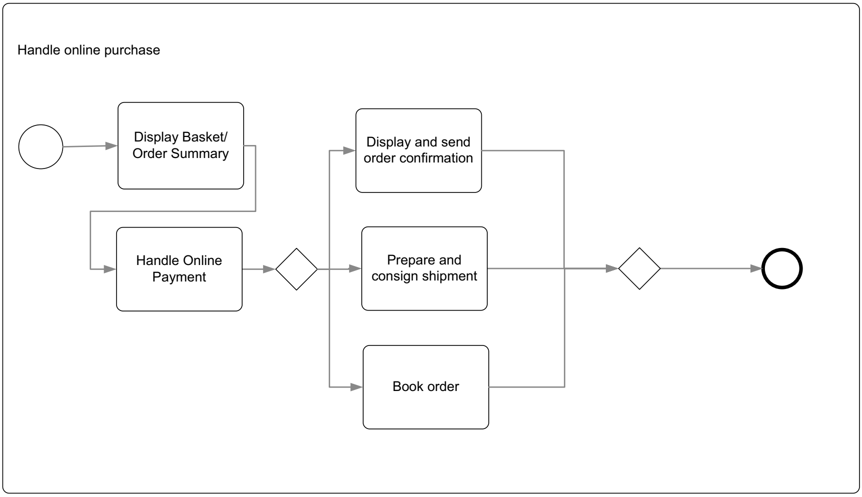

Figure 5.21: Detailed view of the online purchase subprocess

(previously discussed) concepts and measures will be adapted and integrated in the performance measurement system:

- Customer migration
  - General estimation
  - Web-based estimation
- Web-customer behavior
  - Offline payers
  - Payment migration
  - Deliveries to stores
  - Delivery migration

The organization of the model is the same as the organization of the general model. The model is structured along the five ARIS perspectives.

5.2.1 Organization view

The measurement of multichannel customer behavior is an exemption of the rule regarding its classification into the organizational model of the performance measurement system. A migration matrix spans at least two distribution channels. It cannot be estimated for one channel alone. Therefore, the measure is only available for the top level scorecard *sales and distribution*. Better integration of the distribution channels may also be a desirable objective for specific channels. In this case, specific migration rates of the whole migration matrix could be taken out and mapped to the underlying scorecards.

The web-customer behavior measures belong to the sphere of influence of the online sales channel and therefore should only be used in channel-specific scorecards of such channels.

5.2.2 Data view

To integrate the new performance measures into the general model (figure 5.7 on page 84), they are modeled as specializations of the *Customer measure* class. The new branch is displayed in figure 5.22.

The class *Customer migration* generalizes the two subclasses *General migration model* and *Web-based migration model*. The *General migration model* features the estimation of general migration models, based on the recording of customer contacts and transactions in different distribution channels. Internal data, which is needed for the estimation of the model, is marked as private data. The estimated migration matrix is public and therefore can be used by other classes in the performance measurement system.

General migration model

The *General migration model* class relies on a maximum of available information. It demands a data model where transactions are linked to customers. In this context, three types of transaction data can be distinguished [ScSc04]:

- anonymous transaction data
- pseudonymous transaction data
- personalized transaction data

Using *anonymous data*, transactions cannot be associated with different customers, and therefore can not be used for customer-related success measurement. *Pseudonymous data* allows the association between transactions and distinct customers or households. The transaction stays as anonymous since the customer is only known by a pseudonym, for example a customer-id

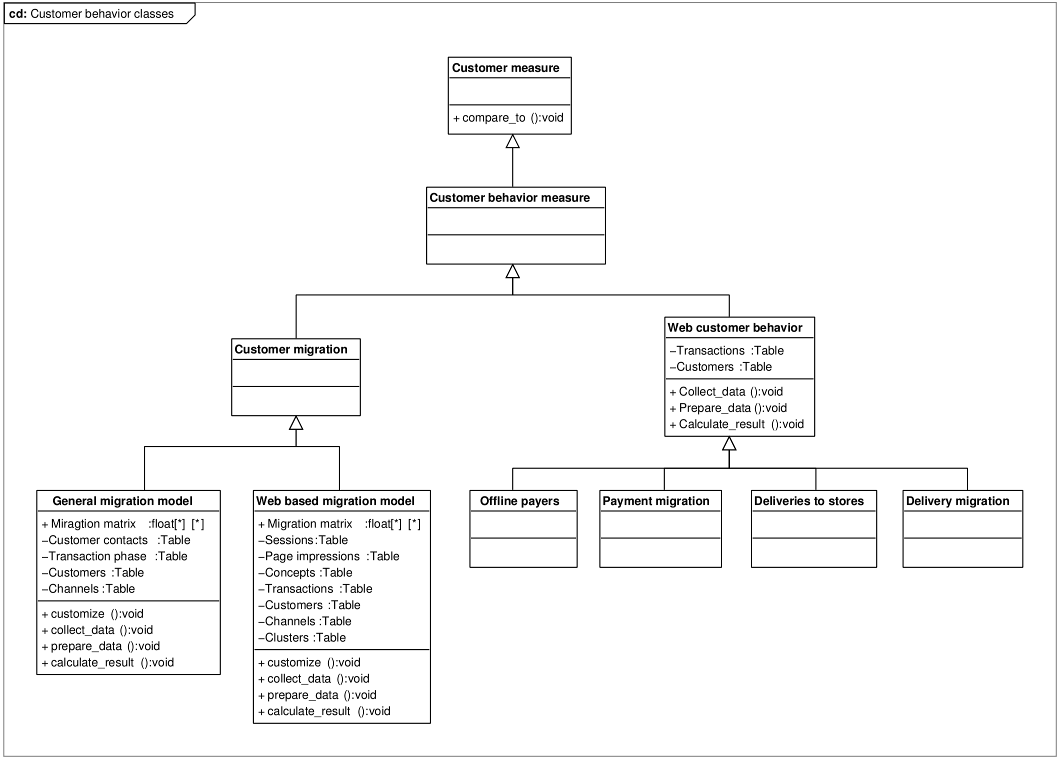

Figure 5.22: Class diagram of the introduced measurement classes for customer behavior

or card-number. The full identity is not recorded. *Personalized data* allows the association of transactions with the customer's identity. Such personalized data can be obtained by customer programs in store-based sales channels and customer orders in online and catalog-based sales channels [ScSc04]. Since the estimation of migration behavior only has to rely on the identification of distinct customers spanning different channels, *pseudonymous data* and *personalized data* can be used for the general migration model.

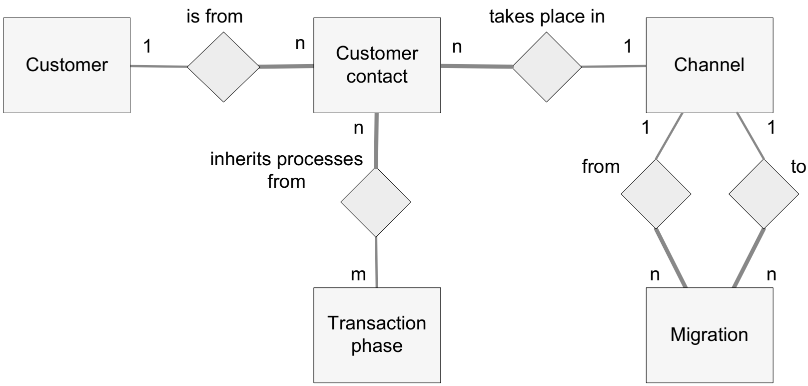

Figure 5.23: Data model for measuring customer migration

The specific data requirements for the estimation of the migration model are shown as ERD in figure 5.23. One part of the data, that is to say all entity types except *Migration*, are used as input parameters for the estimation. The output is a migration matrix which is saved in *Migration*. The specific format of the migration matrix is discussed in the function view section. The interpretation of the results is topic of the output section of this model.

Channel (<u>Channel-Id</u>, ...)

The entity type *Channel* serves as reference to the different sales and distribution channels of the company. This entity type is the same as in the general model. Since it is only needed to serve as reference to distinguishable channels with customer contacts, it will not further be specified in this chapter.

Customer (<u>Customer-Id</u>, ...)

The entity type *Customer* represents distinctive references to customers. As stated before, a complete personalized record of every customer's identity is not important. However, the consistent detection of a distinct customer in the different channels is necessary. Therefore the data model may either be personalized, as well as designed for pseudonymous data, or it allows the storage of both kinds of customer data.

Transaction Phase (Phase-Id, Name)

The entities of the type *Transaction phase* can be deducted from the process model introduced at the beginning of this section and are:

1. Pre-sales phase
2. Sales phase
3. After-sales phase

The entries in the database serve as reference and allow associating customer contacts with subprocesses of the whole sales and distribution process. Since every contact can be associated with more than one phase, the n:m relation has to be implemented as an additional table in the implementation layer of the database management system.

Customer contact (Contact-Id, Customer-Id, Channel, Date)

The entity type *Customer contact* is the central element of the data needed for the estimation of the migration model. It holds the information of which customer visited a channel on what date. At the estimation of the migration model, it is important to know the correct order of the measured contacts. Therefore the *Contact-Id* has to be logged in strict temporal ascending order. If this constraint cannot be fulfilled, the order has to be reproduced by the date of the customer contact.

Migration (From, To, Value)

The entity type *Migration* takes the output of the migration estimation. It stores the probability of the migration between the distribution channels. The detailed format of the migration matrix is discussed in the function view of this model.

Every estimation is only valid if the underlying empirical data represents the surveyed universe. Therefore, the measurement has to be unbiased. For a fundamental analysis, not only contacts, but also the phases conducted during the buying process, are relevant. Measuring these contacts can be problematic. The problem arises from the condition that the various types of channels demand different more or less reliable possibilities of measuring customer contacts. From the perspective of the company, the shown sales and distribution process rather looks as indicated in figure 5.24 (contrast to figure 5.17 on page 103).

The lack of knowledge of the complete process affects the possibility to estimate customer migration behavior. Ideal data for customer controlling would fulfill the following criteria [ScSc04]:

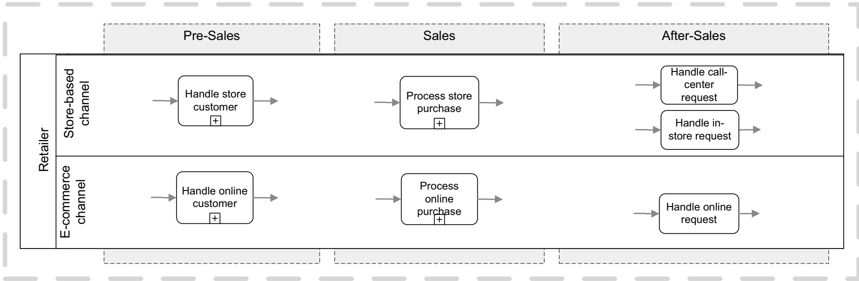

Figure 5.24: Company perspective

- Personal data of each potential and actual customer
- Logging of each customer contact in every channel
- The possibility to analyze all data channel-specific and channel-spanning

The survey of the required information requires the identification of customers in every channel. This is only possible by the use of a channel spanning registration of the customer. For example, customer cards could be issued in the store-based channel. The customer can use the customer identification on his card for shopping in the online store or to order goods through the mail order channel.

If specific data is available, the path a customer has used through the pre-sales, sales, and after-sales phases can be determined. Not every customer can be identified in every store contact. The portion of customers recorded depends on the used technology. A customer will not show his customer card at every visit in the store, for instance. Just as well, they usually will not log in at the online store just to obtain catalog and product information. The web-based identification of a customer can be improved by usage of cookies or the analysis of IP-addresses of the browser sessions. However, even if a multichannel company tries to register all customer contacts, in most cases it will not be possible to obtain full information. More often only parts of the desired customer information will be available [ScSc04].

Even with accurate contact information, it is not always possible to relate each visit to a specific product. If several products are bought over time with overlapping pre-sales, sales and after-sales phases, the allocation of processes to a specific transaction becomes ambient. Web-based technologies allow the most detailed insight into customer behavior for this problem at the moment. It is possible to register each product, the customer accessed information for.

The input data used for the calculation of the migration model determines the conclusions that can be drawn from the result. The normal set of customer contacts, which is used for the model estimation, will be a representative sample or full sample of the company's customers. In this case, overall conclusions about distribution and switching behavior can be drawn. Such overall estimation may also be the basis for considerations about costs which are induced from one channel in another channel. An inspection of specific customer groups is also possible. The grouping would allow to introduce criteria, which is not handled by the model, into the model. Since the characteristic of Markov chains is not to incorporate former customer behavior, customer groups which often switch channels, or typically never switch channels, could be used to estimate and contrast different migration models.

Online channels provide good prerequisites for measuring customer contacts. The measurement can be processed automatically. Using techniques like cookies, session management and the need for customers to identify themselves for the positive accomplishment of a transaction, allows the identification of users in the different stages of the buying process. Even customers which do not log in during a visit in the online store may be identified by a cookie on their web-browser. Nevertheless, a basic level of uncertainty cannot be avoided, since there may always be unidentified users or visits, or there may be falsely identified users in case a customer uses the computer or the IP-address of someone else.

Catalog-based sales channels also bring along good prerequisites for the measurement of customer contacts. The customer has to prove his identity himself during the order process. Pre-sales contacts are more difficult to measure. At least it is known which customers ordered a catalog. Some companies use distinct item numbers in their catalog and online channels, so it is possible to identify the source channel and where the product was inquired, irrespective of the channel through which the product has been ordered.

It is more difficult to measure store-based channels, as customers do not need to prove their identity during the various phases of the sales process. The companies could introduce measures like customer cards or bonus cards which allow the identification of customers over different transactions. Nevertheless, such measures also only allow the identification of customers in the sales and after-sales phases, but not in the pre-sales phases. This may change with the employment of new technology in future. With the use of RFID tagging of goods, for example, consumer behavior in store-based channels can be measured very accurately (cf. [OhSK05, TaVe06]). Most probably such technologies will allow even more in-depth measurement than it is possible in other channels at the moment. The introduction of such technologies therefore also raises privacy issues [GüSp05, OhSK05].

The operation of coordinated sales channels allows introducing marketing measures like coupons. Coupons with traceable IDs can be used to determine which channel was used in the pre-sales phase. For example, coupons distributed in the store-based channel which are used for a transaction in the online channel, indicate migration from the store to the webshop. Nevertheless, more sophisticated examples can be observed in practice. For example REI, an outdoor equipment reseller, uses the adventurous and hedonic, sensation of small electronic shopping devices in their stores [Bude05]. The company integrated their store-based channel and their e-commerce channel in such a way that an electronic shopping list can be transferred from the webshop to the store and vice versa. Side effect for the company: Customer behavior can be traced during their visits in the offline store. The alignment with data from the online store is seamless. Such sophisticated business models provide the chance of collecting high quality customer data. Less sophisticated business models, where such a comprehensive survey is not available, have to rely on inferior customer data.

Finally, it can be assumed that in many cases it is not possible to obtain fully transparent information about customer processes. However, the survey of an adequate sample allows measuring the overall structure of the channel usage different channels by a channel migration matrix [ScSc04]. Different customer groups can be identified by their typical channel usage. At least such measures provide hints how customers use the possibilities of multichannel retailing in general.

In a number of cases the available transaction data will be biased and therefore not representative of its own customer group. In such cases, the results of the analysis of transaction data should be confirmed by another form of data inquiry. Typical other ways to measure cross-channel effects are based on questionnaires, interviews, or focus groups [TeGü03]. Such customer surveys are able to deliver reliable estimations of the actual channel migration.

Web-based migration model

The *Web-based migration model* class has more specific data requirements than the previously discussed more general class. The data comes primarily from website-based logging mechanisms and, therefor focuses on the webshop. The migration estimation also needs transaction data from operational system from other channels [TeBe03]. It only takes into account transactions related to online processes, so the greater part of offline transactions will not be covered by the model. Figure 5.25 shows the data requirements of the *Website-based migration model* estimation in the form of an ERD.

Customer (<u>Customer-Id</u>, ...)

The entity type *Customer* represents distinctive references to customers, too. In this case the entities of this type and their attributes are deducted from the webshop's operational data structure.

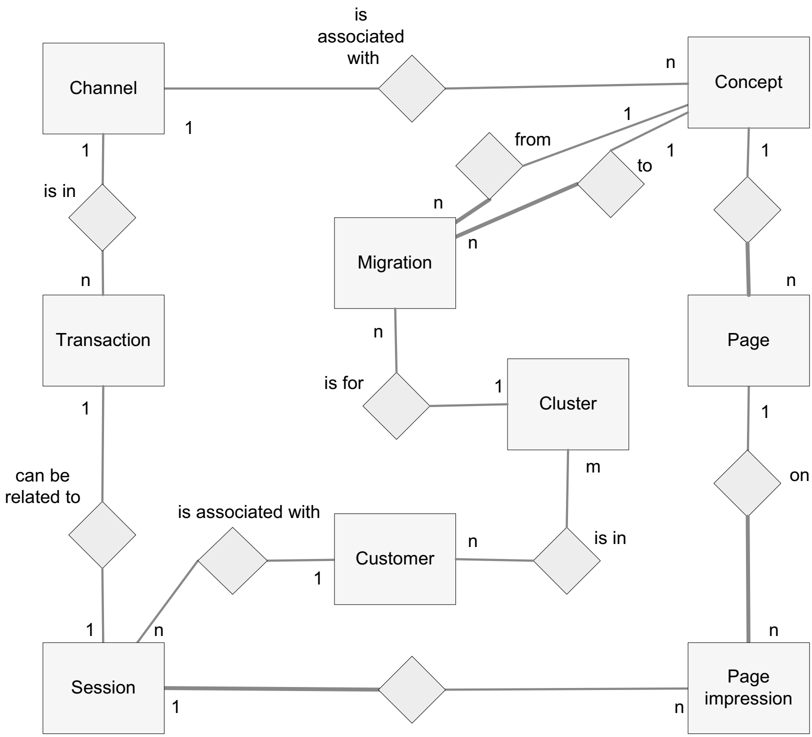

Figure 5.25: Data model for web-based measurement of customer migration (cf. [TeBe03])

Concept (Concept-Id, Channel, Name, Description)

The entities of *Concept* denote the seven recommended concepts for the calculation of micro-conversion rates. Therefore, a webshop is clustered into seven concepts and the conversion between these concepts is surveyed. The concepts are called acquisition, information catalog, information product, service, transaction, purchase information, and offline information [TeBe03, TeBG04]. Most of them will be associated with the online channel, but the areas of the website which point to other distribution channels are associated with the particular other channel.

Page (Page-Id, URL, Concept-ID)

An entity of the type *Page* refers to a visited webpage on the website of the multichannel retailer. Every page has to be assigned to a concept.

Page impression (Impression-Id, Session-ID, Page-ID, Date)

A *Page impression* records the impression of one distinct *Page* on the webshop [CuSt00]. Page impression is a standard measure of website controlling. Every page impression occurs in a session. Since some of the discussed estimation methods rely on the sequence of page impressions, it is important that the *Impression-Id* is stored in temporal ascending order. If this is not possible, the *Date* has to be used to assess the order of page impressions.

Session (Session-Id, Customer-ID, Transaction-ID)

Sessions are a continuous sequence of *Page impressions*. In the scope of this work, the term can be equally used like the term *visit*, which is another basic measure of website controlling [CuSt00]. Entities of this type can be associated with customers of the webshop. Eventually, if a customer does not login into the system, the identity cannot be acquired. Eventually it is possible to identify the customer by cookies saved on his personal computer or his IP-address. If a session cannot be associated with a specific user, it cannot be related with other customer contacts, neither sessions on the webshop nor visits in store-based channels. If a customer completes a transaction during a session, the transaction can also be related to the session. In this case, it is not relevant whether the transaction is a pure online transaction or takes place in another sales channel.

Channel (Channel-Id, ...)

As before in the general migration class, the entity type *Channel* is the same as in the general model. It is only needed to serve as reference to distinctive channels with customer contacts. The class is not further specified in this chapter.

Transaction (Transaction-Id, Channel-ID, ...)

Entities of the type *Transactions* refers to operational transaction data of the sales channels. For the web-based migration estimation, only transactions which are initiated by a customer in the webshop are registered. A transaction points to the channel where the transaction finally occurs.

Cluster (Cluster-Id, Description, ...)

Entities of the type *Clusters* can be used to cluster website customers into different groups. Therefore there exists an n:m relation between customers and clusters.

Migration (From, To, Cluster-Id, Type, Value)

The entity type *Migration* stores the output of the migration estimation between the distinct concepts of the website. Every migration is related to a specific cluster of customers. There are different methods to calculate the migration between the concepts. Further, a set of indicators for the migration from the webshop to another channel can be provided. The different methods will be discussed in the function view and the output view of the model.

Web-customer behavior

The set of proposed customer behavior measures can be calculated with an extended version of the *Transaction* entity type of the web-based migration model. Further the association with entities of the type *Customer* is needed. The relation is displayed in figure 5.26.

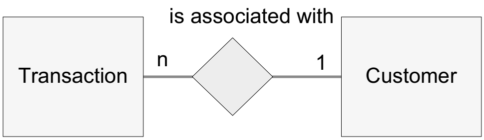

Figure 5.26: Data model for web-customer behavior classes

Transaction (Transaction-Id, Channel-ID, Payment-Channel, Distribution-Channel, ...)

The measures rely on the distinction of channels where the transactions were initiated, channels where the customers paid and over which channel the goods were distributed to the customers. The measures, therefore, are only applicable if the multichannel retailer allows paying goods ordered online in the store, and also delivers online-ordered and paid goods into the store-based channel for pickup. For the calculation it is necessary to store the payment channel and the channel of physical distribution for every transaction.

Customer (Customer-Id, ...)

The measures *Payment migration* and *Delivery migration* also rely on the association with customers. Entities of this type and their attributes are deducted from the webshop's operational data structure and may either be personalized or pseudonymous references to customers.

5.2.3 Function view

The primary necessary functions for all discussed customer behavior measures are the *collection* of necessary data, the *preparation* of data, and the *calculation* of the resulting measures. Since the results of *customer migration* models refer to the whole distribution system functions for aggregation, break down, and channel comparison are not provided. The *web-customer behavior* focuses on the online channel. Depending on the used performance measures in the superordinate scorecard and in the other channels' scorecards, a comparison, an aggregation or a break down could be possible. The calculation would demand transformations to ensure the comparability of the used measures. Therefore, comparison, aggregation and break down are not provided for this class of measures. Figure 5.27 shows a function tree for the customer migration classes.

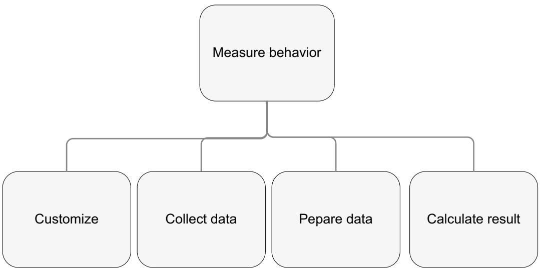

Figure 5.27: Function tree for the migration measurement classes

General migration model

The *Customize* function for the *General migration model* class is used to store the three transaction phases of the distribution process into the database. During the customization phase of the general performance measurement system, the relevant channels, which are later needed for the calculation of the migration model, are also defined.

The *Collect data* function has to ensure that the necessary data for the estimation of the migration model is collected from the particular operational systems. Basically, the database has to be filled with entities from the types *Customer*, *Customer contact*, and *Channel*. The relations between *Customer contact* and *Transaction phase* have to be established, too.

The *Prepare data* function has to prepare the available data for the estimation model. The statistical functions for estimation of the migration models do not accept data as it is stored in the database system. The estimation is based on a number of sequences of outputs for the hidden Markov chain model. The recorded customer contacts and their relations to transaction phases therefore have to be transformed in such sequences. Every sequence refers to one transaction from one distinct customer. If a customer buys different goods at different times, several sequences are generated. The *Prepare data* function also sorts out suspicious data entries. Thus, the data is rectified and its quality for the subsequent calculation is improved.

The *calculation* of the results relies on an extended Markov chain model (see chapter 3.5.1). Markov chain models can be used to describe multichannel customer behavior [PfCa00].

The previously discussed migration models for two-channel retailers only take into account complete transactions. On the other hand, the model presented in this chapter distinguishes between the three phases *pre-sales*, *sales*, and *after-sales*. Therefore the complexity of the estimation model is increased considerably. Figure 5.28 shows the graph for the Markov chain model describing the migration between two channels, and the competing companies (see figure 5.17 on page 103).

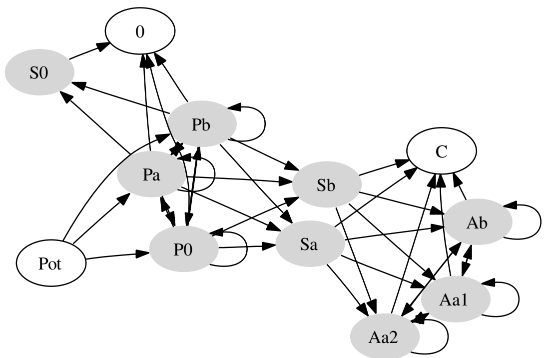

Figure 5.28: Graphical representation of the Markov chain model for channel migration

The stages in the model are:

- Pre-sales phase:

  P_a Customer contact in pre-sales phase process in channel a (Store-based)

  P_b Customer contact in pre-sales phase process in channel b (E-commerce)

  P_0 Customer contact in pre-sales phase process in a competitor's sales channel

- Sales phase:

  S_a Sales transaction in channel a (Store-based)

  S_b Sales transaction in channel b (E-Commerce)

  S_0 Sales transaction with a competitor

- After-sales phase:

  A_{a1} Service inquiry in channel a, service channel 1 (Callcenter)

  A_{a2} Service inquiry in channel a, service channel 2 (In-store)

  A_b Service inquiry in channel b (Online request)

- Customer status:

  Pot Person is a potential customer

  C Person is a customer

  0 Person is not a customer

The transition matrix for the transition model is defined as follows:

$$P = \left(\begin{array}{c|cccccccccccc}
 & Pot & P_a & P_b & P_0 & S_a & S_b & S_0 & A_{a1} & A_{a2} & A_b & C & 0 \\
\hline
Pot & 0 & p_{PP_a} & p_{PP_b} & p_{PP_0} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{P0} \\
P_a & 0 & p_{P_aP_a} & p_{P_aP_b} & p_{P_aP_0} & p_{P_aS_a} & p_{P_aS_b} & p_{P_aS_0} & 0 & 0 & 0 & 0 & p_{P_a0} \\
P_b & 0 & p_{P_bP_a} & p_{P_bP_b} & p_{P_bP_0} & p_{P_bS_a} & p_{P_bS_b} & p_{P_bS_0} & 0 & 0 & 0 & 0 & p_{P_b0} \\
P_0 & 0 & p_{P_0P_a} & p_{P_0P_b} & p_{P_0P_0} & p_{P_0S_a} & p_{P_0S_b} & p_{P_0S_0} & 0 & 0 & 0 & 0 & p_{P_00} \\
S_a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{S_aA_{a1}} & p_{S_aA_{a2}} & p_{S_aA_b} & p_{S_aC} & 0 \\
S_b & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{S_bA_{a1}} & p_{S_bA_{a2}} & p_{S_bA_b} & p_{S_bC} & 0 \\
S_0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
A_{a1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{A_{a1}A_{a1}} & p_{A_{a1}A_{a2}} & p_{A_{a1}A_b} & p_{A_{a1}C} & 0 \\
A_{a2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{A_{a2}A_{a1}} & p_{A_{a2}A_{a2}} & p_{A_{a2}A_b} & p_{A_{a2}C} & 0 \\
A_b & 0 & 0 & 0 & 0 & 0 & 0 & 0 & p_{A_bA_{a1}} & p_{A_bA_{a2}} & p_{A_bA_b} & p_{A_bC} & 0 \\
C & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{array}\right)$$

All transitions between possible states are denoted with the probability p. For example the probability for visiting the online channel (channel b) and afterwards buying the good in the store-based channel (channel a) is described by the transition from state P_b to state S_a. The probability in this case is called $p_{P_bS_a}$ and can be found in the matrix in the line P_b and column S_a.

The model describes the transition of a potential customer (pot) through the pre-sales, sales, and after-sales process. Every potential customer can migrate to one of the pre-sales channels, P_a,P_b or a channel of a competitor P_0. He also may decide not to visit any channel at all which means a migration to 0 (probability: p_{P0}). From any pre-sales state a person may either switch to another pre-sales state (even the same state, if the channel is visited again), buy the product somewhere (S_a, S_b, S_0) or decide not to buy the product at all. If the person buys the product somewhere else, from our perspective it automatically turns into a non-customer ($p_{S_00} = 1$). After a successful transaction in one of our sales channels (S_a or S_b) the person may either repeatedly make use of our service channels A_{a1}, A_{a2}, or A_b, or migrate directly to the Customer status C. The process always begins in the state *potential customer* Pot and always end either in the *customer* state C or the *non-customer* state 0. Therefore, the migration probabilities from C to C and from 0 to 0 are one. Every path through the migration model represents the migration for exact one transaction. Multiple transactions from one single customer have to be detected and treated separately. The model does not take into account repeated transactions from one customer.

The presented Markov chain model explains possible migration paths for individuals shopping in different channels. However, the states, where a person resides in cannot be directly observed. Only outputs can be used as markers for transition into the different states. Such outputs can be customer contacts and transactions as they are described in the data view. The model does include states where the person in interest interacts with a competitor. Since such an interaction cannot be surveyed, the model can be simplified to only represent states, where the outputs can indeed be observed by the company. This is analog to the business process models, which are presented in figure 5.17 on page 103 and figure 5.24 on page 111.

If applied to the Markov chain model this means that the states P_0 (pre-sales at competitor) and S_0 (Sales at competitor) cannot be observed. The transition model is not able to take into account visits to other companies in the pre-sales phase. This means that a potential buyer may immediately proceed to the sales phases S_a or S_b without interaction in the pre-sales processes, if the person used pre-sales services from other companies[1]. Further, it is not possible to record transactions with competing companies. In this case, customers who make business with competing companies are simply treated as non-customers (state 0). Considering the restricted possibilities of observation of outputs, the new simplified model can be described by the graph in figure 5.29.

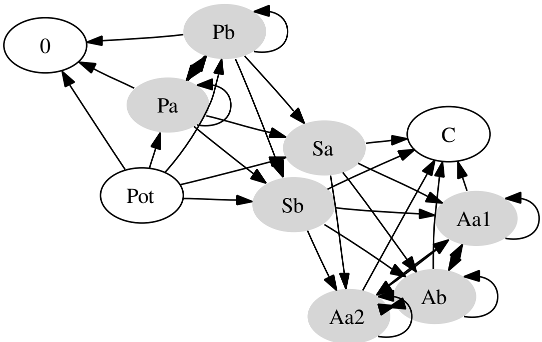

Figure 5.29: Graphical representation of the Markov chain model for channel migration

The proximate transition matrix is defined as follows:

$$P = \left(\begin{array}{c|cccccccccc} & Pot & P_a & P_b & S_a & S_b & A_{a1} & A_{a2} & A_b & C & 0 \\ \hline Pot & 0 & p_{PP_a} & p_{PP_b} & p_{PS_a} & p_{PS_b} & 0 & 0 & 0 & 0 & p_{P0} \\ P_a & 0 & p_{P_aP_a} & p_{P_aP_b} & p_{P_aS_a} & p_{P_aS_b} & 0 & 0 & 0 & 0 & p_{P_a0} \\ P_b & 0 & p_{P_bP_a} & p_{P_bP_b} & p_{P_bS_a} & p_{P_bS_b} & 0 & 0 & 0 & 0 & p_{P_b0} \\ S_a & 0 & 0 & 0 & 0 & 0 & p_{S_aA_{a1}} & p_{S_aA_{a2}} & p_{S_aA_b} & p_{S_aC} & 0 \\ S_b & 0 & 0 & 0 & 0 & 0 & p_{S_bA_{a1}} & p_{S_bA_{a2}} & p_{S_bA_b} & p_{S_bC} & 0 \\ A_{a1} & 0 & 0 & 0 & 0 & 0 & p_{A_{a1}A_{a1}} & p_{A_{a1}A_{a2}} & p_{A_{a1}A_b} & p_{A_{a1}C} & 0 \\ A_{a2} & 0 & 0 & 0 & 0 & 0 & p_{A_{a2}A_{a1}} & p_{A_{a2}A_{a2}} & p_{A_{a2}A_b} & p_{A_{a2}C} & 0 \\ A_b & 0 & 0 & 0 & 0 & 0 & p_{A_bA_{a1}} & p_{A_bA_{a2}} & p_{A_bA_b} & p_{A_bC} & 0 \\ C & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{array} \right)$$

The calculation of the resulting migration propabilities can be accomplished by the estimation of a migration matrix for the stated hidden Markov chain model. Since there is no analytical war for the calculation of the right solution, usually iterative procedures like the Baum-Welch

[1] It is arguable whether it is possible to buy a product without using pre-sales functions like the product catalog or visiting a store. From a cost perspective, the necessary process to buy a product, when someone already knows exactly what he wants to buy, can be regarded irrelevant. Therefore it is assumed that someone is able to fulfill a transaction without prior investigation in a pre-sales phase.

method or other estimation functions are used for the estimation [Rabi89]. For the practical completion of the task statistical software can be used. The statistical computing system R can be integrated by several available interfaces for other applications. The package hmm.discnp for example allows the estimation of hidden Markov models on the basis of given output sequences of the different states of the model [Turn06].

Web-based migration model

The *Customize* function for the *Web-based migration model* allows the definition of *Concepts* on the website. Every *Page* is allocated to its respective concept, and every concept can be allocated to the relevant distribution channel. For example, the store locator on the website would be associated with the offline concept. The offline concept, in turn, is associated with the store-based distribution channel of the company.

The *Collect data* function is responsible to fill the necessary data into the database. Primarily, the data source for the function are webserver logs, which can either be gathered directly from the webserver's logfile, or by using a website controlling tool with an adequate interface. An interface to operational systems to grab relevant transaction data related to online transactions is also needed.

The function *Prepare data* is used to sort out data entries which cannot be related to a pseudonymous or personalized customer or are ambiguous, and therefore cannot be used for the calculation of the migration measures. Before the actual calculation, the customer data can be according to behavior on the website. Three clustering methods are proposed for this purpose [TeBe03]:

1. Single-session clustering
2. Multi-session clustering
3. Transaction clustering

If a particularly interesting customer group can be identified, it is clustered in a seperate group. The clustering can be done along several criteria and depends on the interest of the users of the performance measurement system. Example clusters may be users who already performed successful online transactions, users with interest in special product groups and so on. The results of clustered analysis of website behavior can provide useful insights into customer preferences [TeBe03]. If no clustering is wished at all, one general cluster for all customers can be built. Since customers can be assigned to multiple clusters, it is always possible to additionally calculate user behavior for all website users in general, and compare the results to the clustered analysis.

For the *calculation* of the resulting migration measures, the session data of the website is analyzed. There are two proposed types for the calculation: the *dichotomized* and the *weighted* calculation. The underlying mathematical concepts are discussed in chapter 3.5.3 on page 58 of this work.

Web-customer behavior

A specific *Customize* function for the *General migration model* is not necessary. The functions *Collect data* and *Prepare data* have to ensure the availability and quality of the extended transaction data, as described in the *data view* of the model.

The function *Calculate result* is able to calculate the expected online behavior measures on the basis of the provided transaction data. The four measures which are described by subclasses of the *Web-customer behavior* class are defined as follows:

Offline payers Is the portion of customers who initiated an online transaction and used the possibility for offline payment in a store-based channel [TeBe03].

Payment migration Is the portion of retained customers who purchased online using offline payment methods and who now initiated an online transaction involving online payment methods [TeBe03].

Deliveries to stores Is the portion of customers who initiated an online transaction and used the possibility for picking up the goods in an offline store [TeBe03].

Delivery migration Is the portion of retained customers who have already bought through online transactions using offline pickup, and who have now initiated an online transaction involving a direct delivery of the goods [TeBe03].

5.2.4 Control view

The control perspective of the introduced measurement classes is dominated by the sequence of the functions discussed in the function view. As an independent step, the *Customize* function is executed during the customizing process of the performance measurement system. During the customization, the database is initialized with prerequisite values like transaction phases, webspace concepts, channels and so on. In the other execution branch of the measurement classes, the order of the functions is:

1. Collect data
2. Prepare data
3. Calculate result

The sequence of the function is always the same for all discussed subclasses of *Customer behavior measure*. The difference lies in the used data and the individual calculation of the results which is discussed in the function view.

Figure 5.30 shows the business process diagram for the *general migration model* class. The data collection function uses interfaces to operational systems to grab the necessary customer contacts. The data preparation makes use of the transaction phases and channels declared during the customizing process and the customer contact data. It provides a set of contact sequences which is directly passed on to the calculation procedure. The final result is the estimated migration model, where the corresponding migration probabilities can be taken from.

The business process diagram for the *web-based migration model* class is displayed in figure 5.31. The data collection procedure takes operational data and, in this case, the webserver logfile and the page definitions of the customizing process as input, too. As output entities, the tables Session, Page impression, Transaction, and Customer are filled with data. Data preparation takes the available data entries to update the page impression data and the generation of clusters for the result calculation. Finally, the function *Calculate result* calculates the web-based migration measures.

Figure 5.32 shows the business process diagram for the subclasses of the *Web-customer behavior* class, *Offline payers*, *Payment migration*, *Deliveries to stores*, and *Delivery migration*. In

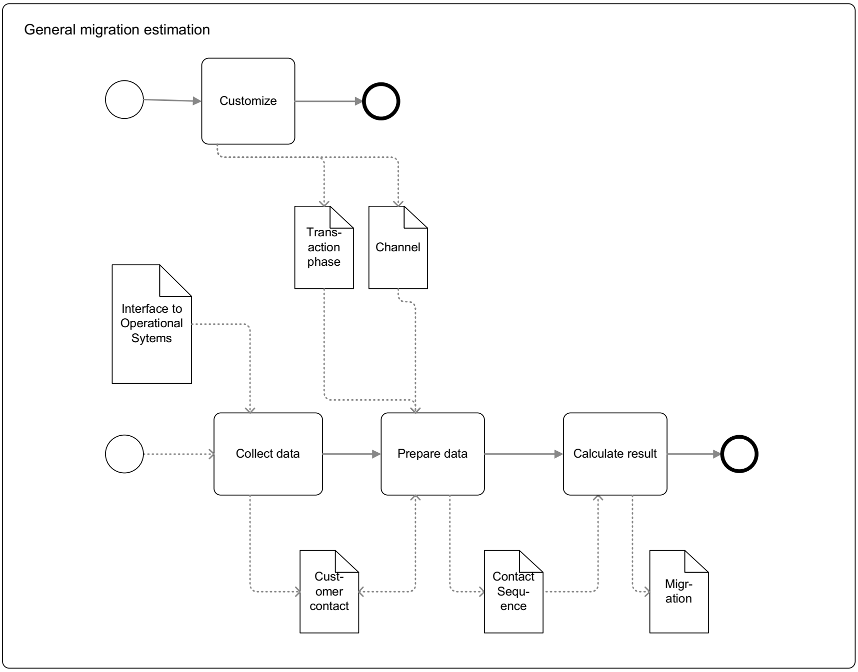

Figure 5.30: Business process diagram for general migration estimation

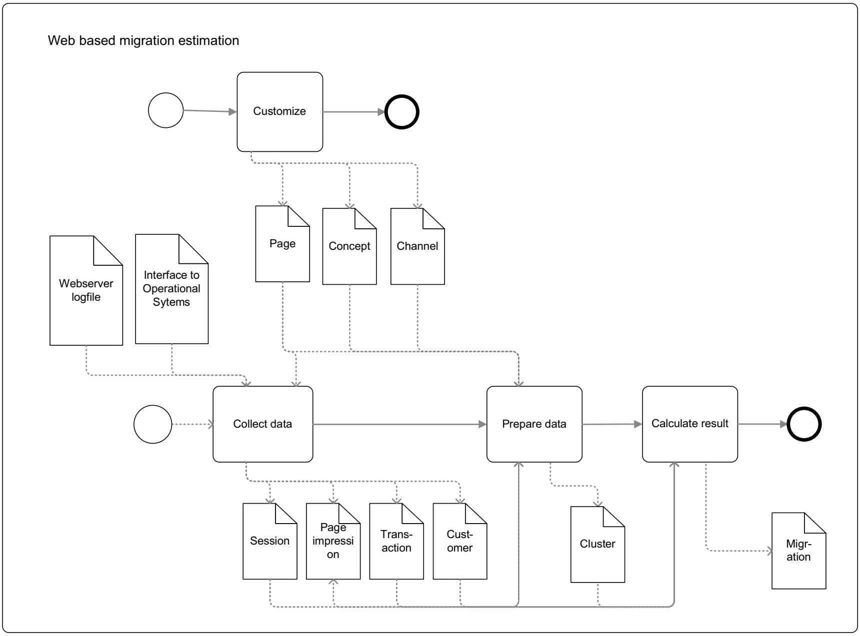

Figure 5.31: Business process diagram for web-based migration estimation

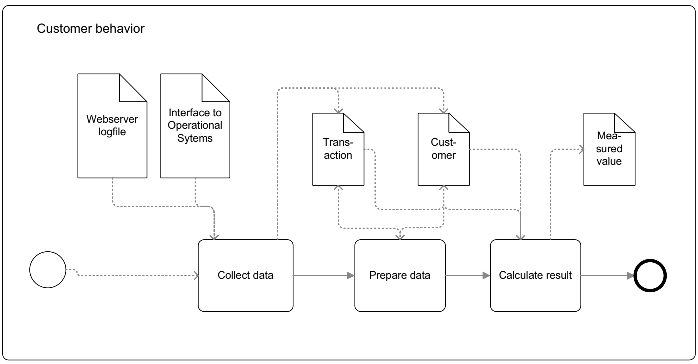

Figure 5.32: Business process diagram for web user behavior measurement

contrast to the other models in this chapter, no customization process is needed for these classes. The sequence of the remaining functions stays the same. Interfaces to operational systems and the webserver logfile are used to fill the tables *Transaction* and *Customer*. The data preparation cleans up those tables for the final calculation of the resulting measures. The results can be directly stored into the *Measured value* table of the performance measurement system.

5.2.5 Output view

After the description of the measurement classes in the other views of the model, the *output view* illustrates the interpretation of the gathered information. The possible implications on other performance measures will also be addressed. The measurement classes of this model relate to the multichannel business process model displayed at the beginning of the superordinate section.

General migration model

The output of the *general migration model* class is a migration matrix, as in the function view. As an advantage, this measurement class is able to deliver valuable insights into the channel behavior of customers of all sales channels of the company. All channels are treated the same way, and therefore no channel-specific bias is expected. A disadvantage of this methodology is that it demands high quality input data, which often cannot be gathered from existing data sources of the company, but has to be surveyed by customer inquiries, etc.

The estimated migration probabilities provide an insight in the migration behavior of customers during the process of information (pre-sales phase), ordering, distribution and payment (sales phase) and subsequent services (after-sales phase). In contrast, the migration models discussed in chapter 3.5.1 describe migration behavior between different independent transactions. If a customer gathers product-related information on the webshop of the company before buying the product in the store-based channel, this behavior would not be taken into account by the conventional migration models since only the offline transaction is counted. Splitting transaction into three phases allows the capturing of such behavior.

This distinction has implications for other examinations of the company. From a cost perspective, information about the fraction of customers who migrate from a channel in the pre-sales phase to another channel in the sales phase is very valuable. In combination with activity-based costing it is possible to reassign costs originating in the channel where the pre-sales service was consumed to the channel where the customer finally bought the product. Such a treatment is able to allocate costs to the channel where the actual revenue is generated. The channel which was able to provide a service to the other channel is liberated from the burden of its – from a channel perspective, unsuccessful – accomplishment of the transaction.

The migration matrix also enables the drawing of insights about the capability of the distribution channel, in order to acquire customers from competing companies. If the direct migration from the state of a potential customer to the sales phase (leaving out the pre-sales stage) is very high, the customers presumably inform themselves elsewhere and then buy the goods from the sales channels. The other way around, if the migration from pre-sales phases to the sales phases is very low, the sales channels are not able to convert interested customers into buyers. In this case, potential customers are either lost to other companies, or decide to not acquire the product of interest at all.

Web-based migration model

The web-based migration model allows the estimation of customer migration based on primarily web-based data. It can only take into account transactions which involved user interaction on the website of the company. User-specific migration data for the website is much easier to obtain than other forms of customer surveys. In this way channel migration from the online channel to another channel can be estimated. Other ways of migration cannot be handled with this measurement class.

Therefore, the interpretation of the results is much more limited than for the general migration estimation. The sample of surveyed users cannot represent all customers of the multichannel company, but only online customers. Implications to other measures, which relate to the overall company, should therefoe not be drawn. These limitations should always be kept in mind when interpreting web-based success measures, as they may otherwise lead to wrong assumptions about multichannel customer behavior of the company in general.

Nevertheless, the web-based migration model can deliver insight into the multichannel behavior of web-customers. Most notably, user sessions including product-specific inquiries and afterwards ending on the offline concept, like a store locator, are a strong indication for the migration from the online channel to a possible transaction on the offline channel [TeBG04]. The possibility to cluster user groups according to their online behavior, and then extract differences in the migration behavior of different customer clusters, may reveal valuable information for the company.

Web user behavior

With the introduction of four additional web-based measures the performance measurement system gains another possibility to reveal multichannel-specific user behavior. The four selected measures *Offline payers*, *Payment migration*, *Deliveries to stores*, and *Delivery migration* relate to transactions, which are primarily conducted in the online channel, but include payment in the store-based channel, or pickup in the offline channel. High values of this measure can reveal existing reservations against pure online transactions. For example, a high rate of customers who prefer offline payment in the store indicates that customers either not want to pay over online channels in general, or do not have enough trust into online payment system of the company. A high number of offline payers may also stand for a strategic advantage of multichannel integration, if competing companies do not allow offline payment, and therefore customers choose to buy the goods from the company that does.

The *Payment migration* measure, on the other hand, indicates whether the company is able to increase customers' level of trust to a level that causes them to switch from offline payment to the available online payments options through repeated transactions with the company. Similar considerations can be drawn from the measure *Deliveries to stores* and *Delivery migration*. It is important to note that the results of all four measures are dependent on the average distance between the customers and the outlets of the store-based channel [TeBe03].

Chapter 6

Demonstration of the performance measurement system model

This section provides a showcase application of the model. The purpose of this demonstration is to offer an easy way of understanding the functionality of the performance measurement system. It does not give comprehensive instructions how the model has to be implemented. The implementation and introduction of a performance measurement system, in practice, will involve a number of necessary decisions and problems emerging through the complexity of company processes and the requirement of covering complete company goals and processes. This example ignores such considerations in favor of allowing a compact example system, which helps the reader understand the model. Nevertheless, a satisfying implementation in terms of completeness and practical usability would involve the implementation together with a real world company and is beyond the scope of this work.

Even if the numbers in this example are fictious, they are built around an example company, the well-known multichannel e-commerce company Office Depot. Office Depot was founded in 1986 and is one of the largest office supplies retailers [Bock04]. Several case studies dealing with Office Depot as a multichannel retailer can be found in literature [Troy99, GuGa00, BoOl02, Bock04]. The numbers used in the example are based on publically available performance numbers of Office Depot in the years 2000-2002. Office Depot started to sell goods over the Internet in the year 1995 [BoOl02]. In 2002, goods worth USD 11,357 million were sold through two channels, a store-based channel with approximately 1150 stores, and an e-commerce channel. The company had a profit of about USD 500 million [Offi], and around 47,000 employees at that time [Bock04]. From 2001 to 2002 Internet sales grew by 34 percent to USD 2,100 million, a share of 18 percent of total sales [Bock04]. The following example relies on the numbers which are taken out from different case studies and Office Depots' Annual Report 2003 [Troy99, GuGa00, Offi, BoOl02, Bock04]. If no values of a specific area of performance measurement could be obtained, they were estimated by the author of this book.

The example implementation of the model is described as a set of performance measures, target values, and measured values. The demonstration implementation was established in a MySQL Database System. MySQL is a popular open source database management system [Fegr02, DePe03]. The Database was defined according to the data model. The values were stored in the database system. Tables 6.1 to 6.17 in this chapter show the results of the specific SQL queries. The database definition and queries that generated these tables are provided in the appendix of this work.

6.1 Customizing the measurement system

As a first step the necessary customization steps were taken. Table 6.1 shows the defined success factors for the performance measurement system and their descriptions in alphabetic order. The success factors are taken directly from the recommendations of the model.

Success factor	Id
Customer satisfaction and behavior	2
Employees	5
Finance and transactions	1
Quality	3
Trust and security	4

Table 6.1: Success factors

In the next step the organizational parameters of the company have to be stored in the database. The company in this example operates two sales and distribution channels. A store-based retail channel, selling goods in over 1,000 stores, and an online channel. The channels sell the same assortment of goods at the same prices. Table 6.2 shows the stored database entries for the two sales channels.

Table 6.3 defines scorecards for both channels, as well as a scorecard for the overall performance of the sales and distribution branch of the company. The channel column refers to the ID of the

Id	Name	Type of distribution	Channel manager
1	Store	Store-based channel	Mr. John Doe
2	Online Shop	Online channel	Mrs. Jane Doe

Table 6.2: Sales and distribution channels

Id	Description	Channel
1	Overall scorecard for sales and distribution	-
2	Scorecard for the store-based channel	1
3	Scorecard for the online channel	2

Table 6.3: Sales and distribution scorecards

corresponding sales and distribution channels. Since the overall scorecard does not refer to a specific channel, the symbol "-" is displayed in the table [1].

The content of the three shown tables constitutes the necessary customizing data. Since these preconditional definitions are accomplished, the actual planning stage can begin.

6.2 Using the system for planning performance

As a requirement for the following planning steps, a strategic plan has to be developed. In this example, six strategic goals are stipulated. Each goal refers to a certain success factor. Table 6.4 displays the strategic goals for the example planning stage. For readability issues, the success factor, stored as integer value factorid, is replaced by the corresponding name of the strategic goal in this table. The *select query*, which performs this replacement, can be seen in the appendix.

Important strategic goals for the company in the near future are the increase of profits and the convergence of trust and security in the online channel and the store-based channel. The financial goals should be accomplished by raising turnover by 5 percent during the next year. The gross profit margin, in principle the difference between the buy and the sell price of the goods sold, shall be held at the same level. This financial goal is supported by a customer-related goal. The company plans to hold customer retention, increase the number of transactions and restore its market share to 10 percent during the year 2007. The strategic plan has implications

[1] Database systems and programming languages typically use "NULL" to indicate that no value is assigned to a given variable. This is also applies to the used MySQL system. For easier reading all "NULL" values in this work were replaced by "-".

Goal	Id	Success factor	Description
Converge trust levels	4	Trust and Security	Increase customers trust into the online channel to meet the store-based standard.
Employee education	5	Employees	The employee education program should be continued. It should reach at least 95 percent of our employees
Gain online shop quality	3	Quality	The quality of the shopping experience has to be increased to the same high level as in the store.
Hold retention	2	Customer satisfaction and behavior	Customer retention shall be hold at 1.9 percent first-time and 8.6 percent repeated customer retention
Increase profit	1	Finance and transactions	Increase turnover by 5 percent in 2007. Keep gross profit margin at 30 percent.
Regain market share	6	Customer satisfaction and behavior	The slightly decreased market share should be restored to 10 percent during 2007.

Table 6.4: Strategic goals

for operating planning, which will be discussed for the specific performance measures in the course of this chapter.

Begin date	End date	Id	Period
$2007{-}01-01$	$2007{-}03-31$	1	1
$2007{-}04-01$	$2007{-}06-30$	2	1
$2007{-}03-15$	-	5	0
$2007{-}07-01$	$2007{-}09-30$	3	1
$2007{-}10-01$	$2007{-}12-31$	4	1
$2007{-}10-15$	-	6	0

Table 6.5: Planning and measurement dates for the year 2007

In the next step, the planning horizon is defined. Performance measures which relate to a period in time are planned and measured on a quarterly basis. Therefore four different periods are defined. Performance measures which are related to a specific point in time shall be measured twice a year. Therefore, two points in time are defined. Table 6.5 shows all defined measurement dates for the year 2007.

In this example eleven different measurement classes are used. As described in the model, measurement classes define all available measures of the performance measurement system. These classes are stored in the table *MeasureClass*. Table 6.6 displays all used measurement classes and their short descriptions. The classes are sorted alphabetically by name.

Measure	Id	Description
Customer migration	6	Customer migration (migration matrix)
Gross profit margin	13	Gross profit in percent of sales
Market share	8	Market share (percent)
Net profit ratio	10	Net profit in percent of total sales
Retention 1	4	Retention from visitor to first time customer (percent)
Retention 2	3	Retention from first time customer to repeat customer (percent)
Sales	7	Total Sales ($ million)
Security issues	2	Numbers of security issues raised (online)
Training completed	9	Training programs completed by employees (hours)
Training reach	14	Percentage of Employees reached by training programs
Transactions	12	Customer Transactions (in thousand transactions)
Trust	1	Experienced trust by customers (inquiry)

Table 6.6: Measurement classes

Customer migration Customer migration is measured by a migration matrix like the one presented in the specialized part of the model in chapter 5.2. In the actual chapter a reference implementation will be shown. A set of user contacts is used to estimate a migration model. The estimated model and its interpretation will be discussed.

Gross profit margin This measure denotes the difference between the sales price for consumers and the acquisition cost (supplier price) of the goods sold. It is an important measure in retailing and thereforr included in this example. The gross profit margin is expressed in percent of the total sales volume.

Market share Market share is the fraction of goods sold in the office supplies market which is covered by the example company.

Net profit ratio Since the gross profit margin does only take into account acquisition costs of the goods sold, this measure is used to indicate the overall profit ratio, also considering total variable and fixed cost. Only the cost of sales and distribution are taken into account. Overhead cost of other company functions are be covered by the net profit ratio in other company scorecards. Using the hierarchic relation of the scorecards a stepwise profit ratio calculation can be established.

Retention 1 The value of retention 1 denotes the percentage of visitors in the company's stores or webshop which finally buy a product and therefore becomes customers.

Retention 2 The second retention measure shows the percentage of first-time customers who commit another transaction with the company and therefore becomes repeated customers.

Sales This number expresses the total volume of the goods sold by the company in monetary value. In this example, sales are measured in million dollars.

Security issues The number of security issues raised either by customers or by employees during daily operations are counted. Since an explicit strategic goal is formulated regarding different perceived security levels of the distribution channels this measurement class is used as an indicator for the perceived security in the online channel.

Training completed The company in this example carries out an educational program for its employees. One performance measure to evaluate the success of the program is the hours of training which are consumed by the employees on average.

Training reach The second performance measure related to the companies educational program is the reach of the program. This measure indicates the percentage of employees which accomplished at least one course during the last year.

Transactions This performance measure represents the total number of transactions. For a multichannel company this is an interesting indicator, especially in combination with sales. The combination of both measures may reveal differences in the structure of transactions, e.g. the overall sales volume or overall number of goods for each transaction.

Trust This measure indicates the level of trust of customers towards the company. Trust typically is evaluated by a customer inquiry. The used scale in this example is an ordinal scale from 1 to 10, where 1 denotes very low trust and 10 denotes very high trust. The used aggregation function for trust is the median. In this example the aggregation of trust is not weighted for the different channels.

The selection of measures for this demonstation shall give a comprehensible overview of the developed performance measurement system. No claims regarding their balance and comprehensiveness are made. The selected measurement classes are used to populate the different scorecards in the example below.

Measureid	Scorecardid	Goalid	Classid	Dateid
51	1	1	7	1
52	2	1	7	1
53	3	1	7	1
54	1	1	7	2
55	2	1	7	2
56	3	1	7	2
57	1	1	12	1
58	2	1	12	1
59	3	1	12	1
60	1	1	12	2
61	2	1	12	2
62	3	1	12	2

Table 6.7: Excerpt of table measure

In the database the use of each measure is defined by the scorecard, its strategic goal, its measurement class and the referenced point or period in time. Table 6.7 gives an exemplary excerpt of the example data. It shows the definition of the measures *sales* and *transactions* for the three existing scorecards and two periods in time, namely the first quarter 2007 and the second quarter 2007. Since this view on the data is not quite comprehensive, another view is presented to give an overview of the used measure. Table 6.8 shows an overview over the measurement classes which are used for the strategic goals in the different scorecards. In order to present related measurement classes together, the table is sorted by the addressed strategic goal.

The last three columns of Table 6.8 indicate whether a measurement class is used in a specific scorecard. A value of *1* indicates measurement class is used, while *0* means that the measurement class is not used in this scorecard. In general, almost every measurement class is used in all three scorecards. This makes sense since every strategic goal should be translated into targets and measures for the whole system and each individual channel. However, some performance measures are only used in specific scorecards.

Security issues is one a case, which is only measured for the online channel. Since, in general, no security issues like customer concerns, security holes, etc. are raised for the store-based channel, the measurement in this channel would not be meaningful. Finally, the strategic goal to converge security means that security issues in the online channel have to be lowered until practically no issues occur.

Measure	Class	Strategic goal	Overall scorecard	Store-based scorecard	Online scorecard
Trust	1	Converge trust level	1	1	1
Training completed	9	Employee education	1	1	1
Training reach	14	Employee education	1	1	1
Security issues	2	Gain online shop quality	0	0	1
Customer migration	6	Hold retention	1	0	0
Retention 1	4	Hold retention	1	1	1
Retention 2	3	Hold retention	1	1	1
Gross profit margin	13	Increase profit	1	0	0
Net profit ratio	10	Increase profit	1	0	0
Sales	7	Increase profit	1	1	1
Market share	8	Regain market share	1	0	0

Table 6.8: Measurement classes used in the three scorecards

Three financial measurement classes are only used in the overall scorecard for the whole sales and distribution system. The class *gross profit margin* is one of these. Since the channels are coordinated in a way that they use the same retail prices and procurement is done by a central logistic system, a differentiated measurement of gross profit margin would lead to no significant differences and therefore is obsolete. Another example is the *net profit ratio*. The measurement of different profit ratios in the different channels would in principle be possible. According to the discussion in chapter 5.1.5, customer migration between the sales channels may introduce bias into this performance measure. Since it is not clear which cost is induced by different customer migration patterns in which channel, it is recommended to measure net profit ratio only for the overall sales and distribution system. The third exceptional class in this example is *market share*. Since the coordinated channels of the example company jointly operate on the same market and cannibalization is no issue, only a joint measurement of the market share is regarded as meaningful.

After establishing measures for the strategic goals in different scorecards for different periods or points in time, target values for each measure can be created. Table 6.9 shows an excerpt of the table *TargetValue*, where target values for the measures sales and transactions are defined.

Measureid	Revisionid	Value	Status	Remarks
51	1	2800.00	revised	
51	2	2790.00	agreed	Corrected down by 10 during the negotiations
52	1	2294.00	revised	
52	2	2288.00	agreed	Corrected down by 6
53	1	506.00	revised	
53	2	502.00	agreed	Corrected down by 4
54	1	2854.00	revised	
54	2	2840.00	agreed	Corrected down by 14
55	1	2282.00	revised	
55	2	2272.00	agreed	Corrected down by 10
56	1	574.00	revised	
56	2	568.00	agreed	Corrected down by 4
57	1	9376.00	revised	
57	2	9343.00	agreed	Correction analog to sales
58	1	6585.00	revised	
58	2	6561.00	agreed	
59	1	2791.00	revised	
59	2	2782.00	agreed	
60	1	9510.00	is negotiated	
61	1	6678.00	is negotiated	
62	1	2831.00	is negotiated	

Table 6.9: Excerpt of table TargetValue

Once again, as an exemplary excerpt the target values of the measures *sales* (measureids 51-56, compare with table 6.7) and *transactions* (measureid 57-62) are shown. In the example, the target values were revised during the negotiation process. The initial values and revised values are represented as revision 1 and 2. The target values for the measure *transactions* are still under negotiation (status = is negotiated). The way the data is stored in the database is not very well-suited for providing an overview. By using an extended SQL command, the data is shown in a more useful way. Table 6.10 shows a condensed structure of the planned values for the overall channel's scorecard, the store-based channel's scorecard, and the online channel's scorecard for period measures of the first quarter 2007. The SQL command to generate this table can be found in the appendix of this work.

Measure	Class	Rev.	Status	Overall	Store-based	Online
Gross profit margin	13	1	revised	30.20	-	-
Gross profit margin	13	2	agreed	30.10	-	-
Net profit ratio	10	1	agreed	2.70	-	-
Retention 1	4	1	agreed	1.91	2.40	1.30
Retention 2	3	1	agreed	8.60	15.20	1.10
Sales	7	1	revised	2800.00	2294.00	506.00
Sales	7	2	agreed	2790.00	2288.00	502.00
Security issues	2	1	agreed	-	-	10.00
Training completed	9	1	agreed	10.30	10.00	13.00
Training reach	14	1	agreed	95.30	95.00	98.00
Transactions	12	1	revised	9376.00	6585.00	2791.00
Transactions	12	2	agreed	9343.00	6561.00	2782.00

Table 6.10: Overview of the planned values for the first quarter 2007

The planned values for the first quarter are chosen according to the example company and the strategic goals. The gross profit margin reaches about 30 percent for the overall sales and distribution system. A net profit ratio of 2.7 percent is aspired for the first quarter 2007. Since no target values for the specific scorecards of the gross profit ratio and the net profit ratio are available, "-" is displayed in the table. As shown, the customer retention of the online channel is expected to be considerably lower than in the store-based channel. The aggregation to the overall retention is weighted by the actual estimated number of transactions in each channel, which can also be seen in the table.

Internet sales are expected to rise to about 20 percent of total sales. The original form in which the data is stored in the database is given in table 6.9, and a more comprehensible form is shown in table 6.10. As stated above the number of security issues is only measured in the online channel. A maximum number of ten security issues are estimated for this quarter.

The planned values for employee training reflect the plan that every employee should spend about one work week per year for education. The program should reach about 95 percent of all employees. A combined examination of training completed an training reach implicates, that there is also a certain fraction of employees who consume more training than the overall 10 hours per quarter (assuming 40 work hours per week). Implicated by the type of the channel, employees of the online channel have to deal more often with complex technologies. Therefore, the aimed training standards are set higher in the online channel than in the store-based channel. The number of transactions is planned along with the estimated sales. As can be derived from the number of transactions, altogether a store-based transaction generated about 1.9 times more sales volume than a transaction in the online channel.

The overview over the planned values for the first quarter 2007 also shows the different revisions and the status of each revision of the measures. The planned value for gross profit margin, sales and transaction were revised during the planning and negotiation process (see table 6.10).

Measure	Class	Rev.	Status	Overall	Store-based	Online
Gross profit margin	13	1	agreed	30.00	-	-
Net profit ratio	10	1	agreed	2.70	-	-
Retention 1	4	1	agreed	1.91	2.40	1.31
Retention 2	3	1	agreed	8.60	15.20	1.10
Sales	7	1	revised	2854.00	2282.00	574.00
Sales	7	2	agreed	2840.00	2272.00	568.00
Security issues	2	1	agreed	-	-	9.00
Training completed	9	1	is negotiated	10.50	10.00	15.00
Training reach	14	1	agreed	95.40	95.00	99.00
Transactions	12	1	is negotiated	9510.00	6678.00	2831.00

Table 6.11: Overview of the planned values for the second quarter 2007

The model stipulates regular planning cycles. In this example, the period-based measures are planned quarterly. Therefore, during the first quarter of 2007, the plan for the second quarter is established. Table 6.11 shows the targeted values for the second quarter of 2007. In comparison to the first quarter 2007, the planned values indicate a targeted increase of sales and transactions. The gross profit margin is marked down, because of an expected price change of the major suppliers. However, due to cost cuts, the net profit ratio is targeted to be kept the same. Regarding retention the retention from visitors to first-time customers in the online channel shall be increased, and the other retention measures should be held at the same level. The planned values for the employee training program are influenced by the decision to further increase the training level of employees of the online channel. This has an impact on the target values for training completed and training reach.

Measure	Class	Rev.	Date	Status	Overall	Store-based	Online
Market share	8	1	2007-05-15	agreed	9.08	-	-
Market share	8	1	2007-10-15	is negotiated	9.09	-	-
Trust	1	1	2007-05-15	agreed	8.00	9.00	7.00
Trust	1	1	2007-10-15	agreed	8.50	9.00	8.00

Table 6.12: Planned values for both points in time

All measures, which refer to points in time in our example, are measured twice a year (see table 6.5). During the first planning cycle, the target values for the first inquiry are worked out. When the results of the first inquiry are available, the planning phase for the second inquiry begins. The planned values for both points in time are given in table 6.12. Please note that the planned values for the second inquiry are established after the measurement values for the first inquiry are available. The order of the presentation of the data, in this case, does not represent the order of planning and measuring.

The planned market share in March is 9.08. In September a slightly higher value is expected. The targeted values for the trust customer survey represent a high level of trust in the store-based channel and a lower level of trust in the online channel. As an ggregated value for the overall channel, the median of both values is calculated. In case of two values the median is represented by the arithmetic mean of the values. An increase in the level of trust in the online channel is expected in September 2007

Although customer migration is included in the overall scorecard, no target values will be stated and discussed in this example. Example data for a general migration model and the actual estimation of a migration matrix is discussed in the following chapter along with exemplary results for other performance measures of this demonstration.

6.3 Measuring performance and interpretation of the values

After the measurement period, which was defined during the planning process, is over, the stated performance measures are acquired and recorded in the performance measurement system. In this example, results for the measures which were already discussed in the planning section, are shown. In addition, the estimation of a migration model is discussed in more detail as a showcase implementation of the proposed performance measure.

Table 6.13 shows an excerpt of the MeasuredValue table of the system. It contains the results of the first quarter of 2007, and the first inquiry of the measures related to a point in time on March 15, 2007. The table also includes remarks for each specific value, which reflects a first assessment of the results and compares them to the planned values for this quarter.

Measureid	Value	Remarks
51	2698.00	Lower than expected
52	2145.00	Lower than expected
53	553.00	Lower than expected
99	30.00	Lower as result of price change of supplier
83	7.50	Result of low value in online channel
84	9.00	ok
85	6.00	Lower than expected
81	6.00	good
109	1.86	could be better
110	2.40	ok
111	1.20	could be better
69	7.70	could be better
70	13.50	could be better
71	1.10	could be better
95	9.08	as expected
89	9.41	slightly below target
90	11.30	slightly below target
91	9.20	slightly below target
103	92.73	quite good
104	92.40	quite good
105	95.70	quite good
57	9343.00	consitent with sales
58	6561.00	consitent with sales
59	2782.00	consitent with sales
115	2.72	very good, we were able to cut overhead cost

Table 6.13: Table MeasuredValue with values

For better readability and an easier comparison with the planned values, the results are also formatted in an overview table for the first quarter in table 6.14. The results are presented in three columns for each of the three involved scorecards.

Measure	Class	Overall	Store-based	Online
Customer migration	6	(matrix)	-	-
Gross profit margin	13	30.00	-	-
Net profit ratio	10	2.72	-	-
Retention 1	4	1.86	2.40	1.20
Retention 2	3	7.70	13.50	1.10
Sales	7	2698.00	2145.00	553.00
Security issues	2	-	-	6.00
Training completed	9	9.41	11.30	9.20
Training reach	14	92.73	92.40	95.70
Transactions	12	9163.00	6187.00	2976.00

Table 6.14: Overview of measured values for first quarter 2007

After the results are stored in the performance measurement system, they can be compared to the target values or results of other periods/points in time. Table 6.14 shows the result values for the first quarter of 2007 as an overview in the three scorecards. They are the basis for performance evaluation, ongoing operational and strategic planning, and employee assessment and/or employee bonus programs. For this purpose, the system can offer a series of assisting operations. For example, the target values can be compared with the measured values. Table 6.15 compares result values with the latest revision of target values, and prints the difference in percent.

Measure	Class	Overall	Store-based	Online
Gross profit margin	13	-0.33	-	-
Net profit ratio	10	0.74	-	-
Retention 1	4	-2.62	0.00	-7.69
Retention 2	3	-10.47	-11.18	0.00
Sales	7	-3.30	-6.25	10.16
Security issues	2	-	-	-40.00
Training completed	9	-8.64	13.00	-29.23
Training reach	14	-2.70	-2.74	-2.35
Transactions	12	-1.93	-5.70	6.97

Table 6.15: Comparison of target and result values for first quarter 2007 (differences in percent)

In this example, several performance measures show differences between target and result values. The gross profit margin is lower than expected. The assumed reason is the already addressed price change of a supplier. Nevertheless, the effect of the cost cut turns out to be higher than expected, resulting in a 0.74 percent higher net profit ration than projected.

The retention from visitor to first time customer did not develop well, either. While the store-based channel could fulfill the expectations, the online channel's retention is about 7.69 percent lower than expected. Therefore, the overall retention 1 is also lower than the planned value. Retention 2, the retention from one-time customer to repeated customer, shows a different picture. For this measure, the online channel could meet the expectations, but the store-based channel could not. Overall, retention 2 was 10.47 percent lower than planned (7.70 instead of 8.60). In summary, retention was in both cases well below the target and will be an issue in the next strategic and operational planning cycle.

Sales did not meet the expected values. Store-based sales underperformed by 3.3 percent. This is a result of a strong decline in store-based sales (-6.25 percent) while online sales performed better than expected (+10.16 percent). Analog to the changes in sales, the number of transactions underperformed in the overall system and in the store-based channel. Internet transactions were more frequent than planned. As a first attempt at an explanation, this development was caused by a strong winter. The heavy snowfall may have drawn a number of repeated customers to switch to the online channel. A positive development can be seen in the number of security issues in the online channel, which were substantially lower than expected (6 issues instead of 10).

Also the employee training program did not perform as well as planned. While the employees of the store-based channel on average consumed 1.3 hours more than expected, the online employees were 3.8 hours (29.23 percent) behind their plan. This may be related with the unexpectedly low utilization of the store-based, and the high utilization of the online channel. In sum, training reach was with 92.73 percent about 2.7 percent lower than desired.

Measure	Class	Overall	Store-based	Online
Market share	8	9.08	-	-
Trust	1	7.50	9.00	6.00

Table 6.16: Overview of measured values for first inquiry

Table 6.16 shows an overview of the values which were surveyed for the first point in time in year 2007 (March 15 2007). Table 6.17 compares these values with the planned values. A

Measure	Class	Overall	Store-based	Online
Market share	8	0.00	-	-
Trust	1	−6.25	0.00	−14.29

Table 6.17: Comparison of target and result values for first inquiry (differences in percent)

pleasant result is the market value. The market value performed exactly as predicted. Trust did not develop as well, since it was not possible to increase trust in the online channel. In consequence, the trust building measures which were taken should be thought over, as they did not result in the desired effect.

As special performance measure, the customer migration model developed in this work is presented. Since the calculation of this measure involves the analysis of a great number of customer contacts, a shortened demonstration calculation is performed. This showcase shall demonstrate the calculation of the migration matrix. The author assumes a set of (fictitious) customer contacts. The data is imported into the statistical software R [R De06]. R is an open source system for statistical computing and graphics [Horn06]. A big repository of extensions (packages) provides functions for a huge number of statistical methods. The package *hmm.discnp* is able to fit hidden Markov models to data sets [Turn06]. The theoretical model is described on page 121. The graphical representation of the model is replicated in figure 6.1.

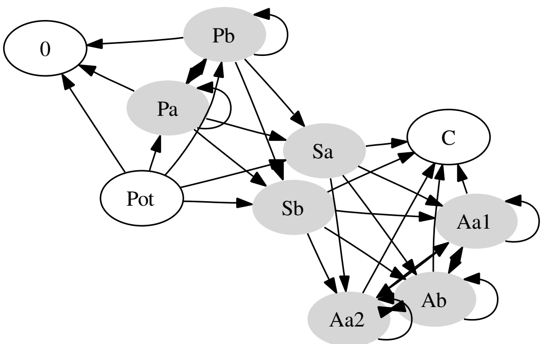

Figure 6.1: Graphical representation of the Markov chain model for channel migration (replication of figure 5.29)

The model specification results in following proximate transition matrix:

$$P = \left(\begin{array}{c|cccccccccc} & Pot & P_a & P_b & S_a & S_b & A_{a1} & A_{a2} & A_b & \mathrm{C} & 0 \\ \hline Pot & 0 & p_{PP_a} & p_{PP_b} & p_{PS_a} & p_{PS_b} & 0 & 0 & 0 & 0 & p_{P0} \\ P_a & 0 & p_{P_aP_a} & p_{P_aP_b} & p_{P_aS_a} & p_{P_aS_b} & 0 & 0 & 0 & 0 & p_{P_a0} \\ P_b & 0 & p_{P_bP_a} & p_{P_bP_b} & p_{P_bS_a} & p_{P_bS_b} & 0 & 0 & 0 & 0 & p_{P_b0} \\ S_a & 0 & 0 & 0 & 0 & 0 & p_{S_aA_{a1}} & p_{S_aA_{a2}} & p_{S_aA_b} & p_{S_aC} & 0 \\ S_b & 0 & 0 & 0 & 0 & 0 & p_{S_bA_{a1}} & p_{S_bA_{a2}} & p_{S_bA_b} & p_{S_bC} & 0 \\ A_{a1} & 0 & 0 & 0 & 0 & 0 & p_{A_{a1}A_{a1}} & p_{A_{a1}A_{a2}} & p_{A_{a1}A_b} & p_{A_{a1}C} & 0 \\ A_{a2} & 0 & 0 & 0 & 0 & 0 & p_{A_{a2}A_{a1}} & p_{A_{a2}A_{a2}} & p_{A_{a2}A_b} & p_{A_{a2}C} & 0 \\ A_b & 0 & 0 & 0 & 0 & 0 & p_{A_bA_{a1}} & p_{A_bA_{a2}} & p_{A_bA_b} & p_{A_bC} & 0 \\ C & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{array}\right)$$

The following states, in which a visitor or customer can remain are used in the model:

Pot is a potential customer. Every visitor of a channel is at first classified into this stage.

$\mathbf{P_a}$ **and** $\mathbf{P_b}$ are the pre-sales states of the online channel (a) and the store-based channel (b). A customer potential customer switches to state P_a if a customer contact in channel A is registered.

$\mathbf{S_a}$ **and** $\mathbf{S_b}$ are the sales states of the Channels. It means that the customer accomplished a transaction in a specific channel.

$\mathbf{A_{a1}}$**,** $\mathbf{A_{a2}}$**, and** $\mathbf{A_b}$ describe the use of after-sales services. The example model covers two different possibilities to consume after-sales services in the online channel (a) and one possibility in store-based channel (b). The online channel firstly provides call-center support for the customers (channel A_{a1}) and an online forum where inquiries can be resolved (channel A_{a2}).

C is the state of a customer who bought the product and does not use after-sales services any more. Every customer finally migrates to this state.

0 denotes the state of a non-customer. Either the visitor did bought the product somewhere else or did not buy the product at all.

The input data for the model are sequences of customer contacts. The customer contacts have to be extracted from the operational systems of the company. Either a full sample of all available customers of a certain period, a representative sample of all company customers, or a specifically selected customer group may be used for the model estimation. The data is used for the example migration model is printed in the appendix of this work. The used example data contain 100 contacts with potential customers ending in 18 transactions and 82 aborts. Five transactions were conducted in the online channel (A) and 13 were conducted in the store-based channel (B).

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	0	0.35	0.65	0	0	0	0	0	0	0
P_a	0	0.3	0.1	0.1	0.1	0	0	0	0	0.4
P_b	0	0.1	0.3	0.1	0.1	0	0	0	0	0.4
S_a	0	0	0	0	0	0.2	0.2	0.2	0.4	0
S_b	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_{a1}	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_{a2}	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_b	0	0	0	0	0	0.2	0.2	0.2	0.4	0
C	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1

Table 6.18: Initialization matrix for the model

The necessary input parameters for the model estimation are the customer contacts, an initial transition probability matrix, and a state probability matrix [Turn06]. The initial probability matrix represents the underlying model by providing initial probabilities for transitions which are possible and which are not possible (probability = 0). The state probability matrix defines probabilities of outputs belonging to a certain state. This allows the specification of models where certain outputs cannot clearly be assigned to states. In this case every output has one clearly defined state.

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	0	0.35	0.65	0	0	0	0	0	0	0
P_a	0	0.3	0.1	0.1	0.1	0	0	0	0	0.4
P_b	0	0.1	0.3	0.1	0.1	0	0	0	0	0.4
S_a	0	0	0	0	0	0.2	0.2	0.2	0.4	0
S_b	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_{a1}	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_{a2}	0	0	0	0	0	0.2	0.2	0.2	0.4	0
A_b	0	0	0	0	0	0.2	0.2	0.2	0.4	0
C	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1

Table 6.19: Initial transition probability matrix

Table 6.19 shows the initial transition probability matrix. According ro the number of transactions, the model specifies a greater chance of potential customers to initially visit the store-based channel (channel b in the example). The initial chance of transition into a non-customer (state 0) is higher than the transition to the pre-sales and sales phases of any channel. The chance of not switching channels is also assumed higher than the chance of switching to another channel. States C and 0 are considered as “end-states”, therefore the chance to leave the state is 0, resulting in a chance of 1 to stay in the state.

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	1	0	0	0	0	0	0	0	0	0
P_a	0	1	0	0	0	0	0	0	0	0
P_b	0	0	1	0	0	0	0	0	0	0
S_a	0	0	0	1	0	0	0	0	0	0
S_b	0	0	0	0	1	0	0	0	0	0
A_{a1}	0	0	0	0	0	1	0	0	0	0
A_{a2}	0	0	0	0	0	0	1	0	0	0
A_b	0	0	0	0	0	0	0	1	0	0
C	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1

Table 6.20: State probability matrix for outputs

The model specification requires the allocation of outputs to the different states. In this case, every state has exactly one output, and the outputs are named after the states. Table 6.20 shows the state probabilities for different outputs. Since the customer migration model works with a one-to-one relation, the chance is always determined by 100 percent (probability 1).

In the example case, the estimation of the model takes 18 steps to fulfill the chosen stopping criterium *square root of sum of squares of change in coefficients* below $1e^{-4}$ [Turn06]. The R commands, which are necessary to estimate the model, are printed in the appendix. The state probability matrix relates the states to surveyed outputs. The matrix in Table 6.21 indicates that the allocation of outputs to states did not change. This is important, because of the nature of the

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	1	0.2	0.2	0	0	0	0	0	0	0
P_a	0	0.8	0	0	0	0	0	0	0	0
P_b	0	0	0.8	0	0	0	0	0	0	0
S_a	0	0	0	1	0	0	0	0	0	0
S_b	0	0	0	0	1	0	0	0	0	0
A_{a1}	0	0	0	0	0	1	0	0	0	0
A_{a2}	0	0	0	0	0	0	1	0	0	0
A_b	0	0	0	0	0	0	0	1	0	0
C	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1

Table 6.21: Resulting state probability matrix

model estimation, the allocation and order of states gets lost during the calculation. Therefore, the allocation may change during the process, which would be indicated by the resulting state probability matrix. The matrix in this example shows a chance of 0.2 for the ouput Pot to be allocated to Pa or Pb. In both cases, 0 would be expected. Further are the probabilities for P_a and P_b 0.8 although 1 would be expected. These values indicate that no perfect allocation of states can be determined. Most likely, this is a result of the relatively similar patterns of pre-sales channel usage in channel A and B in the contact data. Nevertheless, the values indicate that the states could be positively allocated to the outputs.

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	0	0.32	0.68	0	0	0	0	0	0	0
P_a	0	0.39	0.2	0.03	0.02	0	0	0	0	0.37
P_b	0	0.31	0.42	0.01	0.07	0	0	0	0	0.2
S_a	0	0	0	0	0	0.4	0.2	0.2	0.2	0
S_b	0	0	0	0	0	0.31	0	0.31	0.38	0
A_{a1}	0	0	0	0	0	0.27	0.09	0.09	0.55	0
A_{a2}	0	0	0	0	0	0.17	0.5	0.17	0.17	0
A_b	0	0	0	0	0	0.11	0.11	0.22	0.56	0
C	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	0	0	1

Table 6.22: Resulting migration probability matrix

As a final result, the migration probability matrix indicates the probability of transitions between the different states. Table 6.22 shows the estimated transition probability matrix for the example customer contacts. 32 percent of potential customers firstly visit the online channel, and 68 percent use the store-based channel. Looking at line P_a and P_b, one can see that a visitor of the online channel has a 37 percent chance to abort the sales process, while for the store-based channel this value lies only at about 20 percent. However, this does not mean, that only 20 or 37 percent of potential customers jump off. These numbers denote the chance of not returning for another visit, at each visit. The final migration is better evaluated by an n-step transition matrix, as discussed later. Visitors of the online channel have a three percent chance of immediately buying the product in the webshop, and a two percent chance of buying it in the online store without any other inquiry in the store[2]. 39 percent of online visitors come back to visit the online channel and twenty percent switch to the store-based channel in the pre-sales phase. Seven percent of visitors of the store-based channel immediately buy the good there. One

[2]In this example, it is presumed that it is possible to survey a store-based sales contact without pre-sales inquiry. In practice, it will often be difficult to differentiate between visits including or excluding a pre-sales contact. A possible way to measure this would be the recognition of online reservations which are picked up and paid in the store-based channel.

	Pot	P_a	P_b	S_a	S_b	A_{a1}	A_{a2}	A_b	C	0
Pot	0	0	0	0	0	0	0	0	0.19	0.81
P_a	0	0	0	0	0	0	0	0	0.15	0.85
P_b	0	0	0	0	0	0	0	0	0.21	0.79

Table 6.23: Migration probabilities after 15 state-changes

percent buys the article online, and 31 percent switch to the online channel during the pre-sales phase.

Rows S_a to A_b show the behavior of customers after the sales transaction. Most online customers use one of the two online possibilities for after-sales service (altogether 60 percent). Twenty percent use the store-based after-sale service channel, and twenty percent of online customers do not use an after-sales service at all. For goods bought in the store, 38 percent of customers do not use after-sales service. Rows A_{a1} to A_b reveal that 55 percent of customers in the first online service channel are satisfied and do not require any more after-sales services. 56 percent of the customers in the store-based after-sales services to not use any more services. The second online service channel of the company does generate more inquiries, since only 17 percent of the customers in this service channel do not use any further after-sales services. This does not necessarily mean that the second online channel provides bad service, but can be explained by the nature of the service channel. The usual method of using an online forum is to visit it several times. If the issue cannot be resolved by the customers themselves, they have to use the call center or the store-based channel to repair or replace the product.

The last two rows of the migration matrix do no inherit any customer behaviour information. As expected, the estimation of the migration model shows no possibility to migrate away from the state C and 0. This is an indication that the model estimation worked as expected and the data shows no invalid cases where the state C or 0 were left. It should be noted that the estimation of the model turned out to be very sensitive to invalid migration patterns in the data. Only a few cases are sufficient to disturb the estimation. Such cases typically result in ambiguous values of the state probabilities matrix, and unexpected transition probabilities between states where no transition is possible, according to the model.

Table 6.23 shows the transition probabilities for a 15-step-transition matrix for the states Pot, P_a, and P_b. This matrix was calculated by multiplying the original transition matrix by itself 15 times. It gives a good impression of the final retention of visitors in the different channels.

After these 15 iterations, practically all customers either finished or aborted their transactions. Therefore, the percentage of customers who finally made a purchase can be read from the table. In this scenario the figure is 19 percent. The retention in the online channel (15 percent) is lower than in the store-based channel (21 percent). In this migration example, the retention rate is indicated as much higher than the measured retention. On one hand this could be explained by a high percentage of returning customers, which are covered by the migration model but not by retention 1 and retention 2. On the other hand, in this example, a much higher number of input customer visits would be needed to model a lower retention rate. The author accepts this inconsistency of the two different ways of measuring retention in order to keep the necessary input data handy and to make it possible to include them in the appendix.

In summary, this chapter provides a showcase implementation of the model introduced in chapter 5. The general model is implemented in a database management system. The demonstration shows the performance measurement system in the customizing, planning and measurement phases. In the measurment part of the example, an exemplary estimation of a migration model, as described in the theoretical part and the specialized model part of this work, is conducted. The following and last chapter of the book will discuss the findings.

Chapter 7

Summary and discussion of results

The concluding chapter shall reflect a critical appraisal of the findings in this work. In chapters 2, *E-commerce multichannel retailing*, and *3*, *Performance measurement*, the theoretical foundations for the construction of a performance measurement system for e-commerce multichannel retailers were laid. Multichannel retailing and its relevance in marketing literature was pointed out. Also the evolution of performance measurement and the requirements in modern performance measurement systems were discussed. A set of e-commerce relevant success factors was presented. The final part of the theoretical foundation of this work presented the discussion of multichannel-specific performance measures. These measures cover customer behavior and aim to capture the channel switching behavior of multichannel customers.

The modeling section of this book contains the requirements definition of a performance measurement system. It is modeled along a systematic design approach. The ARIS framework for modeling information systems is used to split the model into five different parts. The following paragraphs discuss the created performance measurement system in terms of the general requirements in performance measurement systems, which are elaborated on in chapter 3.2. These are:

- Linking operations and strategic goals
- Provision of a succinct overview
- Multidimensionality and provision of a balanced picture
- Integration of different hierarchical levels

The requirement of *linking operations and strategic goals* is established by the constructive definition of success factors, strategic goals and performance measures. Strategic goals have to be established on top of predefined success factors. They are, furthermore, the basis for the planning of performance measures. The performance measures and their planned values are used to control the operations of the company. As a result, the linkage of operations and strategic goals is not only recommended, but can be enforced by the system.

Provision of a succinct overview: The measures of the performance measurement system are split into different scorecards. The design of these scorecards draws on the design of the Balanced Scorecard framework. Following the recommendations of the concept, a manageable set of performance measures should be used. The performance measurement system in this work does not enforce such sets of measures by technical means, but it encourages them by straightforward reference to relevant concepts, which discuss how a useful scorecard should be established.

A restriction of the model is the focus on sales and distribution functions. Since the model described in this work only covers one specific part of a company, a succinct overview cannot be given over the whole organization but only over the sales and distribution system. To cover the remaining parts of the company, the system has to be integrated in a system-wide performance measurement system. This could be achieved by expanding the general model until it covers the whole company. The basic design of the model is flexible enough to support such an expansion.

The requirement of *multidimensionality and provision of a balanced picture* is addressed by the introduction of basic success factors for multichannel companies, on which the complete strategic planning process is established. A well-founded set of success factors is recommended in this work. AHowever, the system can also be customized with own defined success factors, if the company already has established such factors or wants to lay the focus somewhere else.

The performance measurement model *integrates different hierarchical levels* of the company. It spans the level of the whole sales and distribution system and the level of the separated sales channels. It does not cover the top management level, and subsequent levels like different departments or employees of sales channels. As indicated, the performance measurement system could further be expanded to cover superordinate or subordinate organization levels of the company.

The verification of the four identified requirements in performance measurement systems shows a positive fulfillment in all these criteria in the model. The goal of describing a performance measurement system in the common understanding of this term can therefore be declared a success. After the discussion of the formal eligibility of the model as performance measurement system, a discussion of the content of the introduced system will follow.

The general model offers a comprehensive framework for setting up a performance measurement system which spans across various perspectives of the company's performance. On one hand, it is flexible enough to let the company itself formulate the content in form of success factors, strategic goals, and performance measures. On the other hand the model delivers an ordered framework where processes and their order are predefined, to ensure the compliance of the measurement system with overall performance measurement guidelines.

Modeling a performance measurement systen as a requirements definition of an information system represents a new approach in the field of performance measurement. A similar work, dealing with the construction of performance measurement for supply chain management, could be found [Erdm03]. The selected method has the advantage that some requirements in performance measurement systems can not only be communicated as recommendations, but can also be enforced by the design of the system. For example the model enforces the linkage between success factors, strategic goals, and measures. It addresses the needs of multichannel retailers, and is organized in order to represent the channel structure of the sales and distribution system of the company. The differentiation allows monitoring performance of the whole sales and distribution system, and each channel, separately. The output view of the general model discusses emerging possibilities and pitfalls of the interpretation of results in the different scorecards.

Recommendations for actual performance measures, which should be included into a performance measurement system, are limited to success factors for e-commerce multichannel companies. Only a small set of concrete performance measures are actually discussed in depth in this book. This goes along with the the prevalent opinion that the selection of final measures has to happen in the company itself along its corporate vision and strategic plan. The model, therefore, is flexible enough to be completely adapted to a company's requirements.

After the requirements definition of the model, its use was demonstrated by a simple application. A rudimentary database implementation along the specifications of the model was set up.

On top of a selected company, fictitious customization, planning, and measurement cycles were conducted (The results are documented in chapter 6.). The example demonstrates the feasibility of the model and serves as a showcase, allowing for a better understanding of the modeled performance measurement system. The example also includes the estimation of a general migration model along the specifications of the model. On a set of virtual customer contacts, which shall represent the chosen sample of the company's customers, a migration model is calculated (The process is elaborated in the respective chapter.). The exact implementation by the use of the freely available statistical software R is printed in the appendix of the work. The exemplary calculation of the model allows to show possible interpretations of the results of general migration models. Further it proves that the proposed model estimation yields meaningful results.

The showcase performance measurement system provides certain evidence about the feasibility of the model. Nevertheless, the practical applicability of the model for multichannel retailing can only be shown by a real world example in form of a case study. Due to practical reasons, this work does not provide such case study, and and the conclusions of this work are limited to a model. The model inherits a number of ideas which could deliver interesting solutions for multichannel companies, even if they do not want to adopt the complete model. The conclusion wheter the complete model is a practicable solution for multichannel retailing can only be made after a practical implementation and integration into a company performance measurement system and a documentation of such a case. To make it applicable for the operational use, the model has to be adapted in detail and implemented for a specific company.

The specialized part of the model deals with the detailed specification of a general migration model, a website controlling-based migration model, and a set of measures for web-customer behavior. The general migration model is an applied Markov model estimation for customer switching behavior. Similar customer migration models in literature typically deal with channel migration between different transactions within the same company [PfCa00, SuTh04]. The migration model proposed in this work deals with channel migration in the course of pre-sales, sales, and after-sales phases of the same transaction. It therefore allows the evaluation of transaction-relevant services between different sales channels, which is not possible with other models merely look at the whole transaction. This difference also accounts for a limitation of this approach. While other models allow looking at customers' behavior beyond different transactions, the model in this work cannot predict the behavior of a specific user on the basis of their previous transactions. The migration model therefore rather applies to the general customers of the company, or to specific customer groups which may be defined by the selection of sample customer contacts,as used for the estimation in chapter 6.

The selected performance measures can be distinguished into web-based performance measures and the general migration model. The web-based migration model discusses the integration and use of such measures in a sales- and distribution-specific performance measurement system. The required data should be easily obtainable from the typical e-commerce server infrastructure, as it is typically available from server logfiles and transaction handling systems. The measurement of this model is not as extensive, compared to a general migration model. Nevertheless the explanatory power of the web-based migration model is limited. The specialized model is completed by four measures, which also allow a web-based evaluation of the integration of online channels with other channels of the company. The explanatory power of such measures is also limited, since the data from the webserver can only represent customers which recently made use of the webserver. The general migration model has much more explanatory power, but also demands data which is more difficult to obtain. It needs customer contact data from each sales and distribution channel. At the time when this book was written, online channels provide much more data and more easily obtainable data about customer contacts than e.g. store-based channels. This situation may change when advanced technologies like RFID can be used to track customer behavior in retail stores. In cases where the survey of customer contacts in some channels is not possible, a customer inquiry in form of questionnaires is necessary to obtain the data for the estimation of general migration models.

The exemplary estimation of a general migration model shows how the input data has to be prepared for the model. It shows that with a set of customer contacts and the proper model specification, the calculation can be done with freely available statistical software. The interpretation of the resulting migration matrix has to be done with care, since the migration probabilities are interdependent, and possibly not as easily interpreted as other performance measures.

Altogether, this work first delivers the theoretical foundations of how a performance measurement should be constructed in order to fulfill the requirements in such a system. The second major part of the theoretical foundation of this work is the discussion of multichannel retailing: the phenomenon of multichannel customers, who demand the integration of different channels for their shopping needs, has recently been discussed in marketing literature. The resulting pressure on companies to introduce integrated e-commerce channels makes the topic of this work even more significant.

On top of the theoretical foundation, the modeled performance measurement system creates the basis for the integration of different performance measures for sales and distribution channels. The implementation of specific performance measures dealing with effects of integrated channels is covered by the specialized part of the model. In this part, a set of measures is integrated into the general model. The showcase implementation with an artificial example concludes the book and gives a glimpse on a possible implementation of the model by a real e-commerce multichannel retailer.

Appendix A

Demonstration table definition and queries

Listing 1: Dump of database table structure

```
-- MySQL dump 10.10
--
-- Host: localhost    Database: performance
-- ------------------------------------------------------
-- Server version       5.0.24a-Debian_9-log

/*!40101 SET @OLD_CHARACTER_SET_CLIENT=@@CHARACTER_SET_CLIENT */;
/*!40101 SET @OLD_CHARACTER_SET_RESULTS=@@CHARACTER_SET_RESULTS */;
/*!40101 SET @OLD_COLLATION_CONNECTION=@@COLLATION_CONNECTION */;
/*!40101 SET NAMES utf8 */;
/*!40103 SET @OLD_TIME_ZONE=@@TIME_ZONE */;
/*!40103 SET TIME_ZONE='+00:00' */;
/*!40014 SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0 */;
/*!40014 SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0 */;
/*!40101 SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='NO_AUTO_VALUE_ON_ZERO' */;
/*!40111 SET @OLD_SQL_NOTES=@@SQL_NOTES, SQL_NOTES=0 */;

--
-- Table structure for table `Channel`
--

DROP TABLE IF EXISTS `Channel`;
CREATE TABLE `Channel` (
  `channelid` int(11) NOT NULL default '0',
  `name` char(20) default '',
  `distribution_type` char(100) default '',
  `channel_manager` char(100) default '',
  PRIMARY KEY  (`channelid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `Date`
```

```
--

DROP TABLE IF EXISTS `Date`;
CREATE TABLE `Date` (
  `dateid` int(11) NOT NULL auto_increment,
  `begindate` date default '0000-00-00',
  `enddate` date default '0000-00-00',
  `periodflag` tinyint(1) NOT NULL default '0',
  PRIMARY KEY  (`dateid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `Measure`
--

DROP TABLE IF EXISTS `Measure`;
CREATE TABLE `Measure` (
  `measureid` int(11) NOT NULL auto_increment,
  `scorecardid` int(11) NOT NULL default '0',
  `goalid` int(11) NOT NULL default '0',
  `classid` int(11) NOT NULL default '0',
  `dateid` int(11) NOT NULL default '0',
  PRIMARY KEY  (`measureid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `MeasureClass`
--

DROP TABLE IF EXISTS `MeasureClass`;
CREATE TABLE `MeasureClass` (
  `classid` int(11) NOT NULL auto_increment,
  `name` char(20) default '',
  `description` char(100) default '',
  `break_down_function` char(100) default '',
  `aggregate_function` char(100) default '',
  `comparison_function` char(100) default '',
  PRIMARY KEY  (`classid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `MeasuredValue`
--

DROP TABLE IF EXISTS `MeasuredValue`;
CREATE TABLE `MeasuredValue` (
  `measureid` int(11) NOT NULL default '0',
  `value` decimal(10,2) default '0.00',
  `remarks` char(100) default ''
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
```

```
-- Table structure for table `Scorecard`
--

DROP TABLE IF EXISTS `Scorecard`;
CREATE TABLE `Scorecard` (
  `scorecardid` int(11) NOT NULL default '0',
  `description` char(100) default '',
  `channelid` int(11) default '0',
  PRIMARY KEY  (`scorecardid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `StrategicGoal`
--

DROP TABLE IF EXISTS `StrategicGoal`;
CREATE TABLE `StrategicGoal` (
  `goalid` int(11) NOT NULL default '0',
  `name` char(20) default '',
  `description` char(100) default '',
  `factorid` int(11) NOT NULL default '0',
  PRIMARY KEY  (`goalid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `Successfactor`
--

DROP TABLE IF EXISTS `Successfactor`;
CREATE TABLE `Successfactor` (
  `factorid` int(11) NOT NULL auto_increment,
  `name` char(50) default '',
  `description` char(100) default '',
  PRIMARY KEY  (`factorid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Table structure for table `TargetValue`
--

DROP TABLE IF EXISTS `TargetValue`;
CREATE TABLE `TargetValue` (
  `measureid` int(11) NOT NULL default '0',
  `revisionid` int(11) NOT NULL default '0',
  `value` decimal(10,2) default '0.00',
  `status` char(20) default '',
  `date` date NOT NULL default '0000-00-00',
  `author` char(20) default '',
  `remarks` char(100) default '',
  PRIMARY KEY  (`measureid`,`revisionid`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```

```
--
-- Temporary table structure for view `revisions`
--

DROP TABLE IF EXISTS `revisions`;
/*!50001 DROP VIEW IF EXISTS `revisions`*/;
/*!50001 CREATE TABLE `revisions` (
  `revisionid` int(11)
) */;

--
-- Final view structure for view `revisions`
--

/*!50001 DROP TABLE IF EXISTS `revisions`*/;
/*!50001 DROP VIEW IF EXISTS `revisions`*/;
/*!50001 CREATE ALGORITHM=UNDEFINED */
/*!50013 DEFINER=`apinteri`@`localhost` SQL SECURITY DEFINER */
/*!50001 VIEW `revisions` AS select distinct `TargetValue`.`
   revisionid` AS `revisionid` from `TargetValue` */;
/*!40103 SET TIME_ZONE=@OLD_TIME_ZONE */;

/*!40101 SET SQL_MODE=@OLD_SQL_MODE */;
/*!40014 SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS */;
/*!40014 SET UNIQUE_CHECKS=@OLD_UNIQUE_CHECKS */;
/*!40101 SET CHARACTER_SET_CLIENT=@OLD_CHARACTER_SET_CLIENT */;
/*!40101 SET CHARACTER_SET_RESULTS=@OLD_CHARACTER_SET_RESULTS */;
/*!40101 SET COLLATION_CONNECTION=@OLD_COLLATION_CONNECTION */;
/*!40111 SET SQL_NOTES=@OLD_SQL_NOTES */;
```

Listing 2: SQL Statement for table 6.1: Success factors on page 132

```
select name as Success Factor, factorid as Id
from Successfactor
order by name
```

Listing 3: SQL Statement for table 6.2: Sales and distribution channels on page 133

```
select channelid as 'Id', name as 'Name', distribution_type as '
   Type␣of␣Distribution',
channel_manager as 'Channel␣Manager'
from Channel
```

Listing 4: SQL Statement for table 6.3: Sales and distribution scorecards on page 133

```
select scorecardid as 'Id', description as 'Description',
   channelid as 'Channel'
from Scorecard
```

Listing 5: SQL Statement for table 6.6: Measurement classes on page 135

```
select g.name as Goal, goalid as 'Id', f.name as 'Success␣factor',
    g.description as 'Description'
from StrategicGoal as g, Successfactor as f
```

```
where g.factorid=f.factorid
order by g.name;
```

Listing 6: SQL Statement for table 6.6: Measurement classes on page 135

```
select name as 'Measure', classid as 'Id', description as 'Description'
from MeasureClass
order by name
```

Listing 7: SQL Statement for table 6.5: Planning and measurement dates for the year 2007 on page 134

```
select begindate as 'Begin␣Date', enddate as 'End␣date',dateid as 'Id',  periodflag as 'Period'
from Date
order by begindate
```

Listing 8: SQL Statement for table 6.8: Measurement classes used in the three scorecards on page 138

```
select distinct
        c.name as 'Measure',  c.classid as 'Class', g.name as 'Strategic␣Goal',
        not m1.scorecardid  is null as 'Overall␣scorecard',
        not m2.scorecardid  is null as 'Store-based␣scorecard',
        not m3.scorecardid  is null as 'Online␣scorecard'

from MeasureClass as c left
        join Measure as m1 on c.classid=m1.classid and m1.scorecardid=1
        left join Measure as m2 on c.classid=m2.classid and m2.scorecardid=2
        left join Measure as m3 on c.classid=m3.classid and m3.scorecardid=3,
        StrategicGoal as g

where  g.goalid= (select goalid from Measure where classid=c.classid limit 1) order by g.name,c.name
```

Listing 9: SQL Statement for table 6.7: Excerpt of table measure on page 137

```
select * from Measure where classid=7 or classid=12
```

Listing 10: SQL Statement for table 6.9: Excerpt of table TargetValue on page 139

```
select measureid,revisionid,value,status,remarks
from TargetValue
where measureid in (select measureid from Measure where classid=7 or classid=12)
```

Listing 11: SQL Statement for table 6.13: Table MeasuredValue with values on page 143

```
select * from MeasuredValue
```

Listing 12: SQL Statement for table 6.10: Overview of the planned values for the first quarter 2007 on page 140

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
r.revisionid as 'Rev.',
(select status from TargetValue as t where m1.measureid=t.
   measureid and t.revisionid=r.revisionid limit 1) as 'Status',
(select value from TargetValue as t where m1.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Overall',
(select value from TargetValue as t where m2.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Store-based',
(select value from TargetValue as t where m3.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Online'

from MeasureClass as c
join revisions as r on revisionid > 0
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1  and m1.dateid=1
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2  and m2.dateid=1
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3  and m3.dateid=1

where r.revisionid in
        (select revisionid from TargetValue t
        where m1.measureid=t.measureid OR m2.measureid=t.measureid
            OR m3.measureid=t.measureid)

order by c.name, r.revisionid;
```

Listing 13: SQL Statement for table 6.11: Overview of the planned values for the second quarter 2007 on page 141

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
r.revisionid as 'Rev.',
(select status from TargetValue as t where m1.measureid=t.
   measureid and t.revisionid=r.revisionid limit 1) as 'Status',
(select value from TargetValue as t where m1.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Overall',
(select value from TargetValue as t where m2.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Store-based',
(select value from TargetValue as t where m3.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Online'

from MeasureClass as c
join revisions as r on revisionid > 0
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1  and m1.dateid=2
```

```
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2  and m2.dateid=2
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3  and m3.dateid=2

where r.revisionid in (select revisionid from TargetValue t
        where m1.measureid=t.measureid OR m2.measureid=t.measureid
            OR m3.measureid=t.measureid)

order by c.name, r.revisionid;
```

Listing 14: SQL Statement for table 6.12: Planned values for both points in time on page 142

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
r.revisionid as 'Rev.',
(select begindate from Date where dateid=m1.dateid) as 'Date',
(select status from TargetValue as t where m1.measureid=t.
   measureid and t.revisionid=r.revisionid limit 1) as 'Status',
(select value from TargetValue as t where m1.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Overall',
(select value from TargetValue as t where m2.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Store-based',
(select value from TargetValue as t where m3.measureid=t.measureid
    and t.revisionid=r.revisionid limit 1) as 'Online'

from MeasureClass as c
join revisions as r on revisionid > 0
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1  and (m1.dateid=5 or m1.dateid=6)
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2  and (m2.dateid=m1.dateid)
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3  and (m3.dateid=m1.dateid)

where r.revisionid in (select revisionid from TargetValue t
        where m1.measureid=t.measureid OR m2.measureid=t.measureid
            OR m2.measureid=t.measureid)

order by c.name, m1.dateid;
```

Listing 15: SQL Statement for table 6.14: Overview of measured values for first quarter 2007 on page 144

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
(select value from MeasuredValue as t where m1.measureid=t.
   measureid  limit 1) as 'Overall',
(select value from MeasuredValue as t where m2.measureid=t.
   measureid  limit 1) as 'Store-based',
```

```
(select value from MeasuredValue as t where m3.measureid=t.
   measureid limit 1) as 'Online'

from MeasureClass as c
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1 and m1.dateid=1
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2 and m2.dateid=1
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3 and m3.dateid=1

where NOT (m1.measureid IS NULL and m2.measureid IS NULL and m3.
   measureid IS NULL)

order by c.name;
```

Listing 16: SQL Statement for table 6.15: Comparison of target and result values for first quarter 2007 (differences in percent) on page 144

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
round(((select value from MeasuredValue as t where m1.measureid=t.
   measureid  limit 1) -
(select value from TargetValue as t where m1.measureid=t.measureid
     order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m1.measureid=t.measureid
     order by t.revisionid DESC limit 1 ) , 2 )
as 'Overall',

round(((select value from MeasuredValue as t where m2.measureid=t.
   measureid  limit 1) -
(select value from TargetValue as t where m2.measureid=t.measureid
     order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m2.measureid=t.measureid
     order by t.revisionid DESC limit 1 ), 2)
as 'Store-based',

round(((select value from MeasuredValue as t where m3.measureid=t.
   measureid  limit 1) -
(select value from TargetValue as t where m3.measureid=t.measureid
     order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m3.measureid=t.measureid
     order by t.revisionid DESC limit 1 ) , 2)
as 'Online'

from MeasureClass as c
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1 and m1.dateid=1
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2 and m2.dateid=1
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3 and m3.dateid=1
```

```

where NOT (m1.measureid IS NULL and m2.measureid IS NULL and m3.
   measureid IS NULL)

order by c.name;
```

Listing 17: SQL Statement for table 6.16: Overview of measured values for first inquiry on page 145

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
(select value from MeasuredValue as t where m1.measureid=t.
   measureid  limit 1) as 'Overall',
(select value from MeasuredValue as t where m2.measureid=t.
   measureid  limit 1) as 'Store-based',
(select value from MeasuredValue as t where m3.measureid=t.
   measureid limit 1) as 'Online'

from MeasureClass as c
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid
   =1 and m1.dateid=5
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid
   =2 and m2.dateid=5
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid
   =3 and m3.dateid=5

where NOT (m1.measureid IS NULL and m2.measureid IS NULL and m3.
   measureid IS NULL)

order by c.name;
```

Listing 18: SQL Statement for table 6.17: Comparison of target and result values for first inquiry (differences in percent) on page 146

```
select distinct
c.name as 'Measure',
c.classid as 'Class',
round(((select value from MeasuredValue as t where m1.measureid=t.
   measureid  limit 1) -
(select value from TargetValue as t where m1.measureid=t.measureid
     order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m1.measureid=t.measureid
     order by t.revisionid DESC limit 1 ) , 2 )
as 'Overall',

round(((select value from MeasuredValue as t where m2.measureid=t.
   measureid  limit 1) -
(select value from TargetValue as t where m2.measureid=t.measureid
     order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m2.measureid=t.measureid
     order by t.revisionid DESC limit 1 ), 2)
as 'Store-based',
```

```

round(((select value from MeasuredValue as t where m3.measureid=t.measureid  limit 1) -
(select value from TargetValue as t where m3.measureid=t.measureid order by t.revisionid DESC limit 1 )) * 100 /
(select value from TargetValue as t where m3.measureid=t.measureid order by t.revisionid DESC limit 1 ) , 2)
as 'Online'

from MeasureClass as c
left join Measure as m1 on c.classid=m1.classid and m1.scorecardid=1 and m1.dateid=5
left join Measure as m2 on c.classid=m2.classid and m2.scorecardid=2 and m2.dateid=5
left join Measure as m3 on c.classid=m3.classid and m3.scorecardid=3 and m3.dateid=5

where NOT (m1.measureid IS NULL and m2.measureid IS NULL and m3.measureid IS NULL)

order by c.name;
```

Appendix B

R sourcecode for demonstration migration model estimation

Listing 19: Example customer migration paths

```
Pot->Pb->0
Pot->Pb->Pa->Pa->Pa->0
Pot->Pb->Pb->0
Pot->Pb->Pa->Pb->Pb->0
Pot->Pb->Pb->Pb->Pb->0
Pot->Pb->0
Pot->Pa->Pa->Pb->Sb->C
Pot->Pa->Pa->Pa->0
Pot->Pa->0
Pot->Pb->Pa->Pb->Pa->Pb->Sb->Aa1->Aa2->Aa2->Ab->C
Pot->Pb->Pa->0
Pot->Pa->0
Pot->Pb->Pb->Pb->0
Pot->Pb->Pb->Pb->0
Pot->Pb->Pb->0
Pot->Pa->Pa->Pa->0
Pot->Pa->0
Pot->Pa->Pa->Pa->0
Pot->Pa->Pa->Pa->Pa->0
Pot->Pa->Pa->Sa->C
Pot->Pb->Pb->Pb->0
Pot->Pb->Pb->Pb->Sb->Aa1->Aa1->C
Pot->Pb->Pa->0
Pot->Pb->Pa->0
Pot->Pa->Pa->Pa->0
Pot->Pb->Pb->0
Pot->Pa->Pb->Pa->0
Pot->Pa->0
Pot->Pa->0
Pot->Pb->Pa->Pb->Pb->0
Pot->Pa->0
Pot->Pb->Pb->Pb->Pb->Pa->0
Pot->Pa->Pb->Pa->0
```

```
Pot –>Pa –>Pb –>Pa –>0
Pot –>Pb –>0
Pot –>Pb –>Pb –>Pb –>0
Pot –>Pa –>0
Pot –>Pb –>Pa –>Pa –>Pa –>0
Pot –>Pb –>Pb –>Pa –>Sb –>C
Pot –>Pa –>Pb –>Pb –>Sb –>Aa1 –>Ab –>C
Pot –>Pa –>Pa –>Pa –>Pa –>0
Pot –>Pa –>0
Pot –>Pb –>Pa –>Pa –>0
Pot –>Pa –>Pb –>Pa –>Sa –>Aa1 –>C
Pot –>Pa –>Pb –>0
Pot –>Pb –>Pb –>0
Pot –>Pa –>Pa –>Pa –>Pa –>0
Pot –>Pb –>Pa –>0
Pot –>Pa –>0
Pot –>Pb –>Pb –>Pa –>0
Pot –>Pb –>0
Pot –>Pb –>Pa –>0
Pot –>Pb –>0
Pot –>Pa –>Pa –>Pa –>0
Pot –>Pa –>Pa –>0
Pot –>Pb –>0
Pot –>Pa –>0
Pot –>Pa –>Pb –>Pb –>0
Pot –>Pa –>Pb –>Pa –>0
Pot –>Pa –>Pb –>Pb –>Pa –>Sb –>Aa1 –>C
Pot –>Pb –>0
Pot –>Pb –>Pb –>0
Pot –>Pb –>Pb –>0
Pot –>Pb –>0
Pot –>Pa –>Pa –>0
Pot –>Pb –>Pa –>0
Pot –>Pb –>Sb –>C
Pot –>Pb –>Pb –>0
Pot –>Pa –>0
Pot –>Pb –>Pa –>Pa –>0
Pot –>Pb –>0
Pot –>Pb –>Pb –>Pb –>Sb –>Ab –>C
Pot –>Pa –>Pa –>Pa –>Pa –>0
Pot –>Pb –>Pa –>0
Pot –>Pb –>0
Pot –>Pa –>0
Pot –>Pb –>Pb –>Sb –>Ab –>C
Pot –>Pb –>Pb –>Sb –>Ab –>C
Pot –>Pb –>Pa –>0
Pot –>Pa –>Pb –>Pb –>Sb –>Ab –>Ab –>Ab –>Aa1 –>C
Pot –>Pb –>Pb –>0
Pot –>Pa –>Pa –>Pa –>0
Pot –>Pa –>Pa –>0
Pot –>Pb –>Pa –>0
Pot –>Pa –>0
```

```
Pot->Pa->0
Pot->Pb->Pa->0
Pot->Pb->0
Pot->Pb->Pa->Pb->Pb->0
Pot->Pa->Pb->Pb->Sa->Ab->Aa2->C
Pot->Pb->0
Pot->Pb->Pa->Sb->C
Pot->Pa->Pa->Pa->0
Pot->Pb->Pa->0
Pot->Pb->Pb->Pa->Sa->Aa2->Aa2->Aa2->Aa1->C
Pot->Pa->0
Pot->Pb->Pa->Pb->Pb->0
Pot->Pb->Pb->Pb->Sb->C
Pot->Pa->Pb->Pb->Pb->Pb->Pa->Sa->Aa1->Aa1->Aa1->C
Pot->Pa->0
```

Listing 20: R skript for setting initial model parameters and calculation of the migration model

```
# Load hmm.discnp library
library(hmm.discnp)


# Read customer migration data from csv file
custmig <- read.csv2(file="custmig_hmm.csv",sep=",", header=FALSE)
custmig <- matrix( factor(as.matrix(custmig), levels=c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2","Ab","C","0") ), nrow=dim(custmig)[1] )

#Inspect frequencies of reported customer contacts
summary(as.factor(as.vector(custmig)))


# Set initial model parameters

# tpm is the initial migration matrix for the iterative process
stpm <- rbind( c( 0, 0.5, 0.5, 0, 0, 0, 0, 0, 0, 0),
               c( 0, 0.2, 0.2, 0.2, 0.2, 0, 0, 0, 0, 0.2),
               c( 0, 0.2, 0.2, 0.2, 0.2, 0, 0, 0, 0, 0.2),
               c( 0, 0, 0, 0, 0, 0.2, 0.2, 0.2, 0.4, 0),
               c( 0, 0, 0, 0, 0, 0.2, 0.2, 0.2, 0.4, 0),
               c( 0, 0, 0, 0, 0, 0.2, 0.2, 0.2, 0.4, 0),
               c( 0, 0, 0, 0, 0, 0.2, 0.2, 0.2, 0.4, 0),
               c( 0, 0, 0, 0, 0, 0.2, 0.2, 0.2, 0.4, 0),
               c( 0, 0, 0, 0, 0, 0, 0, 0, 1, 0),
               c( 0, 0, 0, 0, 0, 0, 0, 0, 0, 1))

colnames(stpm) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2","Ab","C","0")
rownames(stpm) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2","Ab","C","0")


```

```
# Rho describes the initial likelihood for the observed output of
    belonging to a certain state of the model
# we use a straight one-to-one relation of outputs and states
srho <- rbind(  c(1, 0, 0, 0, 0, 0, 0, 0, 0, 0),
                c(0, 1, 0, 0, 0, 0, 0, 0, 0, 0),
                c(0, 0, 1, 0, 0, 0, 0, 0, 0, 0),
                c(0, 0, 0, 1, 0, 0, 0, 0, 0, 0),
                c(0, 0, 0, 0, 1, 0, 0, 0, 0, 0),
                c(0, 0, 0, 0, 0, 1, 0, 0, 0, 0),
                c(0, 0, 0, 0, 0, 0, 1, 0, 0, 0),
                c(0, 0, 0, 0, 0, 0, 0, 1, 0, 0),
                c(0, 0, 0, 0, 0, 0, 0, 0, 1, 0),
                c(0, 0, 0, 0, 0, 0, 0, 0, 0, 1) )

colnames(srho) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2","Ab","C"
    ,"0")
rownames(srho) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2","Ab","C"
    ,"0")

par <- new.env()
 par$tpm <- stpm
 par$Rho <- srho
parlist <- as.list(par)


# In the next step the migration model is estimated (by the use of
     the hmm function of the hmm.discnp package)

migration <- hmm( custmig, yval=c("Pot","Pa","Pb","Sa","Sb","Aa1",
    "Aa2","Ab","C","0"), par0=parlist, verbose=TRUE, crit="L2",
    tolerance=1e-4)


# Apply nice column an rownames for the resulting matrices

colnames(migration$tpm) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2"
    ,"Ab","C","0")
rownames(migration$tpm) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2"
    ,"Ab","C","0")
colnames(migration$Rho) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2"
    ,"Ab","C","0")
rownames(migration$Rho) <- c("Pot","Pa","Pb","Sa","Sb","Aa1","Aa2"
    ,"Ab","C","0")



# The resulting migration matrix is stored in migragion$tpm
# ... migration$Rho gives us hints if the allocation between
    observed outputs and expected states was successful


output_rho <- round(migration$Rho, digits=2)
```

```
output_tpm <- round(migration$tpm/rowSums(migration$tpm),digits=2)

#Print the resulting matrices
output_rho
output_tpm


# The matrix can be used to calculate an n-step migration model.
# In this case a 15-step model is calculated

repeatedmatrix <- migration$tpm
for(i in 1:15){repeatedmatrix <- repeatedmatrix%*% outputmatrix}
repeatedmatrix <- round(repeatedmatrix/rowSums(repeatedmatrix),2)

#the first three rows of the resulting matrix are displayed on the
    screen
repeatedmatrix[1:3,]
```

Bibliography

[AcBC+05] *Achabal, Dale D.; Badgett, Melody; Chu, Julian et al.*: Cross-Channel optimization - A strategic roadmap for multichannel retailers. Techn. Ber., IBM Institute for Business Value, 2005.

[AgVe02] *Agarwal, Ritu; Venkatesh, Viswanath*: Assessing a Firm's Web Presence: A Heuristic Evaluation Procedure for the Measurement of Usability. In: Information Systems Research 13 (2002) 2, S. 168–186.

[BaKW+01] *Barua, Anitesh; Konana, Prabhudev; Whinston, Andrew B. et al.*: Driving E-Business Excellence. In: Sloan Management Review 45 (2001) 1, S. 36–44.

[BaRe01] *Balabanis, George; Reynolds, Nina L.*: Consumer Attitudes Towards Multi-Channel Retailers' Web Sites: The Role of Involvement, Brand Attitude, Internet Knowledge and Visit Duration. In: Journal of Business Strategies 18 (2001) 2, S. 105–131.

[BeNK04] *Becker, Jörg; Niehaves, Björn; Kackstedt, Ralf*: Bezugsrahmen zur epistemologischen Positionierung der Referenzmodellierung. In: *Becker, Jörg; Delfmann, Patrick (Hrsg.)*: Referenzmodellierung. Physica-Verlag, Heidelberg 2004, S. 1–17.

[BeSc04] *Becker, Jörg; Schütte, Reinhard*: Handelsinformationssysteme. Redline Wirtschaft, Verlag Moderne Industrie, Frankfurt am Main 2004.

[BeWi06] *Becker, Jörg; Winkelmann, Axel*: Handelscontrolling - Optimale Informationsversorgung mit Kennzahlen. Springer-Verlag Berling Heidelberg 2006.

[Bock04] *Bock, Geoffrey E.*: Office Depot: A Destination for Office Supplies and e-business Expertise: Building Multi-Touchpoint Relationships with Customers and Vendors by Integrating Business Processes. IBM white paper, A Patricia Seybold Group Business Case Study prepared for IBM, 2004.

[BoOl02] *Boyer, Kenneth K.; Olson, John R.*: Drivers of Internet purchasing success. In: Production and Operations Management 11 (2002) 4, S. 480–498.

[BrFJ+91] *Brignall, T.J.; Fitzgerald, L.; Johnston, R. et al.*: Performance Measurement in Service Businesses. In: Management Accounting 69 (Nov 1991) 10, S. 34–36.

[Broc03] *vom Brocke, Jan*: Referenzmodellierung - Gestaltung und Verteilung von Konstruktionsprozessen. Nr. 4 in Advances in Information Systems and Management Science, Logos Verlag Berlin 2003.

[Bude05] *Buderi, Robert*: E-Commerce Gets Smarter. In: Technology Review 4 (April 2005), S. 54–59.

[CeCo90] *Cespedes, Frank V.; Corey, E. Raymond*: Managing Multiple Channels. In: Business Horizons 33 (1990) 4, S. 67–77.

[Chan62] *Chandler, Alfred D.*: Strategy and Structure: chapters in the history of the industrial enterprise. MIT Press 1962.

[Chan77] *Chandler, Alfred D.*: The Visible Hand - The Managerial Revolution in American Business. The Belknap Press of Harvard University Press, Cambridge, Massachusetts and London, England 1977.

[Chen76] *Chen, Peter Pin-Shan*: The Entity-Relationship Model - Toward a Unified View of Data. In: ACM Transactions on Database Systems 1 (1976) 1, S. 9–36.

[CoMo89] *Colombo, Richard A.; Morrison, Donald G.*: A Brand Switching Model with Implications for Marketing Strategies. In: Marketing Science 8 (1989) 1, S. 89–99.

[Craw05] *Crawford, James*: Are You Really Measuring Your Multi-Channel Customer Experience? Techn. Ber., GERS Retail Systems, IBM, Futuretail, 2005.

[CrLy88] *Cross, Kelvin F.; Lynch, Richard L.*: The ”SMART” Way to Define and Sustain Success. In: National Productivity Review 8 (1988) 1, S. 23–33.

[CuSt00] *Cutler, Matt; Sterne, Jim*: E-Metrics - Business Metrics for the New Economy. Report, NetGenesis Corp., Cambridge, MA 02140-2322, 2000, http://www.netgen.com.

[Dear69] *Dearden, John*: The case against ROI control. In: Harvard Business Review 47 (1969) 3, S. 124–136.

[Deki03] *Deking, Ingo*: Management des Intellectual Capital. Dt. Univ-Verlag 2003.

[DeMc03] *DeLone, William H.; McLean, Ephraim R.*: The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. In: Journal of Management Information Systems 19 (2003) 4, S. 9–30.

[DeMc04] *DeLone, William H.; McLean, Ephraim R.*: Measuring e-Commerce Success: Applying the DeLone & McLean Information Systems Success Model. In: International Journal of Electronic Commerce 9 (2004) 1, S. 31–47.

[DePe03] *Denton, James W.; Peace, A. Graham*: Selection and Use of MySQL in a Database Management Course. In: Journal of Information Systems Education 14 (2003) 4, S. 401–407.

[Dies05] *Diestel, Reinhard*: Graph Theroy. 3. Aufl., Springer-Verlag, Heidelberg 2005.

[DoPa06] *Dobing, Brian; Parsons, Jeffrey*: How UML is Used. In: Communications of the ACM 49 (2006) 5, S. 109–113.

[Doub04] *Doubleclick*: Multi-Channel Shopping Study - Holiday 2003, www.doubleclick.net. Techn. Ber., 2004.

[Ehrm03] *Ehrmann, Harald*: Kompakt-Training Balanced Scorecard. Kiehl 2003.

[EhTj98] *Ehterington, Lois; Tjosvold, Dean*: Managing Budget Conflicts: Contribution of Goal Interdependence and Interaction. In: Canadian Journal of Administrative Science 15 (1998) 2, S. 142–151.

[Erdm03] *Erdmann, Mark-Ken*: Supply Chain Performance Measurement. Josef Eul Verlag, Köln 2003.

[EsKu96] *Eschenbach, Rolf; Kunesch, Hermann*: Strategische Konzepte. 3. Aufl., Schäffer Poeschel 1996.

[Fegr02] *Fegreus, Jack*: Building a Global Ecosphere. In: Open, http://www.open-mag.com/7143483279.shtml (October 2002).

[FeLo02] *Fettke, Peter; Loos, Peter*: Methoden zur Wiederverwendung von Referenzmodellen - Übersicht und Taxonomie. In: *Becker, J.; l. Grob, H.; Klein, S. et al. (Hrsg.)*: Arbeitsberichte des Instituts für Wirtschaftsinformatik. Westfälische Wilhelms-Univsersität Münster, Institut für Wirtschaftsinformatik, Leonardo -Campus 3, 48149 Münster 2002.

[FoTD84] *Fombrun, Charles J.; Tichy, Noel M.; Devanna, Mary Anne*: Strategic human resource management. John Wiley & Sons, New York 1984.

[Fowl04] *Fowler, Martin*: UML Distilled. Third edition. Addison-Wesley 2004.

[FrKH00] *Friedman, Batya; Kahn, Peter H; Howe, Daniel C.*: Trust Online. In: Communications of the ACM 43 (2000) 12, S. 34–40.

[GeDS07] *Gensler, Sonja; Dekimpe, Marnik G.; Skiera, Bernd*: Evaluating channel performance in multi-channel environments. In: Journal of Retailing and Consumer Services (2007).

[GeHe05] *Georgius, A.; Heinzl, A.*: Strategien und Erfolgsfaktoren von Anbietern im IT und Business Process Outsourcing in Deutschland. In: Wirtschaftsinformatik 2005 - eEconomy eGovernment eSociety, Physica-Verlag, Physica-Verlag 2005 S. 409–428.

[GhNo96] *Ghalayini, Alaa M.; Noble, James S.*: The changing basis of performance measurement. In: International Journal of Operations & Production Management 16 (1996) 8, S. 63–79.

[GiVe06] *Gilbert, G. Ronald; Veloutsou, Cleopatra*: A cross-industry comparison of customer satisfaction. In: Journal of Services Markeing 20 (2006) 5, S. 298–308.

[Glei01] *Gleich, Ronald*: Das System des Performance Measurement. Verlag Franz Vahlen, München 2001.

[Glob85] *Globerson, Shlomo*: Issues in developing a performance criteria system for an organization. In: International Journal of Production Research 23 (1985) 4, S. 639–646.

[GuGa00] *Gulati, Ranjay; Garino, Jason*: Get the Right Mix of Bricks & Clicks. In: Harvard Business Review May-June (2000), S. 107–114.

[GüSp05] *Günther, Oliver; Spiekermann, Sarah*: RFID and the Perception of Control: The Consumer's View. In: Communications of the ACM 48 (2005) 9, S. 73–76.

[HaAb80] *Hayes, Robert H.; Abernathy, William J.*: Managing our way to economic decline. In: Harvard Business Review July-August (1980), S. 67–77.

[HaMa07] *Hansen, Hans Robert; Madlberger, Maria*: Beziehungen zwischen dem Internet-Vertrieb und anderen Absatzwegen im Einzelhandel. In: *Wirtz, Bernd (Hrsg.)*: Handbuch Multi-Channel-Marketing. Gabler 2007, S. 763–784.

[HaMT+04] *Hansen, Hans Robert; Madlberger, Maria; Treiblmaier, Horst et al.*: Aktuelle Forschungsfragen im B2C-E-Commerce. In: *Trommsdorff, V. (Hrsg.)*: Handelsforschung 2004. BBE Verlag 2004.

[HaNe05] *Hansen, Hans Robert; Neumann, Gustaf*: Wirtschaftsinformatik 1 - Grundlagen und Anwendungen. 9. Aufl., Lucius & Lucius 2005.

[Hans98] *Hansen, Hans Robert*: Ausschaltung des institutionellen Handels durch Informations- und Kommunikationssysteme. In: *Ahlert, Dieter (Hrsg.)*: Informationssysteme für das Handelsmanagement - Konzepte und Nutzung in der Unternehmenspraxis. Springer, Berlin 1998, S. 123–166.

[HaSu05] *Hardesty, David M.; Suter, Tracy A.*: E-tail and retail reference price effects. In: The Journal of Product and Brand Management 14 (2005) 2/3, S. 129–136.

[HeKa01] *Hedman, Jonas; Kalling, Thomas*: The Business Model: A Means to Understand the Business Context of Informationd Communication Technology. Institute of Economic Research - Working Paper Series, ISSN: 1103-3010, 9 2001.

[HeMP04] *Hevner, Alan R.; March, Salvatore T.; Park, Jinsoo*: Design Science in Information Systems Research. In: MIS Quarterly 28 (2004) 1, S. 75–105.

[HoKU96] *Hoffmann, Werner; Klien, Wolfgang; Unger, Martin*: Strategieplanung. In: *Eschenbach, Rolf (Hrsg.)*: Controlling, 2. Aufl. Schäffer Poeschel 1996, S. 211–313.

[Homb95] *Homburg, Christian*: Kundennähe von Industriegüterunternehmen: Konzeption - Erfolgsauswirkungen - Determinanten. Gabler 1995.

[Horn06] *Hornik, Kurt*: The R FAQ. http://CRAN.R-project.org/doc/FAQ/R-FAQ.html, 2006, ISBN 3-900051-08-9.

[Horv01] *Horváth & Partner* (*Hrsg.*): Balanced Scorecard umsetzen. Schäffer 2001.

[Hü04] *Hügens, Torben*: State-of-the-art der Balanced Scorecard und prototypische Entwicklung einer Relationship Management Balanced Scorecard, MOTIWIDI-Projektbericht Nr. 15. Techn. Ber., MOTIWIDI Motivationseffizienz in wissensintensiven Dienstleistungsnetzwerken, Essen/Münster Germany, 2004.

[ItLM03] *Ittner, Christopher D.; Larcker, David F.; Meyer, Marshall W.*: Subjectivity and the Weighting of Performance Measures: Evidence from a Balanced Scorecard. In: The Accounting Review 78 (2003) 3, S. 725–758.

[KaHe96] *Kasper, Helmut; Heimerl-Wagner, Peter*: Struktur und Kultur in Organisationen. In: *Kasper, Helmut; Mayrhofer, Wolfang (Hrsg.)*: Personalmanagement Führung Organisation. Ueberreuter 1996, S. 9–108.

[KaNo92] *Kaplan, Robert S.; Norton, David P.*: The Balanced Scorecard - Measures That Drive Performance. In: Harvard Business Review 70 (1992) 1, S. 71–79.

[KaNo93] *Kaplan, Robert S.; Norton, David P.*: Putting the Balanced Scorecard to Work. In: Harvard Business Review 71 (1993) 5, S. 143–142.

[KaNo00] *Kaplan, Robert S.; Norton, David P.*: Having Trouble with your Strategy? Then Map It. In: Harvard Business Review 78 (2000) 5, S. 167–176.

[KeNe02] *Kennerley, Mike; Neely, Andy*: Performance Measurement Frameworks: A Review. In: *Neely, Andy (Hrsg.)*: Business Performance Measurement. Cambridge University Press 2002, S. 145–155.

[KeNe03] *Kennerley, Mike; Neely, Andy*: Measuring performance in a changing business environment. In: International Journal of Operations & Production Management 23 (2003) 2, S. 213–229.

[Kese03] *Keser, Claudia*: Experimental games for the design of reputation management systems. In: IBM Systems Journal 42 (2003) 3, S. 498–506.

[KiLH+02] *Kim, J.; Lee, J.; Han, K. et al.*: Businesses as buildings: metrics for the architectural quality of internet businesses. In: Information Systems Research 13 (2002) 3, S. 239–254.

[Kirs05] *Kirschner, David*: Multichannel Measurement: Strategies for Success. White paper, Omniture, Omniture, 550 East Timpanogos Circle, Orem, Utah 84097, 2005.

[KiSX04] *King, Ruth C.; Sen, Ravi; Xia, Mu*: Impact of Web-based e-Commerce on Channel Strategy in Retailing. In: International Journal of Electronic Commerce 8 (2004) 3, S. 103–130.

[Klei94] *Kleingeld, Paulus Adrianus Matthias*: Performance Management in a Field Service Department - Design and Transportation of a Productivity Measurement and Enhancement System (ProMES). Dissertation, Technische Universität Eindhoven, 1994.

[Kouf02] *Koufaris, Marios*: Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior. In: Information Systems Research 13 (2002) 2, S. 205–223.

[KrWV04] *Kracklauer, Alexander; Wagemann, Bernard; Voigt, Manuela*: Multichannel-Management in der Konsumgüterwirtschaft. In: *Merx, Oliver; Bachem, Christian (Hrsg.)*: Multichannel-Marketing-Handbuch. Springer 2004, S. 125–145.

[KuVe05] *Kumar, V.; Venkatesan, Rajkumar*: Who are the Multichannel Shoppers and How do they Perform?: Correlates of Multichannel Shopping and Behavior. In: Journal of Interactive Marketing 19 (2005) 2, S. 44–62.

[LePS+01] *Lee, Juhnyoung; Podlaseck, Mark; Schonberg, Edith et al.*: Visualization and Analysis of Clickstream Data of Online Stores for Understanding Web Merchandising. In: Data Min. Knowl. Discov. 5 (2001) 1-2, S. 59–84.

[LeSh05] *Lee, C. Spohpie; Shu, Wesley*: Four Models of Internet-Enabled Distribution Structures. In: Information Systems Management 22 (2005) 3, S. 14–22.

[LiCh04] *Li, Peter Ping; lung Chang, Steven Tung*: A Holistic Framework of E-Business Strategy: The Case of Haier in China. In: Journal of Global Information Management 12 (2004) 2, S. 44–62.

[Lieb02] *Liebowitz, Stan*: Re-Thinking the Network Economy - The True Forces that Drive the Digital Marketplace. Amacon - American Management Association, New York 2002.

[LiSc96] *Lingle, John; Schiemann, William A.*: From Balanded Scorecard to IS Measurement. In: Management Review 85 (1996) 3, S. 56–61.

[LoSL86] *Locke, Edwin A.; Schweiger, David M.; Latham, Gary P.*: Participation in Decision Making: When Should It Be Used? In: Organizational Dynamics 14 (1986) 3, S. 65–79.

[LoVa76] *Lorange, Peter; Vancil, Richard F.*: How to design a strategic planning system. In: Harvard Business Review 54 (1976) 5.

[LyCr91] *Lynch, Richard L.; Cross, Kelvin F.*: Measure Up! How to Measure Corporate Performance. Blackwell Publishing 1991.

[Madl03] *Madlberger, Maria*: Internet marketing by electronic retailers: An empirical evaluation of online shops in the US, UK, and Austria. In: Proceedings of the 6th ICECR Conference, Dallas 2003.

[Madl04] *Madlberger, Maria*: Electronic Retailing - Marketinginstrumente und Marktforschung im Internet. Deutscher Universitäts-Verlag/GWV Fachverlage GmbH, Wiesbaden 2004.

[MaSe05] *Madlberger, Maria; Sester, Antje*: The Last Mile in an Electronic Commerce Business Model - Service Expectations of Austrian Online Shoppers. In: Proceedings of the 13th European Conference on Information Systems, Regensburg, Germany, May 2005.

[Meff00] *Meffert, Heribert*: Marketing, Grundlagen marktorientierter Unternehmensführung, Konzepte - Instrumente - Praxisbeispiele. Gabler, Wiesbaden 2000.

[MeNP+05] *Mendling, Jan; Neumann, Gustaf; Pinterits, Andreas et al.*: Revenue Models for E-Learning at Universities. In: *Ferstl, O.K.; Sinz, E.J.; Eckert, S. et al. (Hrsg.)*:

Wirtschaftsinformatik 2005 - eEconomy, eGovernment, eSociety, Physica-Verlag 2005.

[Meye02] *Meyer, Marschall W.*: Rethinking Performance Measurement - Beyond the Balanced Scorecard. Cambridge University Press 2002.

[MiLB05] *Mitraphoanov, Alexander Yu.; Lomsadze, Alexandre; Borodovsky, Mark*: Sensivity of Hidden Markov Models. In: Journal of Applied Propability 42 (2005), S. 632–642.

[NeAC01] *Neely, Andy; Adams, Chris; Crowe, Paul*: The Performance Prism in Practice. In: Measuring Business Excellence 5 (2001) 2.

[NeAK02] *Neely, Andy; Adams, Chris; Kennerley, Mike*: The Performance Prism - The Scorecard for Measuring and Managing Business Success. Pearson Education Limited, Edinburgh 2002.

[Neel00] *Neely, Andy*: Performance measurement system design: developing and testing a process-based approach. In: International Journal of Operations & Production Management 20 (2000) 10, S. 1119–1145.

[NeGP95] *Neely, Andy; Gregory, Mike; Platts, Ken*: Performance measurement system design. In: Iternational Journal of Operations & Productions Management 15 (1995) 4, S. 80–116.

[Niel00] *Nielsen, Jakob*: Designing web usability. New Riders Publ., Indianapolis 2000.

[NüFZ98] *Nüttgens, Markus; Feld, Thomas; Zimmermann, Volker*: Business Process Modeling with EPC and UML Transformation or Integration? In: *Schader, M.; Kirthaus, A. (Hrsg.)*: The Unified Modeling Language - Technical Aspects and Applications, Proceedings (Mannheim, 1997) 1998 S. 250–261.

[Offi] *Office Depot*: Annual Report 2002. ={http://media.corporate-ir.net/media_files/irol/94/94746/reports/AR02/report/index.htm}, year = 2003.

[OhSK05] *Ohkubo, Miyako; Suzuki, Koutarou; Kinoshita, Shingo*: RFID Privacy Issues and Technical Challenges. In: , Communications of the ACM 48 (2005) 9, S. 66–71.

[Palm02] *Palmer, Jonathan W.*: Web Site Usability, Design and Performance Metrics. In: Information Systems Research 13 (2002) 2, S. 151–167.

[Part99] *Partners, Roland Berger &*: Success factors in electronic commerce. Techn. Ber., Competence Center InfoCom, Roland Berger & Partner GmbH, International Management Consultants, 1999.

[PaZB85] *Parasuraman, A.; Zeithaml, Valarie A.; Berry, Leonard L.*: A Conceptual Model of Service Quality and Its Implications for Future Research. In: Journal of Marketing 49 (1985), S. 41–50.

[PfCa00] *Pfeifer, Phillip E.; Carraway, Robert L.*: Modeling Customer Relationships as Markov Chains. In: Journal of Interactive Marketing 14 (2000) 2, S. 43–55.

[PfPf04] *Pfaff, Dieter; Pfeiffer, Thomas*: Verrechnungspreise und ihre formaltheoretische Analyse: Zum State of the Art. In: DBW 64 (2004) 3, S. 296–319.

[PiFS04] *Piris, Luisa; Fitzgerald, Guy; Serrano, Alan*: Strategic motivators and expected benefits from e-commerce in traditional organisations. In: International Journal of Information Management 24 (2004), S. 489–506.

[PiHM06] *Pinterits, Andreas; Hienerth, Claudia; Maier, Jürgen*: E-Commerce-Erfolgsfaktoren - Wichtigkeit, Einfachheit und Messhäufigkeit in der betrieblichen Praxis. In: *Lehner, Franz; Nösekabel, Holger; Kleinschmidt, Peter (Hrsg.)*: Multikonferenz Wirtschaftsinformatik 2006, Bd. Band 1, GITO mbH - Verlag für Industrielle Informationstechnik und Organisation 2006 S. 143–154.

[PiTP06] *Pinterits, Andreas; Treiblmaier, Horst; Pollach, Irene*: Environmental websites: an empirical investigation of functionality and accessibility. In: International Journal of Technology, Policy and Management 6 (2006) 1, S. 103 – 119.

[Port01] *Porter, Michael E.*: Strategy and the Internet. In: Harvard Business Review 79 (2001) 3, S. 62–78.

[R De06] *R Development Core Team*: R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria 2006.

[RaBa00] *Rangone, Andrea; Balocco, Raffaello*: A Performance Measurement System for Planning and Controlling a BtoC E-Commerce Strategy. In: Electronic Markets 10 (2000) 2, S. 130–143.

[Rabi89] *Rabiner, Lawrence R.*: A Tutorial on Hidden Markov Models and Selected Application in Speech Recognition. In: Proceedings of the IEEE 77 (1989) 2, S. 257–285.

[RiGo80] *Richardson, Peter R.; Gordon, John R.M.*: Measuring Total Manufacturing Performance. In: Sloan Management Review 21 (Winter 1980) 2, S. 47–57.

[Rock79] *Rockard, J. F.*: Chief Executive define their own data needs. In: Harvard Business Review 57 (1979) 2.

[SaPP+01] *Salisbury, W David; Pearson, Rodney A.; Pearson, Allison W. et al.*: Percieved security and World Wide Web purchase intention. In: Industrial Management + Data Systems 101 (2001) 3/4, S. 165–176.

[SaSt05] *Sackmann, Stefan; Strüeker, Jens*: Electronic Commerce Enquête 2005. Techn. Ber., IIG Telematig, Institut für Informatik und Gesellschaft, Albert-Ludwigs-Universität-Freiburg, 2005.

[Sawh01] *Sawhney, Mohanbir*: Don't Homogenize, Synchronize. In: Harvard Business Review 79 (2001) 7.

[ScGo02] *Schoenbachler, Denise D.; Gordon, Geoffrey L.*: Multi-channel shopping: understanding what drives channel choice. In: Journal of Consumer Marketing 19 (2002) 1, S. 42–53.

[Sche98a] *Scheer, August-Wilhelm*: ARIS - Vom Geschäftsprozeß zum Anwendungssystem. Springer Verlag 1998.

[Sche98b] *Scheer, August-Wilhelm*: Business Process Engineering. Springer-Verlag 1998.

[ScNZ97] *Scheer, August-Wilhelm; Nüttgens, Markus; Zimmermann, Voker*: Objektorientierte Ereignisgesteuerte Prozeßkette (oEPK) - Methode und Anwendung. Veröffentlichungen des Instituts für Wirtschaftsinformatik (IWi), Universität des Saarlandes, 1997.

[ScSc04] *Schröder, Hendrik; Schettgen, Gabriele*: Kundenbezogene Erfolgsrechnung im Multichannel Retailing. In: Controlling 7 (2004), S. 337–384.

[Shap53] *Shapely, L. S.*: A Value for n-Person Games. In: *Kuhn, H. W.; Tucker, A. W. (Hrsg.)*: Contributions to the Theory of Games. Princeton University Press 1953, S. 307–317.

[Shne00] *Shneiderman, Ben*: Designing Trust into Online Experiences. In: Communications of the ACM 43 (2000) 12, S. 57–59.

[Simo96] *Simon, Herbert A.*: The Sciences of the Artifical. The MIT Press, Massachussetts, London 1996.

[SK03] *Schramm-Klein, Hanna*: Multi-Channel-Retailing - Verhaltenswissenschaftliche Analyse der Wirkung von Mehrkanalsystemen im Handel. Deutscher Universitätsverlag Gabler Edition Wissenschaft, Wiesbaden 2003.

[SpSS04] *Spann, Martin; Skiera, Bernd; Schäfers, Björn*: Willingness-to-Pay via Name-Your-Own-Price Mechanisms. In: Journal of Interactive Marketing 18 (2004) 4, S. 22–36.

[StAL02] *Steinfield, Charles; Adelaar, Thomas; Lai, Ying-Ju*: Integrating Brick and Mortar Locations with E-Commerce: Understanding Synergy Opportunuties. In: Proceedings ot the Hawai'i International Conference on System Sciences, January 7-10, 2002, Big Island Hawaii 2002.

[StBA01] *Steinfield, Charles; Bouwman, Harry; Adelaar, Thomas*: Combining Physical and Virtual Channels: Opportunities, Imperatives and Challenges. In: Proceedings of the 14th Bled Electronic Commerce Conference, Bled Slovenia, June 25-26 2001.

[StBA02] *Steinfield, Charles; Bouwman, Harry; Adelaar, Thomas*: Thy Dynamics of Click-and-Mortar Electronic Commerce: Opportunities and Management Strategies. In: International Journal of Electronic Commerce 7 (2002) 1, S. 93–119.

[Stei04] *Steinfield, Charles*: Click and brick electronic commerce. In: *Preissl, Brigitte; Bouwmann, Harry; Steinfield, Charles (Hrsg.)*: E-Life after the Dot Com Bust. Physica Verlag - A Springer-Verlag Company, Heidelberg 2004, S. 101–116.

[StEl92] *Stern, Louis W.; El-Ansary, Adel I.*: Marketing-Channels. Prentice Hall International Inc. 1992.

[StHW+02] *Straub, Detmar W.; Hoffman, Donna L.; Weber, Bruce W. et al.*: Measuring e-Commerce in Net-Enabled Organizations: An Introduction to the Special Issue. In: Information Systems Research 13 (2002) 2, S. 115–124.

[SuTh04] *Sullivan, Ursula Y.; Thomas, Jacquelyn S.*: Customer Migration: An Empirical Investigaion Across Multiple Channels. Working Paper, http://www.business.uiuc.edu/Working_Papers/papers/04-0112.pdf, accessed on 14. September 2006, 2004.

[TaVe06] *Taghaboni-Dutta, Fataneh; Velthouse, Betty*: RFID Technology Is Revolutionary: Who Should Be Involved in this Game of Tag? In: Academy of Management Perspectives 20 (2006), S. 65–78.

[TeBe03] *Teltzrow, Maximilian; Berendt, Bettina*: Web-Usage-Based Success Metrics for Multi-Channel Businesses. In: Proceedings of the 5th ACM WebKDD 2003 - Web Mining for E-Commerce Workshop, Springer 2003.

[TeBG04] *Teltzrow, M.; Berendt, B.; Günther, O.*: Ein Kennzahlensystem für Mehrkanalhändler. In: Proceedings Multikonferenz Wirtschaftsinformatik, Essen, Germany 2004.

[Tede01] *Tedeschi, R.*: Bricks-and-Mortar Merchants Struggling to Assess Web Sidelines. In: E-commerce report, New York Times (Sept 3 2001).

[TeGP03] *Teltzrow, Maximilian; Günther, Oliver; Pohle, Carsten*: Analyzing Consumer Behavior at Retailers with Hybrid Distribution Channels - A Trust Perspective. In: ACM International Conference Proceedings, 5th International Conference of Electronic Commerce 2003 S. 422–428.

[TeGü03] *Teltzrow, Maximilian; Günther, Oliver*: Web Metrics for Retailers. In: Proc. 4th International Conference on Electronic Commerce and Web Technologies, LNCS Springer, Berlin/Heidelberg/New York 2003 S. 328–338.

[ThMa03] *Thornton, Jennifer; Marche, Sunny*: Sorting through the dot bomb rubble: how did the high-profile e-tailers fail? In: International Journal of Information Management 23 (2003), S. 121–138.

[Timm98] *Timmers, Paul*: Business Models for Electronic Markets. In: Electronic Markets 8 (1998) 2, S. 3–8.

[ToDh02] *Torkzadeh, Gholamreza; Dhillon, Gurpreet*: Measuring Factors that Influence the Success of Internet Commerce. In: Information Systems Research 13 (2002) 2, S. 187–204.

[Troy99] *Troy, Mike*: Office Supplies: Clicks-and-Mortar Dominates–for now. In: Discount Store News 38 (1999) 23, S. 57.

[TrPD04] *Treiblmaier, Horst; Pinterits, Andreas; Dapeci, Roman*: Retention By Entertainment: How Companies Utilize Web Sites To Strengthen Customer Relationships (Research In Progress). In: Proceedings of the 12th European Conference on Information Systems - The European IS Profession in the Global Networking Environment 2004.

[TrPF04] *Treiblmaier, Horst; Pinterits, Andreas; Floh, Arne*: Antecedents of the Adoption of e-Payment Services in the Public Sector. In: Proceedings of the 25th International Conference on Information Systems (ICIS), Washington D.C.,U.S.A. 2004.

[TrPi05] *Treiblmaier, Horst; Pinterits, Andreas*: Content and Design Metrics for Web Sites: Combining Qualitative and Quantitative Results. In: *Avison, David; Galletta, Dennis; DeGross, Janice I. (Hrsg.)*: Proceedings of the Twenty-Sixth International Conference on Information Systems, Las Vegas, U.S.A. December 11-14 2005.

[Turn06] *Turner, Rolf*: The hmm.discnp Package- Hidden Markov models with discrete non-parametric observation distributions. http://cran.r-project.org/doc/packages/hmm.discnp.pdf, 2006.

[WaLu94] *Waldersee, Robert; Luthans, Fred*: The impact of positive and corrective feedback on customer service performance. In: Journal of Organizational Behaviour 15 (1994) 1, S. 83–95.

[Webb02] *Webb, Kevin L.*: Managing channels of distribution in the age of electronic commerce. In: Industrial Marketing Management 31 (2002), S. 95–102.

[WeSc00] *Weber, Jürgen; Schäffer, Utz*: Balanced Scorecard & Controlling, Bd. 2. Auflage. Gabler 2000.

[Whee02] *Wheeler, Bradley C.*: NEBIC: A Dynamic Capabilities Theory for Assessing Net-Enablement. In: Information Systems Research 13 (2002) 2, S. 125–146.

[Whit] *White, Stephen A.*: Introduction to BPMN. White paper, IBM Corporation.

[WiBe02] *Wirtz, Bernd W.; Becker, Daniel R.*: Geschäftsmodellansätze und Geschäftsmodellvarianten im Electronic Business - Eine Analyse zu Erscheinungsformen von Geschäftsmodellen. In: WiSt 2 (2002).

[WiFa91] *Wisner, Joel D.; Fawcett, Stanley E.*: Linking Firm Strategy to Operating Decisions Through Performance Measurement. In: Production and Inventory Management Journal 32 (1991) 3, S. 5–11.

[WiKl00] *Wirtz, Bernd W.; Kleineicken, Andreas*: Geschäftsmodelltypologien im Internet. In: WISt 11 (2000), S. 626–633.

[WiKr01] *Wirtz, Bernd W.; Krol, Bianca*: Stand und Entwicklungsperspektiven der Forschung zum Electronik Commerce. In: Jahrbuch der Absatz und Verbrachsforschung 4 (2001).

[Wilk02] *Wilke, Kai*: Controlling im E-Commerce - die Balanced Scorecard zu Steuerung des E-Commerce. In: Handel im Fokus - Mitteilungen des IfH 4 (2002), S. 274–294.

[WiOS03] *Wirtz, Bernd W.; Olderog, Torsten; Schwarz, Joachim*: Strategische Erfolgsfaktoren in der Internetökonomie. In: Zeitschrift für betriebswirtschaftliche Forschung zfbf 55 (2003), S. 61–77.

[WiSe06] *lin Winkler, Hsui; Seip, Henning*: Emplomyment Analysis of ERD vs. UML for Data Modeling. In: Journal of Information Systems Education 17 (2006) 1, S. 65–71.

[Witt91] *Witt, Frank-Jürgen*: Handelscontrolling. Verlag Franz Vahlen, München 1991.

[ZaGe02] *Zahra, Shaker A.; George, Gerard*: The Net-Enabled Business Innovation Cycle and the Evolution of Dynamic Capabilities. In: Information Systems Research 13 (2002) 2, S. 147–150.