2012
2013

FACULTY OF BUSINESS ECONOMICS

Master of Management: Management Information Systems

Masterproef

Business modeling

Promotor :
Prof. dr. Koenraad VANHOOF

Pieter Muller

Master Thesis nominated to obtain the degree of Master of Management , specialization Management Information Systems

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Preface

This thesis study about business modeling was set up within the education program ‘Master of Management, Management Information Systems 2012-2013’ at the University of Hasselt and aims to be an integrated research work which shows that the author has sufficiently understood the learning program and that he is able to link theoretical concepts about managing information systems to real life cases.

The study is pointed towards all kind of readers who are interested in business modeling ideas, whether already highly informed about the subject or whether having no background at all.

The using of the thesis study is best done through reading the study sequentially since most of its parts build further on previously discussed ideas.

Finally, I would like to thank Prof. Dr. Koen Vanhoof for the guidance during the thesis process.

Table of contents

List of illustrations

Tables

Figures

Summary

The general problem statement of this thesis is: “How should one set up an integrated business model for an organization?”. The objective behind finding an answer to this problem statement is supporting business people with a theoretical framework in order to model a certain type of organization.

From this general problem statement, seven sub-questions are derived:

1. What are the six business model functions really about?
2. What is the meaning of each of the eight business modeling tools and how do they work?
3. What types of organizations exist?
4. Which business modeling tools apply for all organizations?
5. Which business modeling tools are organization-type-specific?
6. Do the business modeling tools which are available for each type of organization fully cover the six business model functions? If no, can the existing business modeling tools for a certain type of organization be adapted to truly cover all six business functions and how?
7. Given the (possibly adapted) business modeling tools for each type of organization, are there multiple versions of the same information present among the different tools that can be filtered out in order to reach a full complementary business model without duplications?

In order to have sufficient information present within one’s business model, one should understand that six business model functions are crucial to be explored (sub-question 1). A central value proposition or multiple value propositions towards the organization’s customers and eventually towards other stakeholders are the starting point for a business model (I). Customers are targeted via segmentation processes and analyses (II). Segmenting the market and targeting customers can happen first, before defining value propositions, or it can be done after value propositions are defined in order to find good customer segments. Further value chains (III) and value networks (IV) need to be recognized to define the company’s structure of how value is created and delivered towards customers and other stakeholders and how their value is captured. Costs (V) need also to be recognized in order to be able to frame the profitability possibilities. A strategy (VI) is crucial in order to define the context wherein the business is meant to operate.

The answer to the general problem statement is given in table 1. It represents a set of modeling tools per organization type which are fully complementary towards each other in the sense of each modeling different business aspects or modeling the same business aspects at different abstraction levels. These complementary business modeling tools cope with all different business model functions. One can see that the type of an organization depends upon whether it produces products and/or delivers services and whether these products and services are delivered by using repeatable processes or by executing case processes (answer to sub-question 3). One can combine all lanes of table 1in order to reach for a certain type of organization

The VDML modeling tool, SoaML modeling tool, BIM modeling tool, organizational modeling tool and the business context pyramid tool can be applied in order to model every type of business (answer to sub-question 4). BPMN can only be used for organizations with repeatable processes whether CMMN is used for organizations using case processes (answer to sub-question 5).

Duplicated information (answer to sub-question 7) was found between the traditional modeling tool 'value proposition method' and the VDML modeling tool. The value proposition method is in fact no physical tool but just the expression to formulate a value proposition. Since value is the key element in VDML models, there is no need for a separate value proposition method. Therefore, the value proposition method is not present within table 1. The organizational modeling tool could be used in order to present business processes and their executing participants but since business processes are better explained at different abstraction levels within VDML, BPMN and CMMN, organizational modeling is only used for describing pure business hierarchies since otherwise duplicated information would be present towards the other business modeling tools.

Table 1. Complementary business modeling tools per organization type.

Firm 'X'			
Products		**Services**	
Repeatable (lane 1)	**Cases** (lane 2)	**Repeatable** (lane 3)	**Cases** (lane 4)
Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)
Context pyramid	Context pyramid	Context pyramid	Context pyramid
BIM	BIM	BIM	BIM
VDML	VDML	VDML	VDML
BPMN	-	BPMN	-
-	CMMN	-	CMMN
SoaML	SoaML	SoaML	SoaML

In order to answer sub-question 2, each business modeling tool or business architecture sub-discipline will be explored from here on.

VDML models define the value propositions towards the firm's customers and its other stakeholders and they define the value chains wherein products and/or services are created and delivered towards customers. VDML models recognize the value delivering and capturing in a holistic value network model where all stakeholders influence value delivering and capturing. Value chains are described by defining the activities which the business uses. Each activity is described by a capability map in order to analyze if capabilities are sufficiently present in-house in order to fulfill those activities. VDML also focuses on merging capabilities among different activities, which can have advantages such as fastened learning curves. Cost drivers are also presented for the different activities. Further, risk analyses show where activities can go wrong and provide useful information to avoid these risks.

Collaboration schemes show collaborations among internal and external business participants and define their roles within those collaborations.

After VDML models are set up, BPMN is used to describe the repeatable processes within VDML models and CMMN is used in order to describe case processes within those VDML models. BPMN and CMMN are thus fully complementary tools towards VDML and also towards each other. Both BPMN and CMMN can be described at three different abstraction levels (strategic level, tactical level and operational level).

SoaML modeling is used in order to show internal and external business services within a service oriented architecture view. Capability maps show the resources which are necessary in order to deliver certain services. Also choreographies among service consumers and service providers are shown. SoaML doesn't model service processes. There BPMN and CMMN take over, depending upon the service repeatability. So BPMN and CMMN are fully complementary tools towards SoaML.

Organizational modeling is used in order to show hierarchies of business participants, mostly people but in fact the modeling tool can be used in order to model system hierarchies as well.

BIMs are in fact the only non-complementary modeling tools towards the other business modeling tools. They represent stand-alone representations of relationships among core business entities. However, this makes them very popular since they can be used as simple quick-hit business models which can be used by internal or external business people in order to understand things very quickly. BIMs can be defined at different levels of abstraction.

The context wherein the business operates is defined by the context pyramid. A vision, mission and strategic plan are defined from whereon goals and objectives are derived.

In order to answer sub-question 6, one could state that the previously explained business modeling tools sufficiently cover each of the six business model functions. However, a more refined representation exists in order to discuss this question. The architectural framework of John Zachman, represented in Fig. 1, separates a business in different concepts where each concept is defined at different abstraction levels. The sets of complementary business modeling tools within table 1are surely sophisticated enough in order to model the different concepts. Also different abstraction levels can be defined per concept with these tools. However, many more modeling tools already exist in order to cover the architectural framework of Zachman but having a rather simple set of complementary tools is a benefit since simplicity is put forward (not too many sub-modeling tools are used). Within the scope of this thesis, a limited amount of complementary modeling tools is preferred. They might not define too many abstraction levels, but having two or three abstraction levels is considered as being enough for this thesis study.

	Why	How	What	Who	Where	When
Contextual	Goal List	Process List	Material List	Organisational Unit & Role List	Geographical Locations List	Event List
Conceptual	Goal Relationship	Process Model	Entity Relationship Model	Organisational Unit & Role Relationship Model	Locations Model	Event Model
Logical	Rules Diagram	Process Diagram	Data Model Diagram	Role Relationship Diagram	Locations Diagram	Event Diagram
Physical	Rules Specification	Process Function Specification	Data Entity Specification	Role Specification	Location Specification	Event Specification
Detailed	Rules Details	Process Details	Data Details	Role Details	Location Details	Event Details

Fig. 1 Architectural framework of John Zachman. An enterprise is divided into different matrix cells by defining different business concepts and dividing each concept in different abstraction levels.

Beside modeling the current business and its environment, firms need to plan for the future too. Eight different planning techniques exist in order to do so. Each technique represents a theoretical framework which one can consider in order to plan for business evolution. Also combinations of these planning techniques can be useful to plan efficiently. Planning conclusions from these frameworks need to be incorporated into the business context, more specifically into the business strategy part. Once a planning issue is incorporated into the business strategy, VDML, BPMN, CMMN and SoaML models need to be adapted to implement the planning issue in the business model. The planning frameworks can also be used in order to innovate the business since innovations can be nurtured through framework thinking. The eight strategic planning techniques are:

- Critical success factors
- Three emerging forces
- Competitive forces
- Value chain analysis
- Stages of growth
- E-business value matrix
- Linkage analysis
- Scenario planning

Last, business innovation has shifted from closed innovation towards open innovation where firms distribute knowledge across their boundaries since firms don't have the best specialists in-house anymore. Innovation is thus traded among businesses and firms so outsourcing business innovations within the value models will be quite common. Further, differentiating value chains and their products and services or producing them at lowest cost doesn't lead to sustainable competitive advantages anymore since copycats arise faster than ever. If one wants to innovate the business model efficiently, one should also wrap services around products and innovate these service experiences together with

customers (customer driven innovation). That is where the true competitive advantage will be in the future and one should think about it when innovating current business models.

Introduction

The problem statement of this thesis study sounds: “How does one set up an integrated business model for an organization?”. The objective behind this problem statement is to support organizations in setting up their business models through providing a theoretical framework of complementary business modeling tools per organization type.

Literature states that six business model functions exist: determining a value proposition, segmenting and analyzing the market, analyzing the value chain(s), analyzing the value network, handling revenues, costs and profit and shaping a business strategy . Five traditional business modeling tools were already fully described and developed in order to model a business, being: value proposition method, organizational modeling, business context pyramid, business information modeling (BIM) and business process modeling (BPMN). Three more recent modeling tools are currently being developed and adapted in order to describe a business model in a more holistic way: value delivery modeling (VDML), case management modeling (CMMN) and service oriented architecture modeling (SoaML). It is obvious that the relationships and complementarity among these business modeling tools or business architecture sub-disciplines need to be investigated in order to answer the problem statement.

Sub-questions are derived from the problem statement. These sub-questions must be answered in the given sequence in order to reach the answer to the general problem statement. These questions are respectively:

- What are the six business model functions really about?
- What is the meaning of each of the eight business modeling tools and how do they work?
- What types of organizations exist?
- Which business modeling tools apply for all organizations?
- Which business modeling tools are organization-type-specific?
- Do the business modeling tools which are available for each type of organization fully cover the six business model functions? If no, can the existing business modeling tools for a certain type of organization be adapted to truly cover all six business functions and how?
- Given the (possibly adapted) business modeling tools for each type of organization, are there multiple versions of the same information present among the different tools that can be filtered out in order to reach a full complementary business model without duplications?

The first part of the thesis aims to develop a true understanding of the six different business model functions. It is very important to have a very good understanding of each business model function in order to understand later on which business modeling tools are suitable enough to cover one or more business model functions.

During the second phase, when the business model functions are well understood, the eight business modeling tools will be described and investigated in order to understand their functioning.

In the third step, a set of theoretically different types of organizations will be framed and the eight available business modeling tools, which were investigated in the second phase, are divided among the theoretical types of organizations where they fit in.

The fourth and fifth phase of the thesis study really deal with interpretation and conclusion making. The result of the third step is a list of different types of organizations each accompanied by a series of modeling tools which are applicable to that type of organization. The question rises whether these modeling tools for each type of organization are together able to cover the six business model functions. This is analyzed in step four. If the six business model functions are not covered for a certain type of organization, adaptations will be made to the existing modeling tools. The result of step four is a list of different types of organizations each accompanied by a series of modeling tools which are applicable to that type of organization and which together cover all business model functions.

In the fifth phase, the modeling tools per organization type will be checked on multiple versions of the same information. If there is duplicated information present, suggestions will be made to remove waste information leading to a single, well complementary set of business modeling tools which can be used to draw a business model for a certain type of organization. These complementary sets of business modeling tools can be put into a usable framework that organizations can use when making their business models. That is the true objective for the thesis.

After a theoretical framework is set up in order to model a certain type of business, strategic business planning and innovation concepts will be dealt with, which surround the business model from a future point of view since a business model in no inert phenomenon. Business model evolution is crucial here.

After the answers are found to the sub-questions and thus also to the general problem statement and when the planning and innovation chapters are dealt with, an integrated case study of a car rental company is set up in order to link the theoretical aspects to a real life case example which will have the value of making things more concrete.

Information about sophisticated business modeling tools is captured from the website of the 'Object Management Group': *OMG specifications. [Online]. (URL http://www.omg.org)*. Further, strategic planning information is obtained from the book: *Information systems management in practice. 8th ed. USA: Prentice Hall*.

A first restriction of this thesis study can be found in evolving information about business modeling tools. It is possible that during writing the thesis, currently developed/proposed business modeling tools (VDML, CMMN, SoaML) are being improved further and further on. Only information from the 'Object Management Group' which is made available before August 2012 is used. A second restriction is explained by the fact that the 'Object Management Group' provides many more business modeling tools than those which are handled in this thesis. However, the goal of this thesis is to provide a simple complementary set of business modeling tools per organization type, not to purify business modeling within each detail type.

1. Business model

This part of the thesis study describes the meaning of an organization's business model and provides an overview and description of the different functions which any complete business model must focus on.

1.1 Definition

A business model is in heart a blueprint/recipe to operate and visualize an organization's business. It provides detailed information about the current company structure and policies in their broadest views but on the other hand it also gives one information about the direction the company wants to go in the (near) future.

Since a business model provides a true understanding of an organization, it should be set up before the organization is brought into practice. This means that making up a business model should be the first step in the creation of a new enterprise. The business plan will then explain how one should act in order to reach the proposed business model.

However, a business model would be of no importance if one could not identify the benefits of having a well structured and complete business model. The three most abstract benefits of having an integrated business model can be summarized as follows:

- Explicit view on an organization's current business
- Tool to facilitate planning issues
- Tool to facilitate innovation issues

1.2 Functions

In order to continue the story of business modeling and to find a theoretical framework of complementary business modeling tools per organization type, it is important to have a complete list of all different functions each business model must provide to an organization. Literature [1] states that there are six of those functions:

- Determining the value proposition of the organization towards its customers
- Analyzing the market segments to which the value proposition is applicable and can be sold to
- Determining the structure of the company's value chain to create the value proposition and to distribute it towards the targeted customers
- Determining how company revenues will be made and framing the cost structure and profit potentials

- Recognizing the value network to include linkages of the organization with customers, suppliers, competitors, complementors and other actors
- Determining the strategy

The following sub divisions of this chapter, '1. Business model', will each focus on a single business model function. It is important to truly understand each function in order to check later on whether a certain business modeling tool covers one or more of these business model functions.

1.3 Value proposition

Whether an organization delivers a product or a service and whether it does this towards end consumers or towards other business organization customers, it needs a first business model function: a value proposition towards its customers.

The value proposition of a company is in fact the answer to the question of a targeted customer: 'Why should I buy your product or service and why shouldn't I go to your competitor(s)?'. So in fact the value proposition is a proposition in textual form (or even in a visual image form) that shows the differentiation and positioning of an organization's products/services in comparison with those of other competitive enterprise entities.

A value proposition shows a value promise towards the targeted customers. It is set up to cover a customer's need. One could without any doubts say that the value proposition is the most important thing of a business model. If customers don't see the added value from one's products/services, customers won't buy them and the business will have to close down, no matter how good the rest of the business model is built up.

In the margin of the previous definition of value propositions, a distinction can be made between open and closed business models. Both open and closed business models create value for customers (value proposition) and part of the customers' money is turned into profit for the business. The difference between both business models is that in a closed business model the company creates the customer value on its own whether in an open business model the company needs one or more other companies in order to create the total customer value. A good example of open business models are the business models of mobile phone producing companies. The value of a mobile phone doesn't only depend on the quality of the mobile phone itself but also on the quality of the applications which are being developed by other companies. Summarizing, in open business models the total value proposition towards a customer depends on more than one company.

1.4 Market segmentation

A second business model function for the company is the market segmentation and the analysis of the segments. In fact, determining target market segments closely relates to setting up a value proposition since a value proposition is only meaningful for (a) certain market segment(s). An organization can on the one hand determine a target segment and then deciding on a value proposition for that segment or it can on the other hand predetermine a value proposition and afterwards searching for (an) applicable target segment(s).

In general, there are four steps which have to be applied in order to segment the market and to choose for target segments, regardless of whether the value proposition will be done at the end of the segmentation or in advance of the segmentation [2]:

i. Identifying segmentation criteria/variables
ii. Setting up profiles of each segment
iii. Measuring the segment attractiveness
iv. Selecting target segment(s)

Segmentation variables which can be used to start the segmentation process can be of different type [2]: geographical variables (region, city size, etc.), demographical variables (age, gender, etc.), psychographical variables (social class, lifestyle, etc.) and behavioral variables (usage rate, loyalty status, etc.). A combination of different segmentation variables is possible and is widely used. After the segmentation variables are chosen, profiles of different segments can be set up.

A segment's attractiveness relies on different aspects [2]:

- Size of the segment
- Purchasing power of the segment
- Profits that the specific segment can produce for the company
- Fit with the company's strengths, capabilities and policies
- Degree to which the segment can be reached/served

As is argued under '1.3 Value proposition', the value proposition is the most important thing in a business model. Thus, so is also the market segmentation since the value proposition is only applicable to (a) certain market segment(s). Choosing target markets and defining value propositions are complementary tasks and are the central idea in each business model.

However, it remains very important to state that chosen target segments and value propositions are no inert phenomena. Due to changes in the business environment, a company might for example have to change the target market(s) due to a lowering of the profitability power and/or it might have to change the value proposition because of the changing needs of the target segment(s).

1.5 Value chain

As a third business model function, the company's value chain will be described here. A value chain can be described as a set of business functions which each add additional value to the product or service for the customer. These business functions in fact create the value proposition and deliver it to the company's customer.

The value chain was first introduced in 1985 by Michael Porter in *Competitive Advantage* [3]. As can be seen in Fig. 1.1, the value chain consists of five primary activities which are set up in a linear hierarchy and which are supported by four support activities in order to create and deliver the value proposition. The profit margin (net profit/revenues x 100%) is the money value which is caught by the company due to the sale of the value proposition towards its customers and it depends on the efficiency and effectiveness of how the primary and support activities are executed together.

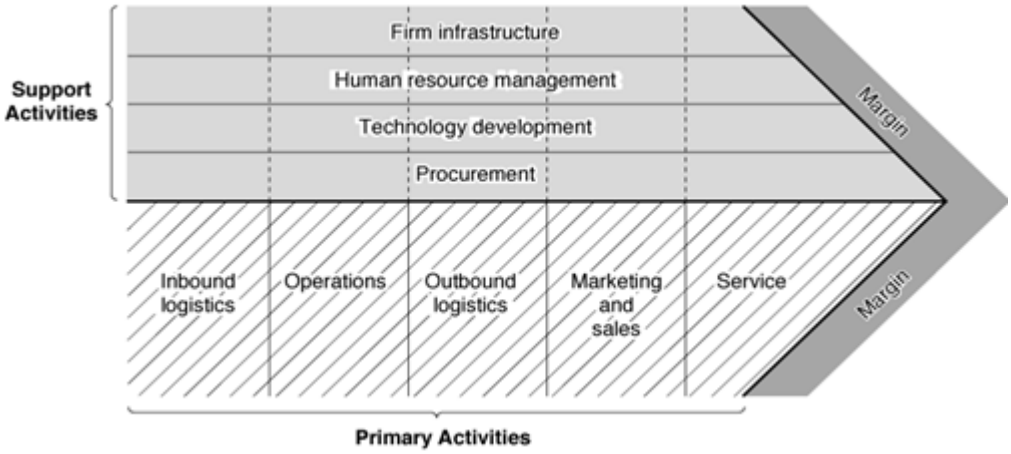

Fig. 1.1 Michael Porter's value chain. Presented are the five primary activities (inbound logistics, operations, outbound logistics, marketing and sales, service) which are supported by four support activities (firm infrastructure, human resources, technology development, procurement) in order to create and deliver the value proposition for the customer and to capture profits from it. [3]

The meanings of the five primary and the four support activities, independent of the fact whether a firm produces products, services or both, are [3] - [4]:

- Inbound logistics: receiving and storing of the inputs
- Operations: converting inputs into products and/or services
- Outbound logistics: collecting, storing and distributing products and/or services to customers
- Marketing and sales: creating incentives for customers to pay for the products and/or services
- Service: after sales service of products or services towards customers

- Firm infrastructure: organizational structures, systems, company culture,…
- Human resources: recruiting, hiring, training and firing of employees
- Technology development: technologies that support value creating activities
- Procurement: purchasing materials, supplies and equipment

However, the value chain is not the newest/highest form of getting a view on how value is created for a customer. The value chain idea represents the value creation within a single firm as being a set of sequential/linear primary activities, from supplier to customer (in case there is a supplier of course). In reality, this model is rather incorrect since it represents a single direction flow of products, services and information from the supplier to the firm to the customer but in real life there are for example also flows of information flowing from the customer towards the firm, from the customer towards the supplier of from the firm towards the supplier. Furthermore, competitors, complementors and other actors are neither present in the value chain model of Michael Porter although they interact with the firm, customers and suppliers and they certainly do draw on the way how value is created and captured within the firm of interest. A more comprehensive view is given under '1.6 Value network'.

Beside these negative remarks in the previous paragraph, value chains are certainly good tools to study the internal structure of the company. They don't draw on a fully holistic value creation and capture view but however remain very useful to describe internal firm behavior which is suitable to be part of the firm's business model. Important aspects to think about in value chain discussions are for example the required knowledge (implicit as well as explicit knowledge), facilities, resources and other assets needed to perform the value chain activities. Also the interactions, roles and collaborations among people/systems in those value chain activities and processes are of interest. Furthermore, controlling time to perform the activities together with recognizing and handling cost issues are important aspects.

1.6 Value network

In order to improve the value chain idea, a real life comprehensive value network concept system will be explained here as being the fourth function of a business model. Neither firm can produce/influence value delivery or value capturing (customers' money) on its own. Each company is surrounded by a network which will co-determine how value is created within the company and how value is captured by the company.

Fig. 1.2 gives a proposition towards a holistic value network model. This model is built up from the perspective of 'Firm A'. Its stakeholders are: suppliers, customers, regulations, banks, shareholders, competitors, co-opetitors and complementors. Other stakeholders are possible but are not represented in the framework to keep representations rather simple. Complementors are firms which produce products and/or services which complement/support those of the firm of interest. Playing consoles for example indirectly increase the value of televisions for final customers because you can play games on them. Co-opetitors are firms which have both competitive and co-operational relationships with the firm of interest.

The amount of arrows and actors in Fig. 1.2 make it impossible to explain the model very detailed but two small case examples will be given here to show the relationships among the stakeholders and the firm. The goal of these cases is to show the reader the fact that a firm can't fully determine the value delivery and the value capturing towards and from its customers. 'Firm A' has suppliers which deliver services/products in return for money, like it is the case in the traditional value chain model. However, knowledge, emotions and/or influences can be exchanged between the firm and the suppliers so that

the value of the exchanged products/services changes which will also lead to a change in the money flow towards the suppliers. A firm may for example be unsatisfied with the quality of raw materials and by saying this to the supplier, the firm might pay less per unit of raw material. On the other hand the supplier can heavily increase the quality and thus the value of the raw materials leading to higher unit prices for the firm. Suppose 'Firm A' pays less per unit of raw materials. It then will make higher profits if customers pay the same prices for the firm's products. However, customers can react to this situation by stating that the perceived value of the products of 'Firm A' is not aligned with the price they have to pay for them. As a result prices for customers will drop and the firm won't capture the amount of money it had planned to capture.

One can also look to a different example where competitors play a role. Competitors can go to the customers of 'Firm A' and say that their products/services are better than those of 'Firm A'. As a result 'Firm A' will lose customers. As a reaction on that, 'Firm A' will have to increase for example the quality of its products/services at the same selling price or they will have to decrease the selling price of their current products/services to capture their former customers back. Both actions lead to a lower profitability for the firm because of influences of external actors.

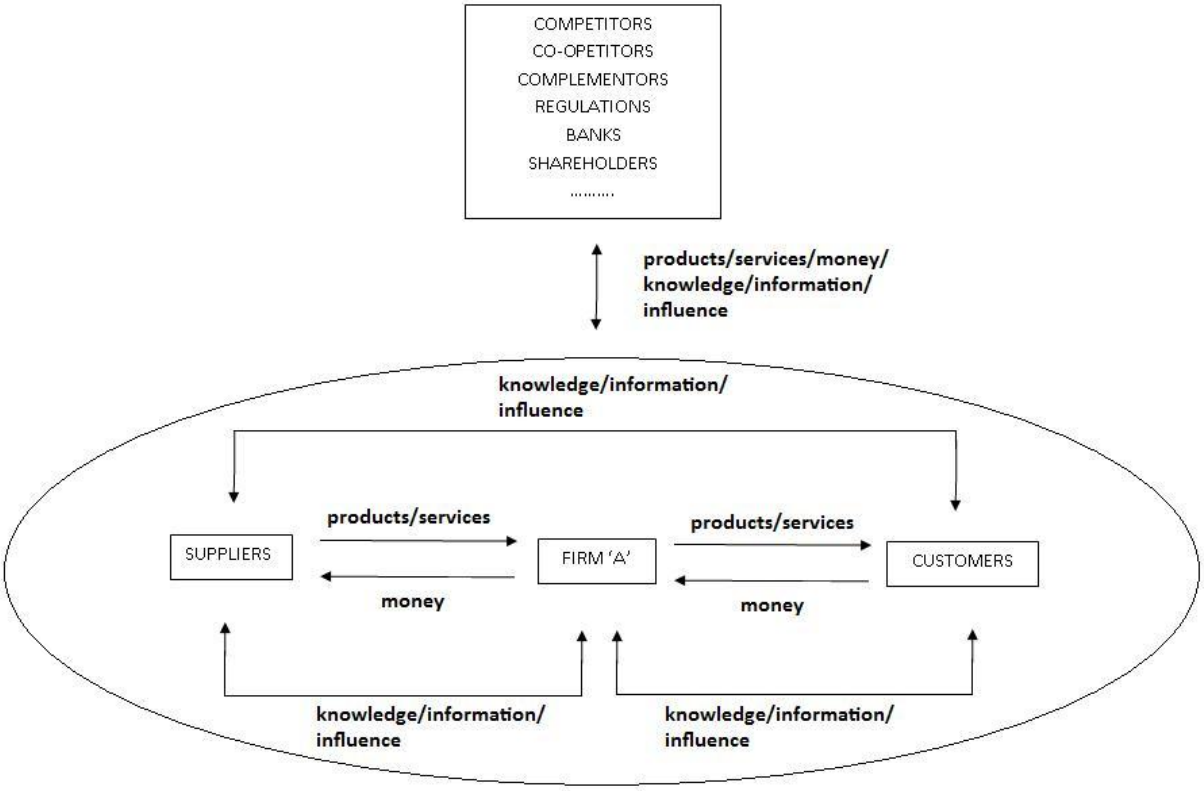

Fig. 1.2 Value network model from the viewpoint of 'Firm A'. Shown are various stakeholders: suppliers, customers, banks, regulations, shareholders, competitors, complementors and co-opetitors. The value which 'Firm A' delivers to its customers through products and services and which it captures from them through money flows does not only depend upon 'Firm A' itself. The whole value network around 'Firm A' is influencing those value flows.

Many more examples can be given here (as well positive as negative influences on the firm's profitability) but they will all lead to the same conclusion that no firm has full control over its value delivery to and its money capturing from its customers. This conclusion states indeed that the value chain model of Michael Porter is incomplete and that one should always consider an integrated value network.

The value network model in Fig. 1.2 isn't even in its most complete form. Customer relationships with other customers and supplier relationships with other suppliers are not shown for simplicity of the model. Neither are the relationships shown between the other stakeholders such as banks towards competitors, competitors towards shareholders, etc. The circle doesn't mean that suppliers, customers and the firm of interest are isolated from the other stakeholders. It's just a tool in order to be able to use a single bi-directional arrow to show the relationships between 'Firm A'/suppliers/customers and the six other stakeholders. The circle thus brings simplicity in the model.

There is still an important remark to be covered. The previous paragraphs stated that a value network representation is a more holistic view on value delivery to and value capturing from customers than it is the case in a value chain representation. However, the value chain sub-components are not shown in the model of Fig. 1.2 although they are very important to be shown. The value chain sub-components are not shown in the value network model for the model to remain simple. In fact, 'Firm A' should in reality in a value network not be presented as a black box but as a value chain model of Michael Porter. That is also true for other stakeholders such as suppliers, competitors, etc. They all consist of value chain models. Black boxes, however, put simplicity first but one should always remember that the relationships and arrows in the value network model don't interact with black boxes but with components of value chains! Regulations can for example make tougher rules for outbound logistics within a firm.

Summarizing, to have a true holistic and clear view on value behavior, both value chains and value networks are suitable to be dealt with and they should be used as complementary tools, each giving information on a different level of abstraction.

1.7 Revenues, costs and profit

Once the value chain and the value network are built up, it is important to think about the financial part of the firm's business. Framing revenue making and cost structures to reach for profits is a crucial activity in order to be profitable. After a value chain is established, it is suitable to assign costs to each value chain activity and it is even better to recognize different activities within each single value chain activity of Fig. 1.1 and assigning costs to each sub-activity. In this way the total cost is split up between the different value producing activities which makes cost analysis more efficient. If total costs rise, one can relatively easily assign the activities which contribute the most to the general cost increase.

In order to lower costs, a firm has two choices to do so:

- Reducing costs in one or more of the different value chain activities
- Restructuring one or more value chain activities

To reduce costs in any value chain activity, being the first possibility to lower costs, one can think of many cost drivers. Although these cost drivers apply more to strategic issues to handle costs, they will already be explained here. These strategic cost drivers will be referred to in '1.8 Strategy'. Michael Porter indentified ten different cost drivers to think about [4]. However another one, 'economies of scope', is worth to be added to his list. By adding 'economies of scope' to the list, the 'capacity' point becomes irrelevant because it is both explained by 'economies of scale' and 'economies of scope'. The list is given below with examples or definitions to make things clear:

- Economies of scale: the larger the volume of a single product/service, the lower the fixed cost per unit of product/service
- Economies of scope: each time the same infrastructure is used for different products/services, the lower the fixed cost per unit of product/service
- Learning: the more experience is gained with a certain technology over time, the lower the cost and time will be to accomplish a job based on that technology
- (Capacity)
- Linkages between activities: linkages among activities can drop costs
- Interrelationships among business units: interrelationships between different business units can drop costs
- Vertical integration: a firm controlling its suppliers and/or distributors for example in order to have more control over costs, for example by acquisitions or alliances
- Timing: electricity costs are different during the day than during the night
- Firm's policy: choosing among 'FIFO', 'LIFO' or 'weighted average' inventory systems will have an influence on tax paying
- Geographic location: wages are different in different countries
- Institutional factors: regulations can impose severe and expensive safety systems within a value chain activity

A second possibility to lower costs is to restructure value chain activities, as has been stated before. Possibilities here are to search for different production processes, rethinking distribution channels, etc. In fact, this is also a strategic issue which is valid for '1.8 Strategy'.

Profits depend upon the costs which were handled until now, but also on the revenues. Revenues depend upon the quantity being sold and the selling price per unit of product or service. The quantities being sold mostly heavily rely on marketing activities which are strategic issues. Also the selling price can be seen as a strategic issue. Therefore revenue making is suitable to be mentioned under '1.8 Strategy'.

1.8 Strategy

As a sixth business model function, strategy will be dealt with. A company's strategy is no stand alone function. So far, it has been stated that the central idea of a firm is to deliver a valuable value proposition towards target segments in the market. This value delivery towards customers (products/services) and value capturing from customers (customers' money) are realized within a value network where multiple different value chains are present. The strategy of the firm is the plan how to get this value delivery and capturing implemented in a real life business environment.

One could also see strategy as a realization of a firm's mission and ultimately its vision. A mission statement gives the answer to what a firm does on a day to day basis and it can generally be set up by answering the following three questions:

- What kind of business is the firm of interest in?
- What are the target segments, who are the firm's customers?
- What is the firm's value proposition about?

One should notice that the previous three questions have all been dealt with in previous discussions about the different business functions. (The kind of business a firm is in has not really been dealt with explicitly but however a value chain and value network model have been discussed to show the value influencing environment of a firm, which is a more comprehensive answer to the question which kind of business a firm is in.) So seeing strategy as a realization of a firm's mission is nothing different than seeing strategy as a plan to implement the value flows discussed earlier in this chapter.

As told before, strategy ultimately realizes a business vision. A business vision statement gives an idea about the way the company wants to go in the (near) future, on a five year basis for example. Typically, firms review their vision statement at a frequency of once a year. However, strategy is not the end point of discussion here. Every strategy should determine goals which further determine clear objectives. Objectives must always be specific, measurable, achievable, relevant and time-based [5]. Summarizing, the following business hierarchy exists: vision ↔ mission ↔ strategy ↔ goals ↔ objectives. Arrows to the right have the meaning of 'determining' whether arrows to the left have the meaning of 'realizing'.

The important question of which components a strategy should be composed of, still remains unanswered. Literature [6] gives a good starting point of thinking about those components but adding additional elements seems to be required. A complete strategy should always consist of the following elements:

- Scope
- Resource deployments
- Identification of sustainable competitive advantages
- Interpretation of the value network
- Framing costs and revenues (profit making)
- Synergy

The scope should always tell in which industries the firm is active and plans to be active in. Also the target segments should be mentioned together with the answer to the question whether other new segments will be served in the near future.

Resource deployments reflect to the manner in which as well financial, human and material resources should be exploited within the company. How many people will be required within a value chain activity and of which graduation types? Which tangible assets are necessary to keep the business running efficiently? How are investments paid?

Interpretation of the value network points to the fact that it is extremely important for any firm to understand and effectively manage the partners in the value network since these partners co-determine the value flows from and towards the firm of interest. Since value is the key term in an organization, factors influencing this value should always be carefully managed. If a company is for example working together with a co-opetitor in a certain business domain, it is very important to have very tight contracts with that partner. Crucial technology being stolen, can for example lead to the situation where the co-opetitor becomes stronger and nibbles away the customers of the firm it is allied with. Therefore, the firm should take actions to gain its customers back, which can lower the profitability of the firm. This is certainly an important point which is often missing in today's business strategies.

Profit making can also be seen as a strategic issue. How are marketers expected to have an influence on sales? What selling price is suitable? Should the firm set a high selling price to search for a certain type of customer or is a lower selling price more applicable because a larger amount of customers is targeted? The firm should also think about how to influence its cost structure in the different value chain activities. Cost drivers were given under '1.7 Revenues, costs and profit'. Restructuring value chain activities and processes is also a possible strategic issue to handle costs beside looking to cost drivers. Possibilities of restructuring activities were also given under '1.7 Revenues, costs and profits'.

In order to be able to compete in market space, competitive advantages are the elements to be recognized to reach for a sustainable and profitable business. Michael Porter presents three strategies for efficient dealing with competitive forces [7]:

- Differentiating products and services
- Being the lowest cost producer
- Searching for niche markets

If a firm chooses to operate in a niche market, it will often be the lowest cost producer and have a differentiated product or service as well since it is the only firm present in that specific market.

To close the discussion about strategy, a strategy must always focus on synergy. The building blocks of the strategy should be considered together, not separately in order to reach for ultimate value. Choosing a niche market as a competitive strategy for example automatically removes the competitors in the value network model which will lead to a more stable and controllable value delivery and value capturing for the firm of interest.

Summarizing chapter ‘1. Business model’, business models give an explicit view on a firm’s business, they facilitate planning issues and they are a necessary tool in innovation. The central idea of a business model is a value proposition towards targeted customers. The value chain delivers this value to the customers in return for customers’ money. The value delivering from and capturing by a firm are however also influenced by the value network in which the firm operates. The firm’s strategy is the central tool to manage these value streams.

2. Object Management Group

This part gives the reader an overview of what the so called 'Object Management Group (OMG)' is all about. First, the group's mission is described followed by its composition and scope. Finally, examples of realizations which have been produced by the group will be discussed to give the reader information about the kind of products/services that the group delivers. All information is gathered from [8]. The importance of the analysis of the group's work is to search for tools which are suitable to be used for business modeling.

2.1 Mission

The mission of the group literally states: *"OMG's mission is to develop, with our worldwide membership, enterprise integration standards that provide real-world value."*. These standards are created by task forces and can vary heavily in type. Standards are being set up for: business modeling and integration, finance, government, manufacturing technology, robotics, health care, life sciences research, software-based communications, etc. It's not surprising that standards for business modeling and integration are in the interest of this thesis study.

2.2 Composition and scope

The group was founded in 1989 as an international open membership consortium and counts by now, 2012, some hundreds of organizations who are member of the group. Members heavily vary in organization type. Some generally well known partners are: 'K.U. Leuven', 'Nokia', 'Hewlett-Packard', 'NASA' and 'Microsoft Corporation'. Profit making is not in the interest of the group. An important relationship to mention is the cooperation with 'ISO (International Organization for Standardization)'. Many standards of the 'Object Management Group' have been incorporated into 'ISO' standards.

2.3 Realizations

Plenty of specifications have formally been published by the 'Object Management Group'. Since many of these specifications are very technical in their domains and are not in the interest of this thesis study, only those realizations will be mentioned which are useful for business modeling. The group regularly improves existing realizations, leading to multiple versions. Only the newest versions of the available business modeling tools of interest will be dealt with in this thesis. It is also plausible that during writing this thesis study new business modeling tools are being created by the group or adaptations are made to existing modeling tools. However, these new or adapted business modeling tools won't be included in the thesis study.

The business modeling tools, provided by the group, which will be handled in this study are:

- Business Process Model and Notation (BPMN)
- Service oriented architecture Modeling Language (SoaML)
- Value Delivery Modeling Language (VDML)
- Case Management Model and Notation (CMMN)

3. Business modeling tools

This part describes the different business modeling tools which can be used to build up a business model. A business model can be seen as a framework to represent a business architecture and therefore the different business modeling tools can also be called business architecture sub disciplines. A traditional view on business modeling tools is given by Fig. 3.1.

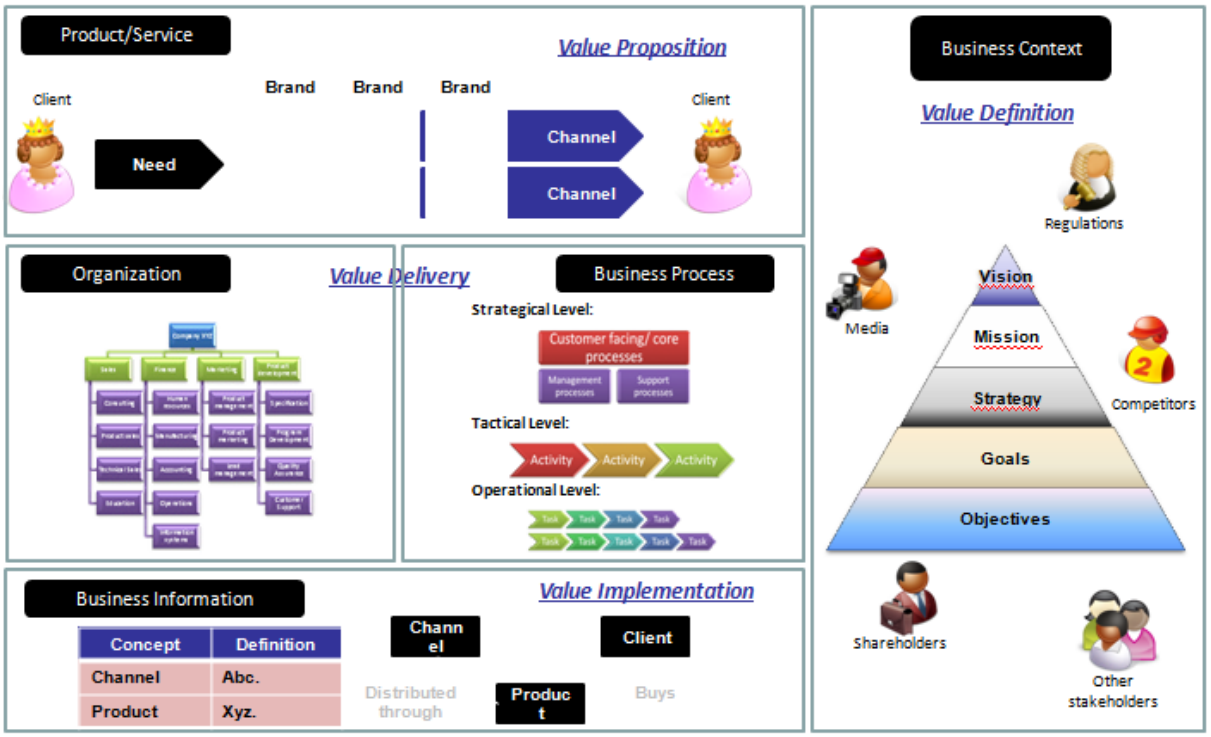

Fig. 3.1 Traditional business architecture sub-disciplines to build up a business model for an organization. These are the value proposition method, organizational modeling, business process modeling, business context and business information modeling. [9]

Derived from '2. Object Management Group', additional business modeling tools can be added to this traditional view in order to reach for a more valuable and complete business model. The complete list of traditional modeling tools together with the additional business modeling tools from the 'Object Management Group' looks like:

- Value proposition
- Organizational Modeling
- Business context pyramid
- Business Information Modeling (BIM)
- Business Process Model and Notation (BPMN)
- Service oriented architecture Modeling Language (SoaML)
- Value Delivery Modeling Language (VDML)
- Case Management Model and Notation (CMMN)

The following sub-chapters of chapter '3. Business modeling tools' will each describe a business modeling tool but they won't focus yet on duplicated information present among the different tools or on missing information in the modeling tools to obtain a complete business model. This will be handled under '4. Organizations'.

3.1 Value proposition method

The value proposition method is nothing more than describing the value promise towards the targeted customers. Although this method can consist of a few sentences, one should not underestimate the importance of it and the work needed to prepare such a value proposition. One can first develop a value proposition and afterwards searching for the right market segments but mostly market segmentation happens first followed by choosing an appropriate value proposition. The segmentation part is a time consuming job but also choosing a value proposition should take enough time and discussion in order to position the product or service well against competitive products or services. The customer should feel that his/her need is best covered by the chosen value proposition. Value is the central idea in a business model and thus so is the value proposition method.

3.2 Business context pyramid

The business context pyramid tool ensures that an organization correctly aligns its vision, mission, strategy, goals and objectives. The meanings of each of these statements have already been explained under '1.8 Strategy'. The crucial idea of this tool is that statements higher in the pyramid determine statements lower in the hierarchy and that statements lower in the pyramid logically realize statements higher in the hierarchy.

As can be seen in Fig. 3.1, one can place the different stakeholders of an organization around the pyramid but this represents in fact loose information. As has been stated under '1.8 Strategy', one of the tasks of a business strategy is to deal with the interpretation of the value network of an organization. This means that the stakeholders are already shown in the strategy part of the business context pyramid since they are drawn in the value network model. In the value network model, one can more easily see the relationships of the stakeholders with the firm of interest and one can see how these stakeholders co-determine the value flows from and towards the firm of interest. Summarizing, placing stakeholders around the business context pyramid can be done as a visual tool, but it is more important to implement them within the different statements of the business context pyramid because that is where the true value arises.

3.3 Business Information Modeling

The business information modeling tool is a concept to visualize an organization's behavior or functioning through plotting structured reverse relationships among products, services, people, customers, projects, etc. [10]. The point of discussion here is to ask the question how detailed a

business information model (BIM) can be or has to be. In fact, one can draw up business information models which contain plenty of relationships among products, services, people, projects, customers, tasks etc. to reach a full understanding of what an organization does and how these entities are interconnected. In some way, one is even able to model business processes within a business information model in order to represent the processes which are part of the value chain activities and which deliver the value proposition towards the customers and which capture the monetary value from those customers. However, the notation of business information modeling is no good notation to fully describe business processes. Above all, the models would become extremely large. In real life business environments, business information models are used to describe only the core entities and the most important relationships among them. So, a business information model gives one a quick visual idea of what the core entities and their relationships are within an organization. It should be relatively easy to understand for outsiders. However, the fact that these models only contain core entities doesn't mean that business information models are simple and small representations. Complexity can and does surely exist in real life information models.

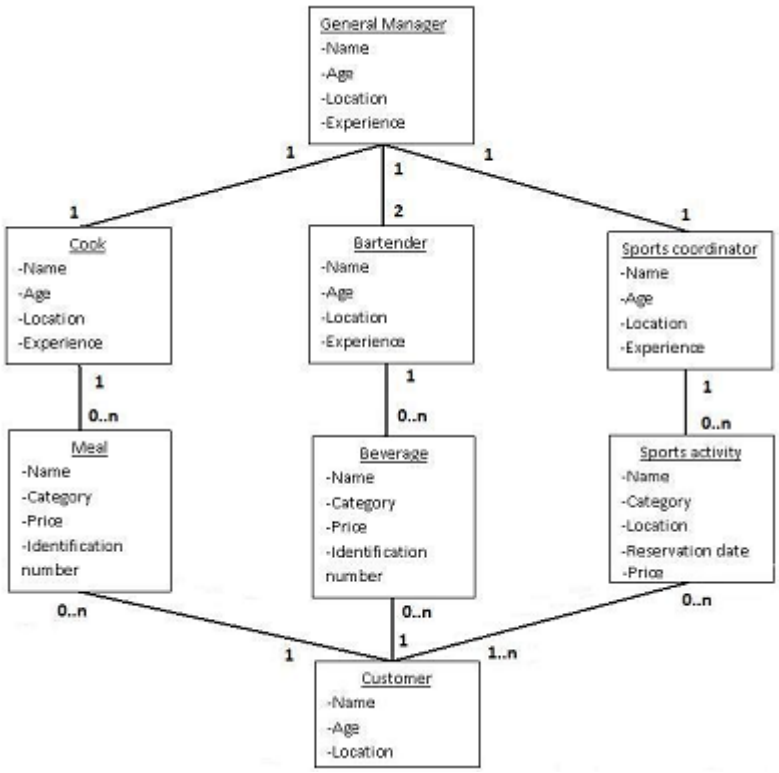

Fig. 3.2 Fictive business information model example describing the abstract relationships between core entities in a brasserie where also sports activities are provided. One general manager has the supervision of a cook, two bartenders and a sports coordinator. The cook prepares zero to many meals, the bartender prepares zero to many drinks and the sports coordinator facilitates zero to many sports activities. Each meal, drink and sports activity can only be 'prepared' by one person. Each meal and beverage have one customer consuming them but the customer can have none or multiple meals and/or drinks. A sports activity can have one or multiple practitioners and the practitioners can do zero to many activities. Each entity has specific parameters which, once filled in, turn the abstract model into a concrete snapshot.

As already has been stated, business information models are not meant to deal with describing processes because then the models become too complex and the notation language is not refined

enough to do so. One could further think of the possibility to integrate the business hierarchy in a business information model. However, this is neither recommended since the business information model will become too large in enterprises where many subdivisions in employee hierarchy exist and then the core entities still have to be represented on top of that already complex model. The main purpose of an information model is giving a rather simple overview of relationships among core entities and representing the business hierarchy of employees in it would drive one too far away from the real meaning of the model. Yet another reason can be given to avoid business hierarchies in information models: people are executing processes and since processes are not shown (in detail) in information models, showing only the executing people would deliver low and incomplete value to the model. Having a modeling tool where the hierarchy of people and their processes are shown together would lead to a more integrated way of thinking. However, stating that a business hierarchy should not be part of a business information model doesn't mean that people are not allowed to be represented in the model. Representing people in business information models is often necessary to show the relationships among core entities.

Fig. 3.2 shows an example of a simple business information model. Represented is the model of a brasserie where one can eat, drink and/or practice sports activities. An important characteristic of a business information model is the fact that every shown entity is abstract. There is for example a cook but the name of the cook is not shown. The entity 'cook' has characteristics such as name, age, location and experience. The entity 'meal' has characteristics such as name, food category, price and identification number. When one fills in the abstract model with concrete information, one gets a snapshot of the information model, being one possible state of the abstract model.

The business information model of Fig. 3.2 shows that in the brasserie there are one general manager, one cook, two bartenders and one sports coordinator. The cook can prepare zero or multiple meals, the bartender can prepare zero or multiple drinks and the sports coordinator can facilitate zero or many sports activities. Each meal, beverage and sports activity can only be handled by one staff member. Each meal and beverage have one customer consuming them and the customer can have none or multiple meals and/or drinks. Any sports activity can have one or multiple practitioners and people can practice zero to many activities.

Last, a new way of handling business information models could be considered. Business information models should provide information to in- and outsiders of the firm of interest. Since in-and outsiders are definitively thinking at different levels of detail, it should be wise to develop an electronic business information model which one could zoom in and zoom out. In that way, one could choose the level of detail one wants to see. Then, outsiders could zoom the model out until a low detail level is reached (and afterwards they could zoom in to refine their insights in the firm). Insiders of the firm would then mainly use the high detail level of the business information model.

Summarizing, a business information model gives an abstract model of core business entities and their most important relationships. Business hierarchies and business processes are not suitable to be dealt with within business information models. A business information model's purpose is giving in- or outsiders a rather simple overview of the organization's core entities.

3.4 Organizational Modeling

Organizational modeling is a business modeling tool which is used to model the relationship between the business hierarchy of workers and business processes. However, the ongoing sequential tasks of these business processes are not represented in the model since the model's notation is not built to deal with process notation. An organizational model can be seen as a simple model which visualizes the connection of people with processes. As stated under '3.3 Business Information Modeling', using a tool where people and processes are connected shows integrated value since people execute the business processes in the value chain activities of Michael Porter in order to deliver and capture value respectively towards and from customers.

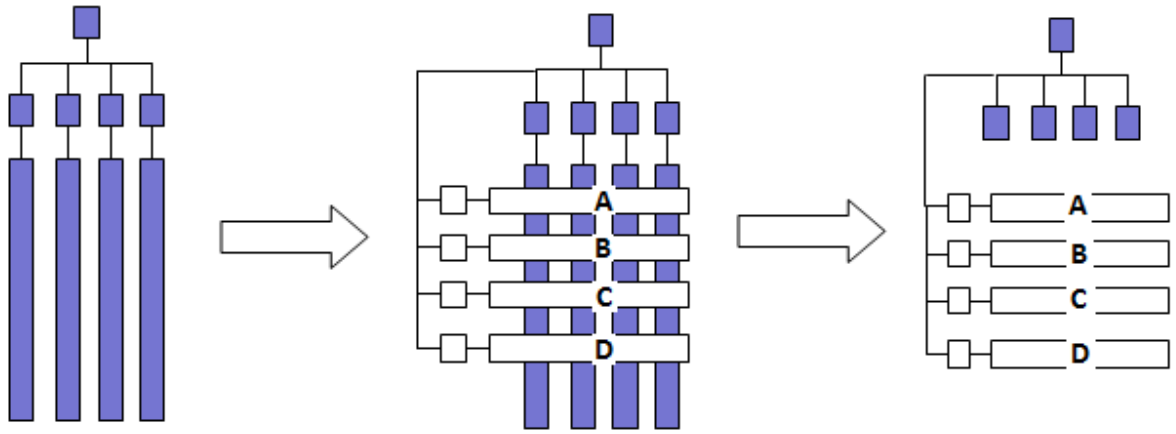

Fig. 3.3 Organizational model. Shown are classic business domains in the first image (marketing, finance,…) without business processes in order to represent the pure business hierarchy of workers. The second image shows the fact that business processes (A-B-C-D) are executed within a firm and that each process mostly requires human expertise which covers multiple business domains. The small white boxes in front of the processes determine process owners. The third image represents the most holistic view of organizational modeling where business domains are not represented anymore but where organizational modeling is done in function of processes, not in function of business domains. There, process working is the central idea. [10]

Fig. 3.3 shows the way to simply model the connection between the business hierarchy and processes being executed by those people. The first image shows a business hierarchy of people working in different business domains such as 'production' and 'sales'. However, business processes (A-B-C-D) are executed by those people and those processes need information of multiple business domains, represented in the second image. The actual most holistic organizational modeling notation is the one represented in the third image. Business domains are not represented anymore since the organizational modeling is done in function of the processes, not in function of business domains anymore. Working in process structures, rather than in domain structures can have enormous advantages such as cost savings and time savings. Business domain chiefs remain necessary for control and supervision.

Although business processes and people are connected in this kind of modeling, more refined modeling techniques exist in order to show in detail how these processes are executed and by whom. At a low level of detail, to have a quick understanding of which processes are done and by whom, organizational modeling presents a good technique but higher level insight is needed for sure too. One such technique for higher level information is given under '3.5 Business Process Model and Notation'.

As was already said under ‘3.3 Business Information Modeling’, zooming in and out to different levels of detail provides value for in- and outsiders of a firm since they need information at different levels of detail. Organizational modeling provides a low level of detail and if one wants to zoom in to a higher level of detail, one needs another business modeling tool or multiple ones.

3.5 Business Process Model and Notation

3.5.1 BPMN objectives

Business process modeling is a more refined business modeling tool in order to describe business processes in detail and to represent the people who are executing those processes. In comparison with organization modeling, which represents processes at the lowest details, business process modeling can be used to gain more information about the activities in those processes and about the interaction among people in those processes. Describing business processes in detail is very important since those processes make up the value chain activities described by Michael Porter, given under ‘1.5 Value chain’. Those processes deliver and capture the value streams within a firm. Furthermore, business processes even describe the relationships and activities among the firm of interest and its stakeholders, which are represented in the value network of Fig. 1.2. People and their processes are the engines which keep the value network running.

Well developed, documented and managed business processes provide many benefits in comparison with ad-hoc processes, being processes which are improvised each time again [11]:

- Formal tasks and communication
- Consistent prioritization
- Complete and accurate data flow between systems
- High level of control
- High visibility into process performance

In fact, one should see business processes as tools to implement a business strategy. The goals and the objectives which should realize the strategy and ultimately the vision, are translated into business processes. Thus business processes realize the strategy statement and ultimately the mission and vision of the business context pyramid shown in Fig. 3.1.

3.5.2 BPMN notation language

The modeling notation that will be explained here is ‘Business Process Model and Notation version 2.0’. It is a recognized notation which is made available by the ‘Object Management Group’.

A business process is in fact a representation of activities which are executed sequentially or in parallel in order to reach the goal of the business process. As can be seen in Fig. 3.4, image ‘2’ and ‘3’, a business process is executed within a box, called a pool. The pool represents in fact the

organization where the business process is done. A business process is always executed within a single pool but information flows can be exchanged between different pools as can be seen in image '3'. Within those pools, lanes are often present in order to show the people or departments in the organization which are executing the activities of the business process, as can be seen in Fig. 3.4, image '3'.

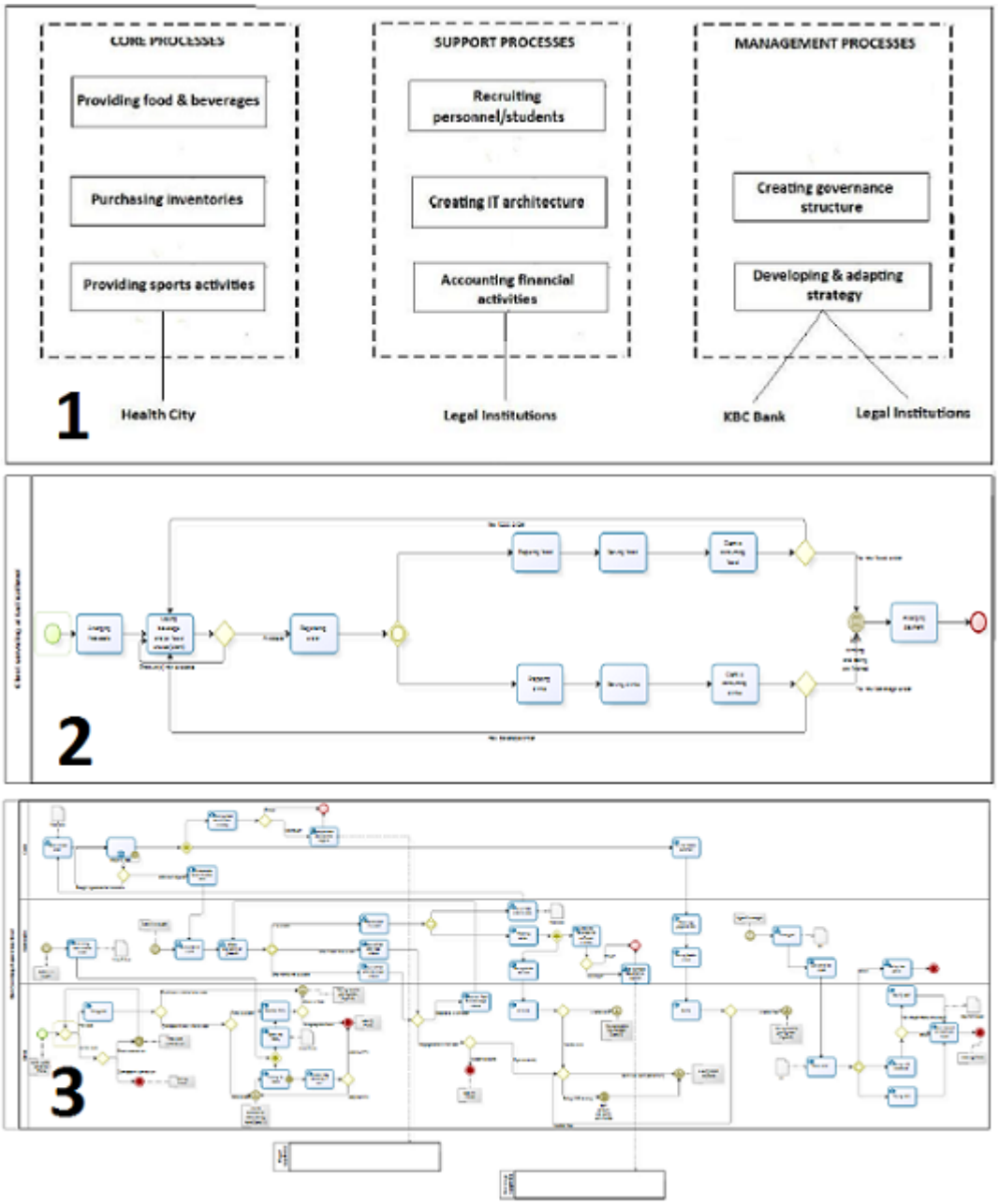

Fig. 3.4 Business process modeling example of a fictive brasserie at the strategic (1) level, the tactical (2) level and the operational (3) level. The tactical and operational level only show the core business process 'Providing food and beverages' represented in the strategic level. The strategic level shows all core, support and management processes together with stakeholders influencing them. The tactical level represents a certain process rather abstract whereas the operational level shows this process in detail in order to know how things are done.

As stated before, business process modeling works at a higher detail level than organizational modeling. However, business process modeling can also show information at different abstraction levels, as can be seen in Fig. 3.4. The strategic level represents the different core, support and management business processes without any details of those processes in an ecosystem structure. External actors influencing those processes are also shown in the strategic level. These are also the stakeholders of the value network model. The tactical level shows those business processes from the strategic level at a low level of activity detail in order to keep the process rather abstract. An abstract model is a good tool in order to know what is done, not how it is done. The operational level representation shows the same processes but highly detailed in order to get a very concrete model. This is good if one wants to know how things are done.

An important difference between the business process model notation and traditional flow charting is the use of events. One or more tokens travel throughout the process activities in order to reach the goal (end) of the process. The trick of using events is that the travelling of tokens in a business process can be controlled. By this, one knows exactly when a certain activity is executed and where the tokens currently reside in the process diagram. Three types of events exist: start, intermediate and end events. Tokens are created by start events and they are destroyed by end events. Intermediate events are used in between of start and end events. Start events are represented by a small circle, intermediate events by a double circle and end events by a thick circle, as shown in Fig. 3.5. Symbols are often used within all these events. Start events can catch a trigger such as for example a message or a signal (unfilled marker), through which a token is created which will travel further in the process. End events on the other hand destroy tokens and they can throw a result such as for example throwing a message or a signal (filled marker). Intermediate events can as well catch as throw.

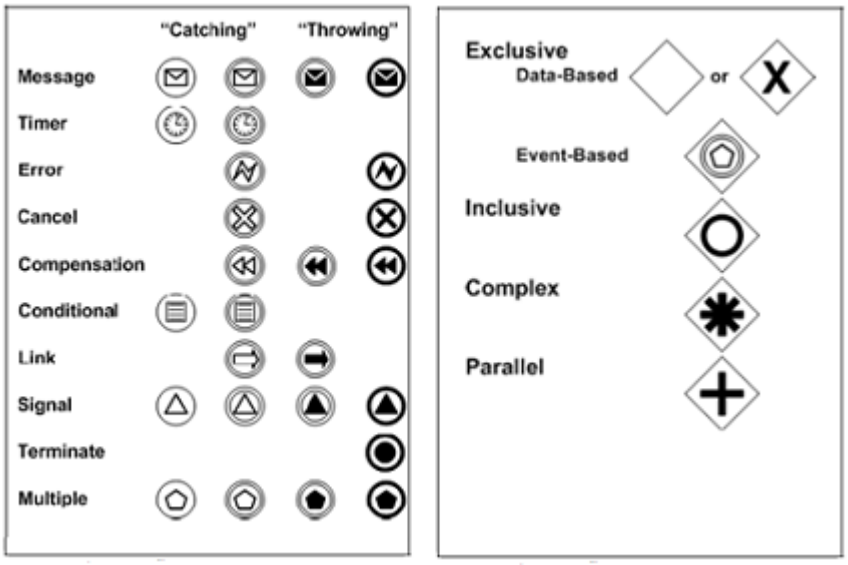

Fig. 3.5 Business process events and business process gateways. Events are shown at the left side and gateways at the right side. Start events are represented by a thin circle line, intermediate events by a double circle line and end events by a thick line. Start events can only catch a trigger (unfilled marker), end events can only throw a result (filled marker) and intermediate events can both catch and throw. Events are used to control the flow of tokens in the business process. Gateways are tools used to merge or split paths in a business process and thus also have the function of controlling the flow of tokens. [12]

Business processes always start by a start event which catches a trigger such as for example a condition which becomes true or an amount of time which has been passed. A token is created and travels throughout different process activities, which are represented by small rectangular boxes placed within the different swimlanes in the big pool box. Gateways, which have a diamond shape as represented in Fig. 3.5, can split or merge paths. So it is possible that multiple tokens are travelling throughout the process. The marker within the gateway determines its behavior. Tokens can meet an intermediate event such as a throwing a signal for example. When the token reaches this event, a signal is thrown and somewhere else in the process the signal is caught by an intermediate event which catches this kind of trigger. Intermediate events can also stop tokens from travelling until a condition becomes true or till an amount of time has been passed. Many options are possible. Activities can sometimes also be a sub-process in itself which means that one can click on them to reveal more details of the activity. Sub-processes have start events without triggers since they consume the tokens which are sent towards these sub-processes. Normal activities are called tasks. The business process always ends by an end event. Information flows are allowed to cross pool boundaries towards other processes. Normal sequence flows, which connect activities, are not allowed to do so since processes are executed within a single pool.

Artifacts are used to increase the understandability of the process model by using text annotations, data objects and groups. Documentation is very important in business process modeling: text annotations can add additional textual information to events for example in order to truly understand them. Showing data objects (small document images) to represent data and document flows within the process are also value adding to the process model. Furthermore, groups (dotted rectangles) are used to categorize a set of entities. Groups can go beyond pools.

An important thing to remember is using a consistent granularity within the process model. The detail of the activities should always be rather concrete or rather abstract. Otherwise things will get too unclear. Furthermore it is always important to avoid deadlock and aging phenomena while designing processes. Aging means that one will never get the end result of the process by for example residing in an infinite loop (loop counters can provide a solution here). A deadlock means that the process can't go on further, for example when a certain token is needed to continue the process but that token doesn't arrive (using a timer can be a solution to this specific problem).

Until now, only limited information is given about the business process modeling notation syntax. Many more modeling notation issues are possible such as for example placing boundary events on activities' or on sub-processes' boundaries to let the process continue when time outs or errors occur within these activities or sub-processes. Transaction and compensation issues are neither dealt with. The goal of this section is to give the reader a global idea of what the business process model notation can do within the story of business modeling, not to overload the reader with plenty of pages about all different possibilities in business process model notation or to obtain easy page filling.

3.5.3 BPMN and business rules

Instead of digging enormously deep into the process model notation, exploiting the story of business rules will be more value adding to the business process study. Business rules are no independent entities from business processes. Rules and processes are interconnected since business rules are present within processes. Business rules, often also referred to as decision logic, can be of different types such as company policies, taxation rates, conditional statements, etc. In order to achieve the way in which business rules should be handled within an enterprise's processes, the business rule story will be dealt with making use of a fictive process example. The theoretical ideas behind this example are obtained from [13].

Consider a simple business process of determining the status of a certain customer of a shop. In order to determine this status, five business rules are used in this example:

- Rule 1: Client = good customer if:
  - Yearly spending > € 500
  - Yearly shop visits = high
- Rule 2: Client = medium customer if:
  - Yearly spending > € 500
  - Yearly shop visits = low
- Rule 3: Client = bad customer if:
  - Yearly spending ≤ € 500
- Rule 4: Yearly shop visits = low if:
  - Visits ≤ 10
- Rule 5: Yearly shop visits = high if:
  - Visits > 10

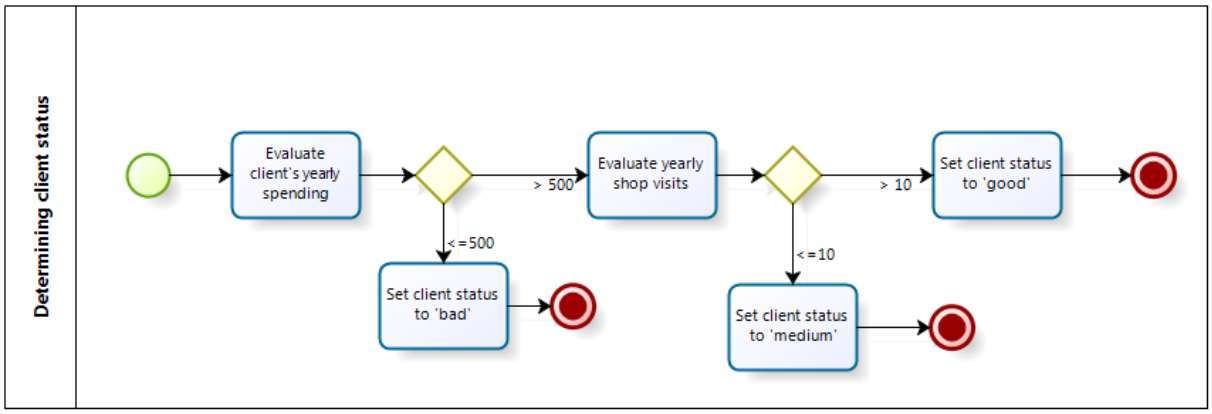

Fig. 3.6 First modeling solution to the customer status process problem. A customer is a good client when he/she spends more than € 500 yearly and visits the shop at high frequency. A customer is a medium client if he/she spends more than € 500 yearly and visits the shop at low frequency. A customer is a bad client if he/she spends € 500 or less a year.

One should notice that the fourth and fifth business rule are implemented within the first and the second business rule. As a first solution to model this business process, Fig. 3.6 is established. No

lanes are represented since this is not the focus of this research. Suppose all activities are done by one person within the organization.

Although all information is present in the business process of Fig. 3.6, some negative remarks exist which raise the need to a more holistic representation of this business process. These negative remarks can be summarized as follows:

- Business rules can change so changes will lead to the need of changing the hard code of the business process model, which is difficult and time consuming
- If duplications are present in the model, changes to them will require additional work
- The business process model becomes too complex
- Changes in business rules can't be tested/simulated easily
- No holistic view of business rules exist

A solution for all of these negative remarks linked to the first proposed solution, is to bring the business rules into the activities just by stating the number of the business rule. This can be done when a business rule or decision logic is externalized within a central rule repository. A process which needs a certain business rule will then search for that specific business rule in the rule repository by making for example a request via a web service. The new proposed solution is given by Fig. 3.7.

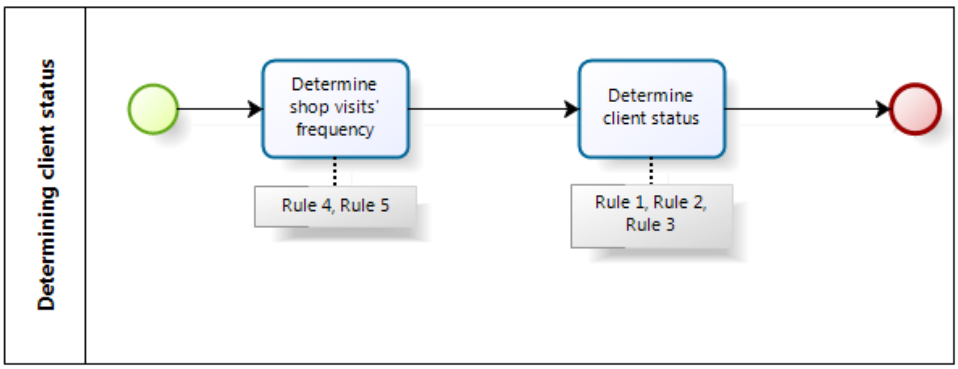

Fig. 3.7 Second modeling solution to the customer status process problem. First the frequency of the customer's visits is checked, making use of the fourth and fifth rule, and afterwards the client status is determined, making use of the first three rules. The business rules are not explained anymore within the process notation itself but are externalized into an external rule repository.

Still, this second modeling solution shows some problems:

- Lists of business rules don't show information about their relationships
- Changes in the process model itself are required when groups of business rules need to be changed

In order to solve these previous two problems, a third modeling solution to the customer status process problem is proposed. This solution makes use of decision tables, as shown by Table 3.1 and Table 3.2, where the five different business rules are incorporated in.

Table 3.1 Decision table 1. Business rules 1, 2 and 3 are incorporated within this decision table. A client is good when he/she spends more than € 500 yearly and visits the shop at high frequency. A medium customer spends more than € 500 yearly and visits the shop at low frequency. If one spends € 500 or less a year, this customer is called a bad one.

Decision table 1			
Yearly spending	> € 500	> € 500	≤ € 500
Visits' frequency	high	low	
Client status	**good**	**medium**	**bad**

Table 3.2 Decision table 2. Business rules 4 and 5 are incorporated here. A client's visit frequency is low when he/she visits the shop ten times a year or less and it is high in all other circumstances.

Decision table 2		
Yearly visit amounts	> 10	≤ 10
Visits' frequency	**high**	**low**

Fig. 3.8 shows the third solution to the customer status problem, making use of decision tables where the business rules are incorporated in. However, still one important disadvantage remains in this process model solution: connections among decision tables are not represented in a holistic way.

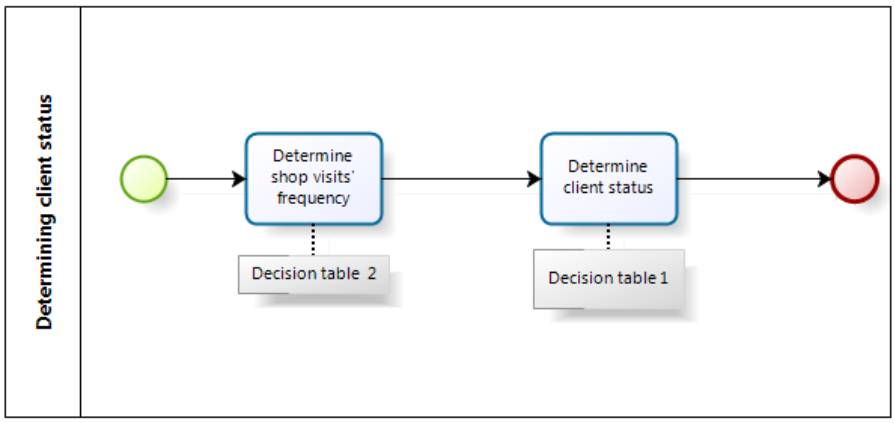

Fig. 3.8 Third modeling solution to the customer status process problem. First the client's shopping frequency is determined, making use of decision table 2, and afterwards the client status is determined, making use of decision table 1. These decision tables are externalized from the process itself.

In order to solve the low recognition of connections among decision tables, a fourth and final modeling solution is proposed to optimize the use of business rules within a business process model, making use of a decision model. The decision model is shown in Fig. 3.9. In order to determine the client status, decision table 1, shown in Table 3.1, makes use of information about the yearly spending and the visits' frequency. However, to determine the visits' frequency, decision table 2 is needed, shown in Table 3.2, which makes use of the yearly visit amounts of the customer to the shop. So a decision model shows the interconnectivity between decision tables by placing entities which are not explained in other decision tables below the dotted line and by placing entities which are explained in other decision tables above the dotted line.

In order to close the discussion about the business rules in the client status problem, Fig. 3.10 gives the ultimate modeling solution to this problem. Only the decision model image is used within the single

activity ‘Determine client status’. This model makes use of a fully holistic, externalized way of handling business rules within processes.

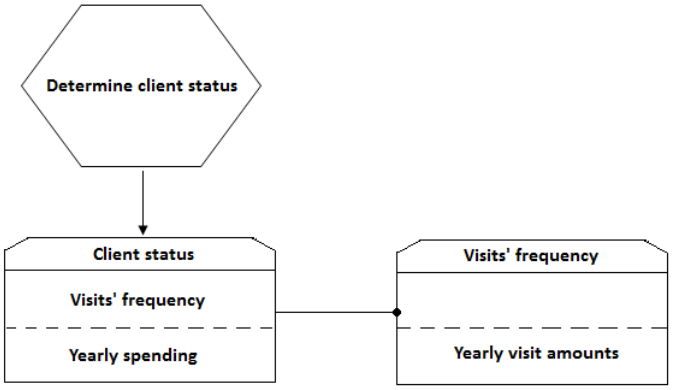

Fig. 3.9 Decision model of the customer status problem. In order to determine the client status the visits’ frequency and the yearly spending must be known. The yearly spending is not explained in another decision table and is placed below the dotted line. The visits’ frequency, however, is explained in another decision table and is placed above the dotted line. In the decision table of the visits’ frequency, only the yearly visit amounts are present which are not further explained in other decision tables. The connectivity between decision tables is highly visible is decision models.

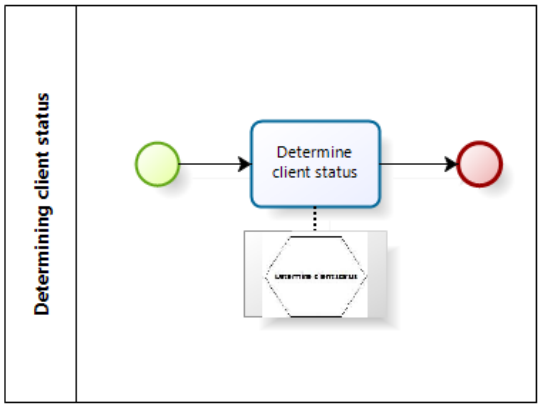

Fig. 3.10 Fourth modeling solution to the customer status process problem. This solution is the best one since a decision model is used which clearly relates decision tables to each other. This model is also the simplest one since only one activity is represented in the model.

Summarizing the chapter about business process modeling, one should not only make an efficient and effective use of the notation language in order to model a process, but one should also make use of externalized decision models in order to make effective and efficient use of business rules, which are present within process models. Business rules should be implemented in decision tables, which on their turn should have a clear relationship with respect to each other making use of complete decision models.

3.6 Value Delivery Modeling Language

This section describes the meaning and structure of value delivery models. However, the 'Value Delivery Modeling Language' is not yet an adopted specification of the 'Object Management Group' with a standard notation language. At the time of writing, the modeling tool is in its build-up phase. A so called 'Request For Proposal' had been published in 2009 by the 'Object Management Group' which invited organizations to submit proposals for 'Value Delivery Modeling'. Ten companies worked together on proposals and made it publically available. The two main submitters of the proposals, 'Cordys' and 'CSC', were supported by eight other co-developers, being: 'Aalborg University', 'Adaptive', 'Agile Enterprise Design', 'Enterprise Agility', 'REA Technology', 'SINTEF', 'ValueNet Works'and 'XiBiX'. Furthermore, these initiating companies were also supported by 'NEFFICS (Networked Enterprise transFormation and resource management in Future internet enabled Innovation CloudS)', a consortium of organizations.

The 'Request For Proposal' aimed to build up a value delivery meta-model, which focuses only on standardizing concepts, not yet on building a normative notation language. Notation languages are currently being investigated but they are vendor-based. Normative notation will possibly be implemented later on, but not yet in version 1.0 since this is a bridge too far at the moment of writing (Henk de Man, Cordys, personal communication, August 10, 2012).

As will become clear in this section, value delivery modeling encompasses many concepts so one could argue whether one integrated normative notation language could handle this all. The answer is yes. Although, value deliver modeling encompasses many concepts, it is a small modeling idea in comparison with other specifications which were set up by the 'Object Management Group'. So one integrated normative notation language which covers all value delivery concepts will certainly be possible to build (Henk de Man, Cordys, personal communication, August 10, 2012).

The current absence/unavailability of a (normative) notation language is however no limitation for this thesis study: it is important to know what is done by the modeling tool, knowing how it is done is of less importance in order to be able to analyze the suitability of the modeling tool for business modeling.

As a source for investigation, two submissions to the 'Object Management Group' from the submitters and co-developers mentioned above in this introduction will be used: the submission of May 23, 2011 [14] and the submission of May 21, 2012 [15]. A third submission is planned for to be submitted during December 2012, but this submission will not be taken into account in this thesis study.

As an introduction, one can state that value delivery models deal with the central idea of value creation and delivery in value chains of Michael Porter and with the managing of these values within the broader value network context. So one can immediately feel that value delivery modeling is not just a loose tool to model some part of the business. No, it is a holistic view to think about and to model the essence of each organization since value should be the key concept behind each enterprise.

3.6.1 VDML objectives

A first important thing to know are the objectives of the modeling tool. Hereafter, they are each presented and summarized:

Linking value delivery to activities: the modeling tool should determine value for both the firm's customers and for its other stakeholders. The term value can be as well value that is already being delivered or value that is of future concern. Moreover, the activities should be visualized which are sources or potential sources of these values.

Identifying characteristics of capabilities: the activities which deliver the values require a firm's capabilities to perform them. The modeling tool should encompass a capability model element in order to identify the facilities, resources, assets, processes, intellectual capital (explicit and tacit knowledge), etc. needed to perform value delivering activities. Possibilities for outsourcing can be discovered in this way also.

Providing levels of abstraction: meaningful abstractions remain important, also in VDML. Many organizational relationships, dependencies and networks exist so that the ability to expand and miniaturize these entities is a necessary option for the VDML modeling tool . Different users want different information so abstraction is needed.

Supporting analysis of value requirements and sources of value: each recipient of a product or service has specific value requirements for those products or services delivered by the firm's value chain(s). These value requirements must be evaluated against the values currently delivered or potentially delivered. Handling information about the value chain activities and the capabilities that produce these values, is crucial. Recognizing perceived value gaps in the modeling tool is the main issue here. One should notice that different customer segments can have different satisfaction levels of delivered value.

Supporting capability consolidation: a firm sometimes has more than one value chain in order to deliver different products or services. Some capabilities such as facilities, resources, assets, processes and intellectual capital will be required in more than one the firm's value chains. Identification and consolidation (merging) of these capabilities should be a function of the VDML modeling tool. In that way the learning/experience curve will be faster gone through for example. Another benefit can be explained by economies of scale.

Identifying opportunities for process improvement: the VDML model must focus on critical customer value delivery processes in order to identify opportunities to improve the value delivery. However, modeling these processes into detail, like it is the case in BPMN, lies not within the scope of VDML.

Optimization across multiple lines of business: the VDML model must focus on the relationship between the implementation and integration of capabilities and the multiple lines of business. The key point here is to recognize enterprise consequences of changes and trade-offs between multiple lines of business and to recognize and understand priorities for investments.

Supporting analysis of value exchanges in an enterprise ecosystem: the modeling tool should link the firm to the extended value exchange network in order to include relationships with customers and key business partners.

Supporting extended organizational modeling: organizational modeling is differentiated in VDML through defining different kinds of collaborations among people and defining specific roles for the participants in each of those collaborations. These collaborations can as well be internal as external to the firm. The extended organizational model is thus not restricted to describing the internal hierarchy of a firm but can also be used to describe relations in more loosely structured cross boundary communities among the firm and other business partners for example. The traditional organizational modeling described under '3.4 Organizational modeling' was restricted to describing an in-house business hierarchy which represented only one state of many possible collaborations among people.

Cost and performance variables: cost and duration variables with respect to the value chain activities should be implemented in the VDML modeling tool in order to understand cost drivers and the variables which influence the time part of value delivering. When the business' competitive strategy is being the lowest cost producer, understanding these cost drivers is of key essence.

Risk analysis: risk analysis covers multiple instances to discover the possible causes which can lead to value failure of delivered products or services to customers. Possible risk factors are: single source suppliers, critical machines, critical personnel, natural disasters,… Such risk analysis closely relates to investigating the capabilities which are needed to perform value chain activities. It is important to analyze the risks and to think about possible negative scenarios which can influence the (customer) value.

Summarizing, although no normative notation is present yet, the role of VDML is to create a model where the value creation and its exchange are placed in a central position and where that value is investigated through making use of representations of the organizational structure, the capabilities which produce and exchange the value, the handling of resources and the roles within collaborations among internal people/systems and with stakeholders.

As already stated briefly before, VDML handles the way in which deliverables travel throughout the value chain in order to create and exchange value but it avoids the details of the operational business processes. In that sense, VDML is more abstract than BPMN, which is a pure process modeling tool (but also nothing more than that). The roles of participants (people or machines) within collaborations are provided by VDML, like these roles are also present within BPMN. However, VDML focuses more on describing collaborations and roles both within and across the company boundaries to integrate in the view of a value network and to implement relationships with all kind of stakeholders, from customer driven innovation collaborations to collaborations with co-opetitors. The VDML language's normative notation will be more suitable to represent sub-collaborations within a bigger collaboration part (working groups within a department for example). In BPMN, such sub-collaborations would be more chaotically represented and less recognizable since one can only define participants in the lanes' names of a pool.

A next thing to discuss about is how heavily an organization is supposed to integrate a VDML model. An enterprise can have for example multiple lines of business. The question then is whether one or multiple VDML models should be prepared. The answer is that one model which implements total business behavior is the most suitable because then the most comprehensive view of the business is being represented. But, however, an organization can choose to build up separate VDML models for each line of business in order to reach for simplicity. This is no crime but one should always remember and be aware that the true benefits of value delivery modeling arise when separate VDML models are integrated in order to see the connections. However, the level of integration of VDML models remains a business culture issue for sure too.

A VDML model can vary from pure product or service concepts to the commercialization and the delivery of those products or services, customer support included. This is however the fact for all business modeling tools (remember business modeling is also needed before an enterprise's start up).

3.6.2 Graphical representations VDML

This section describes some possible graphical representations of the objectives and concepts which are part of value delivery modeling, as explained under '3.6.1 VDML objectives'. Certainly not all representations will be given here which are necessary to build up a complete VDML model but some remarkable and essential ones will be shown. These representations are no normative representations and will probably not be represented in the normative notation as they will be shown here. However, they will give the reader a surplus on information of how the VDML concepts can be visualized in a way to capture a lot of information very fast.

Value chains and value models are central in the VDML idea so they should always be represented in VDML models. Possible representations of value chains and their implementation into more comprehensive value networks were already shown in Fig. 1.1 and Fig. 1.2.

Table 3.3 Collaboration and role representation. Shown are two participants which can have roles in multiple collaboration forms. The table gives a quick understanding of the huge amount of collaborations, roles and participants within organizations.

Participant	**Participates in**				
	Engineer in team X	Facilitator of project Y	Accountant in process B	Member of committee Z	…
Person A	v	v	v		
Team X				v	
…					

Table 3.3 shows a possible representation of collaborations and the participants which fulfill roles in those collaborations. Shown collaborations are: 'team X', 'project Y', 'process B' and 'committee Z'. Participant 'person A' is an engineer within the collaboration 'team X' whereas that same 'team X' is a sub-collaboration or a participant within the collaboration 'committee Z'. This kind of mapping is a good tool in order to define participants and roles within processes which need to be performed to

execute value chain activities and thus which build up the customer value. Such a collaboration map is also a good tool to represent the accountability framework within an organization: it gives clear information about who is responsible for what if something goes wrong and who should be rewarded when something is done well.

As already stated under '3.6.1 VDML objectives', capability models should mention the required capabilities such as resources, facilities, processes, intellectual assets, etc. for performing value creating activities in the value chain. These capability maps should not only mention these capabilities but they should also present a hierarchy of the capabilities needed for these activities together with the current performance of these capabilities. A simple example of such a capability map is given by Table 3.4. This is a self-established capability map for payroll activities which is too simple for a reality view but it gives however an idea of the elements which could be certainly part of it.

Table 3.4 Capability map of a payroll activity. Shown are capabilities required to perform the payroll activity together with a performance check. The capabilities are organized from highly critical (1) to less critical (6) to perform the activity.

	Payroll activity			
Importance	**Capability**	**Amount**	**Performance**	**Comment**
1	ERP software	1	Not ok	Legacy system
2	Head accountants	1	Ok	
3	Accountants (5 year education)	3	Ok	
4	Accountants (3 year education)	5	Ok	
5	Department	80 m²	Not ok	Too small
6	Education sessions	1/year	Not ok	2/year required

3.7 Case Management Model and Notation

In this part the so called 'Case Management Model and Notation (CMMN)' will be investigated. Just like it is the case for VDML, the 'Object Management Group' has no normative document available at the time of writing which describes this modeling tool properly. However, a 'Request For Proposal' has been published in 2009 to which a response document has been made available. This response document [16], made available on May 23, 2011, will serve as the source of information for the discussion in this section. Three companies were involved in the formation of this submission document: 'Cordys', 'Unisys' and 'Visumpoint'. These companies were further supported by: 'Agile Enterprise Design', 'Commitment', 'Computas', 'SINTEF', 'Sword-Ciboodle' and 'Tibco'.

The discussion about CMMN is in fact a discussion about an extension to BPMN 2.0. BPMN deals with modeling repeatable processes in a value chain. However, in some organizations, this repeatability is not guaranteed when particular cases need to be handled. Specific cases lead to different approaches for each case, especially when ad hoc choices have to be made and circumstances are not clear from the beginning. An important characteristic of case management is the fact that the case process often needs to be planned at runtime (because new unexpected documents suddenly

appear during the processes for example). Recording case records and supporting human decision making lies definitely within the scope of CMMN. Documents and other information sources should be carefully captured and handled since they provide the sources for decision making and they determine the accountability of the processes' decision makers. Stating that case processes have no repeatability present within them, is certainly not true. Separate case activities can be perfectly repeatable for example, but in general the case process is not. Relevant examples of case processes are medical issues for patients, resolving problems by call centers and repairing machines. It is very hard to model these processes in a strict, repeatable BPMN model. However it should be possible by using a very extended model, BPMN is not the appropriate language to do so.

3.7.1 BPMN and CMMN integration

One can ask the question why BPMN cannot be used for case process modeling or certainly why it can't be extended towards a language which covers both repeatable and ad hoc processes, since one sees CMMN as "an extension to BPMN". Hereafter some reasons will be discussed why a separate language is required:

Paradigm shift: BPMN processes are repetitive sequences of tasks and/or sub-processes. This repeatability is not completely present within case processes. Decisions have to be made at runtime. So participants in case processes do as well the planning as the execution whereas participants in repeatable processes do only the execution.

Data and event driven: BPMN processes are task centric since all tasks and events are predefined in the process model. In case processes, models are case centric. The case is always in a certain state which depends upon actions and events. Changes in that state trigger actions and planning issues. So case processes evolve, they are not predefined.

Different modeling paradigm: BPMN has strongly repeatable processes and changes to these processes are due to observations and problem reporting. Changes to case processes come from learned case patterns. So a case model will evolve much more than a BPMN process model. In case management, discovering best practices is a key issue and it takes time.

Difference in state of evolution: BPMN has already become a stable process notation language whereas the modeling ideas of case processes are still being developed at the time of writing. Users' experience will lead to an evolution and improvement of these first case modeling ideas. Therefore it is better to separate BPMN and CMMN to let case process modeling go its own way and become a better standard over time. Users are not waiting for an integrated BPMN and CMMN notation that will change for a couple of times due to the case process implementation. Repeatable BPMN processes are well developed and changes to that notation are not demanded. Furthermore, BPMN is already a quite complex model and extensions to that model to implement case processes will make the model even more complex which will avoid easy evolution of case process modeling.

Participant collaboration: BPMN makes use of lanes in a pool which define which people need to execute certain tasks. Mostly, tasks are executed by single person participants. In case processes however, teams of participants are more used since decision making and planning are more present within case modeling than within repeatable process modeling.

Guidance and control: a case process is characterized by a process state in which the process currently resides. Rules provide control in order to apply best practices and certain policies to the case process at runtime. In a repeatable BPMN process, those rules are already put in the model at the time of model design.

Knowledge ability: case processes require having participants which are knowledgeable in order to make decisions and planning options at runtime. Participants in a BPMN process are not required to have those knowledge skills. Executing predefined processes is all what they have to do.

Continuous improvement: case processes will possibly lead to the recognition of patterns or best practices. Since case processes are handled at runtime, these best practices and learned patterns can already be implemented within the current case. This is not true for predefined BPMN processes.

Detailed guidance and tracking: in BPMN, process participants will logically execute tasks. But generally, these participants need to execute a number of small ad hoc sub-tasks in order to be able to complete the described head task. These sub-tasks are not documented and learning from these sub-tasks is difficult since they seem not to exist within the BPMN model. CMMN however will describe these smaller tasks since the detail level within CMMN is better (in order to be able to plan). Results from these smaller tasks will thus be captured and learning will be better within CMMN.

Innovation: since participants in CMMN are allowed to implement current experience or knowledge into a process model, innovation is stimulated at runtime by knowledgeable users. Within BPMN innovation is only possible when processes are being revised by external knowledgeable users. Users within BPMN processes are often not knowledgeable enough to innovate.

3.7.2 CMMN and business rules

As is the case in BPMN, business rules (decision logic) are present in CMMN to guide the process. However, these rules are quite at a different level than those in BPMN. Whereas rules in BPMN are quite definable, clear and to the point in advance, business rules which are present in CMMN rely more on human knowledge about the case and its context which is evaluated at the time of process running. Rules in BPMN also rely on human knowledge of course since they are created by this knowledge but in CMMN it is harder to define the rules in advance. In CMMN, the majority of rules is not present within a central rule repository from where they are called upon, like it is the case in BPMN. Rules are mostly present in people's heads from where they are called upon when needed.

An important aspect to mention here too, is the learning effect. When a certain case has been passed through, the case outcome and the followed path to reach that outcome can serve as a learning issue.

The outcome and the followed path can lead to the implementation of improved business rules which stimulate the formation of more repeatable case processes since the execution of some process activities is getting clearer and clearer when more cases are being dealt with. So, executing cases with low repeatability by using ad hoc human decision rules can lead to the formation of more stable and repeatable processes where some standard decision logic is implemented in. Shifting case processes towards repeatable BPMN processes is certainly possible over time, due to learning effects.

3.7.3 CMMN objectives

However some CMMN characteristics and objectives have already been discussed is previous sections about CMMN, some general modeling objectives will be mentioned here:

Integrating knowledge and procedure based information work: CMMN users should be knowledgeable in order to plan for case evolution. Thus beside procedural behavior, they should also show knowledgeable capabilities. This centralizes process control because planning and execution are done by the same people.

Supporting the specification of useful case management elements: planning elements should be available for runtime users of case processes in order to plan for and to continue the case process. These planning elements can be of different type and are certainly industry dependent. When certain medications don't work for a medical patient for example, doctors can use lists of closely related drugs to decide on new medication treatments for the patient.

Supporting timely response to events: based on the case status, the runtime system can inform process participants that actions are needed to be done when certain events occur. Those events are triggered due to changes in the current state of the case.

Supporting collaboration of participants: the runtime system can stimulate collaboration and information sharing between participants based on known role relationships, activity dependencies and joint tasks.

Supporting role based assignments of participants: CMMN needs to define in detail which participants execute which tasks. So role definitions and collaborations should be clarified. Multiple participants within certain roles will definitely pop up easily in CMMN since case processes need to be planned during runtime and knowledge of multiple people can be asked for in order to do so. Since some cases can take very long to be executed, the CMMN model should be constructed in order to deal with flexibility of assignments due to personnel changes and the implementation of new ad hoc participants for example.

Record keeping and accountability: since case process modeling is done during the execution of the process itself, record keeping is very reliable and extended and thus the framing of the accountability framework (who is responsible if something goes wrong) and the search for root causes in case of problems are more easy to achieve.

CMMN guidance: a CMMN model should provide four types of guidance. This guidance can be either mandatory or advisory. A first type is the provision of planning options in a CMMN runtime pallet. Secondly, frequently used groups of tasks should be available to be chosen for easy planning. The third type of guidance is the provision of alternatives when one needs to make a decision. A fourth and last guidance mechanism is the showing of constraints on chosen tasks so that it will become clear if a certain task is suitable to be used in the current case context.

Planning authorization: it is possible that certain participants or groups of participants have different planning authorizations available than other ones. So the CMMN's runtime pallet should provide the available planning elements to the different participants and make a distinction between the authorizations for each participant. Using usernames and passwords to log in to the CMMN system can provide useful information to the system about authorization issues.

Handling of events: one is able to make a distinction between two types of events in CMMN. Just like in BPMN language, the same events can be used in CMMN language since a CMMN model can have repeatable and definable process structures in it beside the indefinable parts of the case process. Beside those known events from BPMN language, another type of event can happen. One must remember that a case process is slightly build up by its participants. At a certain moment in the case runtime, the case process resides in a certain case status, for example a medical patient being in the recovery phase of a surgery. Then, certain events can happen, for example the occurrence of complications, which will have an influence on the case status and which will call the process participants to take action. So summarizing, one can identify internal defined process events, present in the process language, and external events which have an influence on the case status.

Process evolution: as already stated, non predefined case processes can evolve towards real BPMN processes which are predefined due to learning effects and recognition of patterns. These learning effects should be stimulated by CMMN through the capturing of case histories from where certain implementations can extract recognizable patterns.

3.7.4 Graphical representations CMMN

Although no normative notation for a CMMN language exists at the time of writing, this section will give the reader a visual summary of the concepts, discussed before, which should be present in a CMMN model. This visualization will be established through making use of BPMN language but one should remember that a CMMN model will not be defined in that language. However, it is a good tool here in order to show the meanings of CMMN models. The visualization is shown in Fig. 3.11. Shown is a case pool 'X' with three executing parties: participant 'A', participant 'B' and team 'Z'. Participants 'A' and 'B' are internal employees but team 'Z' can consist of a mixture between internal employees and external company participants. One can see that the case process is started by two predefined tasks: task 1 and task 2. This is in fact a BPMN predefined notation. Also an internal event is present between these two tasks, shown by a timer symbol. After the two first predefined tasks are executed, however, the pathway to follow in order to continue the process is not clear anymore. At this point in time, the switch from BPMN predefined tasks towards a CMMN notation occurs. Team 'Z'

has to invent and plan the process continuation during runtime of the process. The fact that a team is allocated to the planning issues is due to the fact that they must use their knowledge (rules inside people's heads) in order to invent the case process activities. A team has a more holistic and complete view on process planning than one single participant. The fact that also company outsiders can be present in the team is due to the fact that, for example in a car insurance claim process, an external damage controller checks the car's damage status and then reports to the insurance company's team about his/her findings. These findings will co-determine the pathway that will be chosen to continue the case process.

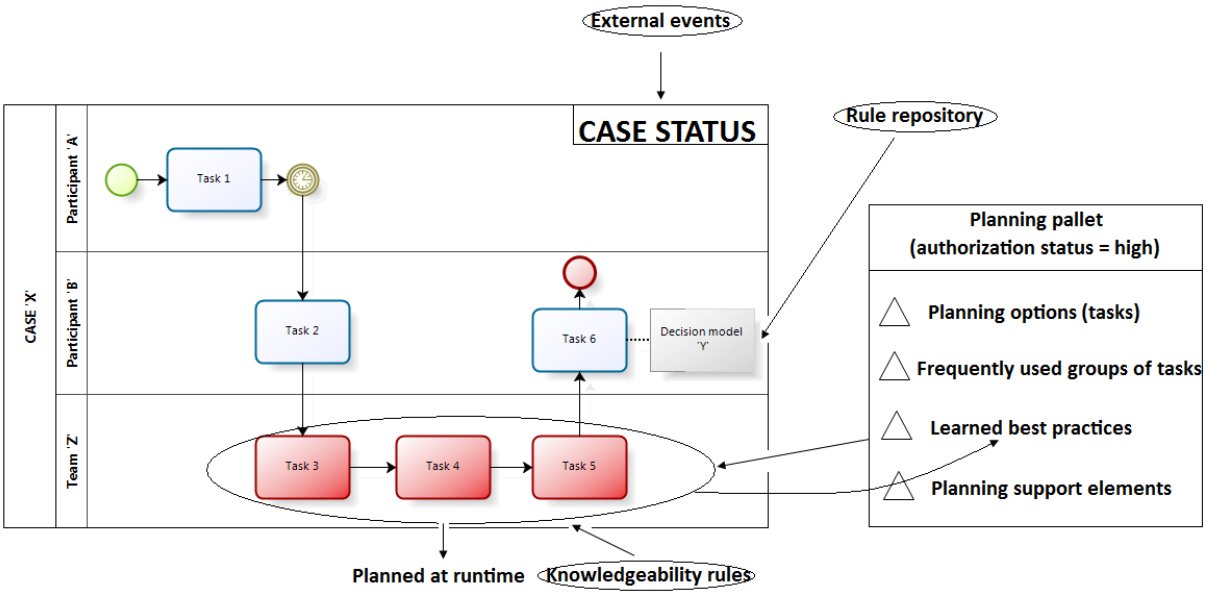

Fig. 3.11 Planning and execution of case process 'X'. Participants 'A' and 'B' execute predefined tasks (task 1,2 and 6). Externalized decision logic can support the execution of these tasks. These tasks are predefined in BPMN language. Between tasks 2 and 6, the process in unclear in advance and a team of possibly both internal and external people needs to plan and execute the tasks in between (CMMN). This planning occurs at runtime of the process, not in advance. A team is used since combined knowledge (rules) is needed in order to plan efficiently. A planning pallet supports the planning of the CMMN tasks. The planning of tasks at case process runtime is influenced by the case status. The status of the case is influenced by external events such as the receipt of new external documents for example.

Once task 3 is planned and executed for example, the next process steps become unclear again. The case status plays an important role in the at runtime planning of tasks. After task 3 is executed for example, the process can stop for a while. Once an external event occurs, such as for example the availability of certain external documents, the case status is updated to a new level and team 'Z' can plan further in the case process, leading to task 4 and 5 for example. A planning pallet can help team 'Z' in planning the different activities. The pallet contains for example possible tasks which can be planned for, groups of tasks which are commonly used, support elements for planning tasks such as documents and also learned best practices. It is possible that best practices are learned during a certain case process and that those best practices are already used again within that same process. The planning pallet can be both obliged to use or it can be a pure support element which users can neglect if they want to do so. The authorization status points to the fact that users/planners can have different authorizations concerning planning tasks. Whereas a certain user can plan for example what he/she wants to plan, another user can need the approval of the other one if he/she wants to plan certain tasks.

After the three at runtime planned tasks (task 3, task 4 and task 5) are planned and executed, a predefined task 6 is executed. So here again, the switch from CMMN towards BPMN occurs. Task 6 makes use of a decision model (decision logic) that is implemented in an external rule repository. After task 6 is executed, the case process is completed.

It remains important to note that the visualization of Fig. 3.11 is no normative notation but just an informative representation of CMMN objectives.

3.8 Service oriented architecture Modeling Language

Beside BPMN, VDML and CMMN, a fourth modeling tool, extracted from the 'Object Management Group' will be described here: 'Service oriented architecture Modeling Language' or SoaML. The version that will be handled here is version 1.0.1. All information about SoaML is gathered from the official specification document [17] which is made available by the standard setting 'Object Management Group'. In comparison with VDML and CMMN, this part will not deal with a specific submission to a so called 'Request For Proposal' document since an official specification document exists. This specification document is in fact a summary of all submissions which were submitted to a 'Request For Proposal' which aimed to describe services. This request was issued in 2006.

The overall goal of SoaML is to model services but furthermore the SoaML tool should serve as a foundation for future extensions to service modeling ideas. An important issue to tackle in this section is certainly the relationship of SoaML towards BPMN and CMMN.

3.8.1 Unified Modeling Language

The notation language in which SoaML is defined, is in fact no new language which was especially developed for the service modeling tool. The notation in which SoaML is modeled is called 'Unified Modeling Language' or UML. UML is in itself an 'Object Management Group' standard. UML is no specific modeling tool but a general visual language in which different modeling tools of all application domains can be notated. SoaML uses this language and brings some standardization forms in it in order to be able to build a standard service modeling language.

3.8.2 Service Oriented Architecture

'Service Oriented Architecture' or SOA defines how people, organizations and systems deal with the provision and use of services in order to reach predefined results. Thus, these services are in fact provided or used in order to obtain business goals. Providing services also deals with exchanging capabilities to others in exchange for value. Services allow people, organizations or systems to do something without doing it themselves. The term 'system' can refer to as well organizations, communities, processes and IT systems.

3.8.3 SoaML objectives

Before continuing to a section describing the notation issues about describing services within SoaML, some general SoaML objectives will be summarized here. The main objectives of SoaML are [18]:

- The identification of services among people, organizations and systems within a 'Service Oriented Architecture' environment
- The definition of service providers and consumers
- The discovery of dependencies among services
- The formulation of service requirements
- The specification of services (message exchange patterns, defining capabilities,…)
- Defining policies for providing and consuming services
- Forming of basic foundations which can be used in further service modeling extensions and which form the basis of concepts of integrating service modeling within other modeling tools

3.8.4 SoaML notation language

Before going to visual notation representations, it is important to first describe some necessary notation elements which standardize the service modeling idea.

Like in other modeling tools, participants are present within SoaML notations. Participants can be defined as being the entities that provide or use the services of interest. Those entities can be people, organizations or information system components.

The services that participants use and provide are provided and used via ports. A port is an interaction point which is linked to a participant and where a service is provided or used. A 'Service' port is a port where a service is provided and a 'Request' port is a port where a service is consumed.

Service specifications or service descriptions are used in order to show how the service participants interact with each other. Two possible ways of service descriptions exist: a UML Interface and a ServiceInterface. A service description describes the way how participants are expected to interact via ports but it doesn't show the way how they do this. A UML Interface is used for one-way interactions between the service provider and service consumer. A ServiceInterface allows for bi-directional services. The information which is sent between provider and consumer (choreography) can also be stated by the ServiceInterface.

Another essential element in service modeling are the capabilities which a service provider needs in order to be able to provide that service of interest. It is possible that a same service is provided by different providers making use of different capabilities. The possession of a capability by a provider can for example also rely on services which are provided to that provider by third parties.

Now that the basic terminology is explained, the visual notations can be explored. It is wise to first discuss the UML Interface. UML interfaces are simple interfaces which do not require defining

protocols for interaction among participants since one-way services are provided. Fig. 3.12 shows a simple UML Interface called ‘Shipment status’. Since this kind of interface is a simple UML Interface, the showing of interactions among the participants is rather obvious: a service consumer makes a request through which a service is provided by the service provider (no interaction protocol exists here). Also two participants are shown: the dealer which represents the service consumer and the shipper which represents the service provider. The meaning of the service is that a dealer wants to know what the shipments status of a certain product is. The shipper can obviously tell this to the dealer.

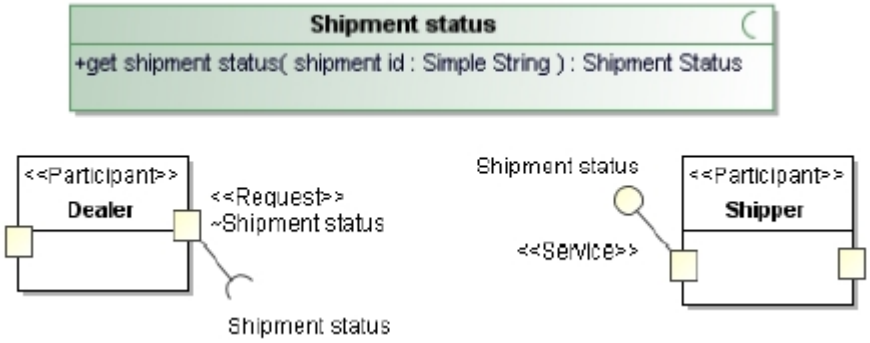

Fig. 3.12 Service provision of a shipment status. Shown is a simple UML Interface ‘Shipment status’ which defines the ports of two participants, a dealer and a shipper. The dealer is the service consumer and has a ‘Request’ port whether the shipper is the service provider and has a ‘Service’ port. [17]

Each of the two participants has a described port available through which the service interaction is meant to flow, represented by small rectangular boxes. The dealer is the service consumer and has a ‘Request’ type port whether the shipper is the service provider and has a ‘Service’ type port present. The ports are given the name of the UML Interface: ‘Shipment status’. The ports are thus compatible. Other ports are also present on the participants (but not named) since multiple services can be described.

As already mentioned, beside using a simple UML Interface, a ServiceInterface also exists. It is the most commonly used interface type. There, protocols are used in order to define bi-directional services. In a ServiceInterface, both the service provider and the service user have responsibilities of exchanging messages and events for example. A choreography representation is always coupled to this type of service representation. Fig. 3.13 shows a ServiceInterface (Place order service), which represents a service, with two participants: a dealer (service consumer) and a manufacturer (service provider). The role of the provider is being an order taker whether the role of the consumer is being an order placer. The operations and signals which an order taker and an order placer can receive are mentioned in the boxes pointed by the dotted arrows. The dealer and the manufacturer have each a port named ‘Place order service’ indicating the service. The manufacturer is the provider and has a ‘Service’ port whether the dealer is the user and has a ‘Request’ port. The port of the manufacturer requires the ‘Order placer’ interface and delivers the ‘Order taker’ interface. Consequently, the port of the dealer requires the ‘Order taker’ interface and delivers the ‘Order placer’ interface. The ports are thus compatible. Also other ports are shown on the participants which means that each participant can provide and use multiple services.

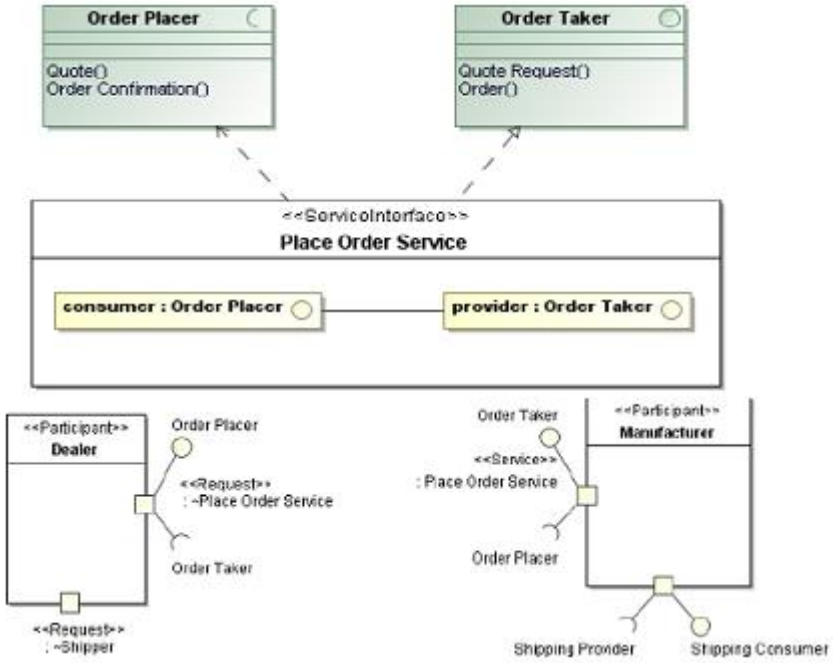

Fig. 3.13 'Place order service' provision. The manufacturer is the service provider and the dealer is the service consumer. The role of the manufacturer is an order taker and the role of the dealer is an order placer. The 'Request' port of the dealer participant and the 'Service' port of the manufacturer participant are compatible. Operations and signals which are received by the participants are shown in the two boxes pointed by the dotted arrows.

As already mentioned, a ServiceInterface is also meant to deal with a choreography representation among the participants. Operations and signals which participants of a service receive are already shown in Fig. 3.13 but it is better to show a real choreography in order to be able to see which communications are exchanged when and in which sequence. This communication choreography is shown in Fig. 3.14.

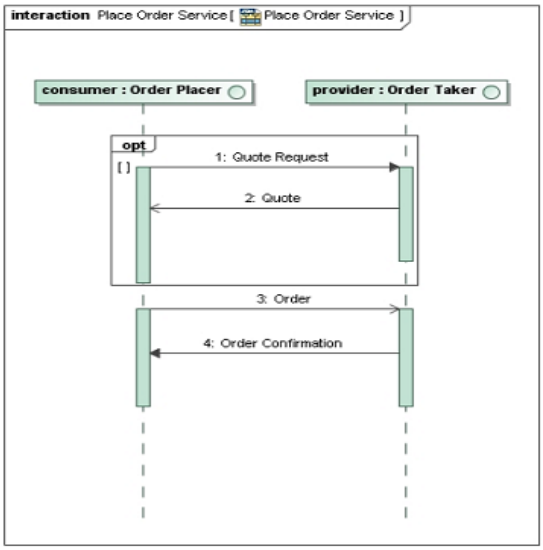

Fig. 3.14 Service choreography. Shown are the communications sent and received by the two participants, the order placer and the order taker.

The previous discussions about service modeling always included one service provider and one service consumer. It is however possible that more than two parties are involved in a certain service exchange. Then, Fig. 3.13 will contain multiple participants and Fig. 3.14 will show a choreography interaction among multiple participants too.

Now that the notation language for single services between two participants is described, it is wise to further think about some kind of notation to describe a more complete 'Service Oriented Architecture' view. The purpose is to visualize a kind of network in which different participants work together and provide services to reach business goals. So in fact, one can talk about a collaboration among different participants, which can be people, organizations or systems. This collaboration must show the 'SOA' of some organization, community, etc.

Fig. 3.15 'Service Oriented Architecture' network UML collaboration among participants. A purchasing service between a dealer and a manufacturer, a shipping service between a manufacturer and a shipper and a shipping status service between a shipper and a dealer exist.

Fig. 3.15 shows a 'SOA' for a community including a dealer participant, a manufacturer participant and a shipper participant. Three kinds of services are represented: a purchasing service between the dealer and the manufacturer, a shipping service between the manufacturer and the shipper and a ship status service among the shipper and the dealer. The individual services can all be represented as discussed before in this section. The 'SOA' overview in Fig. 3.15 is in fact a low detail level representation in order to show and easily understand a network of services. It is also a good tool in order to show dependencies among services.

In order to provide a certain service to a service consumer, the service provider must have the necessary capabilities present. Such capabilities can be represented in a capability hierarchy overview, as represented in Fig. 3.16. Fig. 3.16 represents an order processing service. One can see that for the order processing, capabilities are needed such as for example invoicing and inventory management. Each capability can be further split up into sub-capabilities in order to show the highest detail level of capabilities which are needed to execute a service. Inventory management can for example be split up into time management and spatial management (not shown in Fig. 3.16).

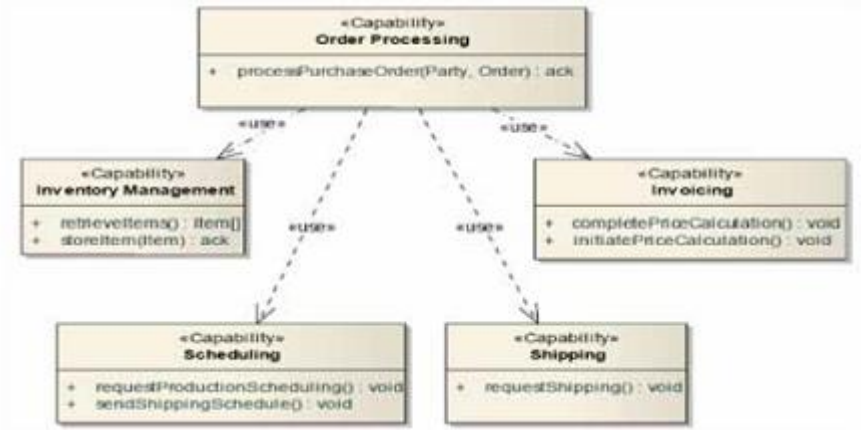

Fig. 3.16 Service capability hierarchy. Shown is a hierarchy of capabilities which are needed in order to execute an order processing service. Each capability can be further specialized into refined and more specific sub-capabilities.

3.8.5 SoaML relationship towards BPMN and CMMN

At this point of discussion, it is important to relate the SoaML discussion to the previously held discussions about BPMN and CMMN. SoaML is a good tool to show 'Service Oriented Architecture' networks and communities. Each service of those networks can be clarified using UML language giving rise to a clear definition of the services' participants (users and providers), their roles, the choreography among these participants and of the needed capabilities to execute these services.

However, the deepest detail level of SoaML seems to stop at the choreography level, the supposed interaction pattern between participants. Whether these participants are people, organizations or systems and whether they are internal to a company or cross boundary, a process can be defined that describes the working pattern of a participant. A further division can be made concerning the fact whether the participants' processes are repeatable processes or case processes, leading to a BPMN notation or a CMMN notation respectively.

Summarizing, SoaML provides an interesting notation for a rather low operational detail level insight into services which are active in a 'SOA' environment. However, in order to obtain a more detailed level insight into the services of which a 'SOA' is built, BPMN will be used to describe clear processes whether CMMN will be used to describe specific case processes. Thus, SoaML is a pure complementary business modeling tool towards BPMN and CMMN, which is good.

4. Organizational business modeling

This part of the thesis study is meant to focus on different types of organizations and the different business modeling tools which are applicable to them. Those applicable business modeling tools per organization type will be investigated on their business model functions' covering and adapted when needed in order to reach a full business model functions' covering per organization type. Furthermore, duplicated information will be eliminated among the different modeling tools when present. The goal of this section is to reach for a theoretical framework of complementary business modeling tools per organization type.

4.1 Organizational types

A first important thing to do when searching for different organization types is selecting the differentiation criteria which will lead to those different types and which are valid criteria within the context of this thesis study. A first criterion is whether an organization delivers products or services (or both). Regardless of whether products and/or services are being provided to customers, a second criterion exists. Products and services within an organization can both exist in repeatable processes, in case processes or in both of them.

Table 4.1 Possible organization types for organization 'X'. Differentiation criteria are based on whether the organization delivers products or services and whether they are executed in repeatable processes or not.

		Repeatable
	Products	Cases
		Repeatable + cases
		Repeatable
	Services	Cases
		Repeatable + cases
Organization 'X'		
		Repeatable
		Cases
		Rep. products, case services
		Rep. services, case products
	Products + services	Rep. + case products, rep. services
		Rep. + case services, rep. products
		Rep. + case products, case services
		Rep. + case services, case products
		Rep. + case products and services

Table 4.1 gives an overview of the different organization types, based on the differentiation criteria. One can see that these criteria lead to the existence of fifteen different organization types.

4.2 Applicable business modeling tools

Now that the different organizational types, within the context of this thesis study, are specified, the next step to do is the linking of applicable business modeling tools to these organizational types. These business modeling tools were described under '3. Business modeling tools'. Table 4.2 gives an overview of the business modeling tools per organization type. Note that not all fifteen organizational types are represented separately for simplicity but that the table provides a 'lane view' such that the reader can combine the four lanes in order to reach all fifteen possibilities which are represented in table 4.1.

Table 4.2 Applicable business modeling tools per organization type. The eight modeling tools, described under '3. Business modeling tools', are divided among the different organizational types.

Firm 'X'			
Products		**Services**	
Repeatable (lane 1)	**Cases** (lane 2)	**Repeatable** (lane 3)	**Cases** (lane 4)
Value proposition	Value proposition	Value proposition	Value proposition
Organizational modeling	Organizational modeling	Organizational modeling	Organizational modeling
Context pyramid	Context pyramid	Context pyramid	Context pyramid
BIM	BIM	BIM	BIM
VDML	VDML	VDML	VDML
BPMN	-	BPMN	-
-	CMMN	-	CMMN
SoaML	SoaML	SoaML	SoaML

The strangest thing on the first sight in table 4.2 might be the presence of the SoaML modeling tool for organizations which deliver products. An organization which delivers services can use SoaML in order to describe the services it provides to its customers. So one could think that SoaML is no appropriate modeling tool for organizations handling products. One should not forget that SoaML can also be used in order to describe services that a company uses from external service providers. A product producing company can for example use some external services in order to produce its products. Therefore, SoaML might also be a good modeling tool for those companies since 'Service Oriented Architecture' networks can be represented.

However, the discussion of whether SoaML should be used in product producing companies is of little importance in that sense that services are always used in such companies. External services can be absent (however this is very rare) but internal company services always exist. Internal services are for example services provided by internal IT system participants and used by other internal IT system participants. So services always exist in such companies and SoaML should always be used when modeling a complete business. However, if one doesn't want to model a business in its deepest details, SoaML can be avoided in these companies. It all depends upon the level of detail one wants to model.

4.3 Business model functions' covering analysis

This section investigates the degree in which the business modeling tools, presented in table 4.2, cover all business model functions. This investigation will be done through describing the business model functions, put forward in '1.2 Functions', as an integrated entity and linking the different modeling tools to the applicable functions.

It is wise to start the discussion with the central concept of every organization: value. Value propositions towards analyzed market segments are the key issues in every organization since they position and differentiate products and services from those of competitive entities, if any. These value promises are set up by the value proposition modeling tool which is applicable to any type of firm, as can be seen in table 4.2. However, also the VDML modeling tool covers the value proposition and is applicable to any type of organization, as stated in the next paragraph.

The value creation and delivery towards customers happen through the functioning of the value chain. This chain is a set of business functions which each add value to a product or service. This chain is a good model in order to investigate a firm's activities but it is no single truth version of reality since it represents a single direction flow of products, services, information, etc. from suppliers to the firm to the customers. In reality, a firm operates in a value network where all its stakeholders are present and interact with the firm via flows in all possible directions. The value network co-determines the value creation from and the value capturing by the firm of interest. A company's value chain and the presence of this value chain within a more holistic value network are handled by the VDML modeling tool which is widely applicable for all type of organizations. VDML starts with describing the value concepts towards customers but also towards stakeholders since this modeling tool recognizes the presence of the company's value chain(s) within a bigger value influencing network. All activities which create and deliver these value forms are also recognized by VDML, in fact leading to the different value chain activities and sub-activities. For each activity, VDML sets up a capability model including the necessary facilities, resources, knowledge, etc. to be able to perform these activities. The capability model further indicates whether outsourcing is applicable when in-house capabilities are poor. Similar capabilities can be present among multiple value chains or among different activities within the same value chains. VDML focuses on merging similar capabilities (capability consolidation) if possible which leads to advantages such as fastened learning curve effects. A next important feature of VDML is measuring the difference between the values actually delivered and the expected values to be delivered. Focusing on perceived value gaps and restoring them continually puts the focus on the central idea of VDML: value. Cost drivers related to the different recognized value chain activities are also listed to help framing and influencing profit potentials. Furthermore, VDML executes a risk analysis on each value chain and on the value network where it is present in. This risk analysis focuses on critical occurrences which can negatively influence the value delivery and capturing (single source suppliers, critical machines). Last, internal and external collaborations among people, machines, systems (participants) are described by VDML in order to indicate the collaborations which execute the value chain activities and which are present within the value influencing network. Summarizing, VDML is a widely applicable modeling tool for all organizations, which truly covers the most important aspects about value delivery and value capturing.

The detail level of VDML however stops when it comes to describing the processes and their participants within the recognized value chain activities and the processes and their participants present in the value network. This is the point where BPMN and CMMN take over. BPMN will describe repeatable processes which are clear in advance of process execution whether CMMN is meant to deal with case processes which are modeled at runtime of the case process. BPMN and CMMN can each work at three levels of abstraction. The strategic level just mentions the core, support and management processes within a business ecosystem of stakeholders. A tactical level describes each process in an abstract way (what is done) whether the operational level focuses on concrete process execution (how it is done). In BPMN, all three levels of abstraction can be modeled in advance. In CMMN however, the tactical level and certainly the operational level are modeled at process runtime. Concluding, BPMN and CMMN are pure complementary business modeling tools towards VDML.

These business processes and their participants can also be visualized using the organizational business modeling tool which is evolved towards a process oriented visualization. However, the organizational business modeling tool only mentions the different business processes and their participants, but gives no information about operational execution details. A pure business domain and hierarchy structure can also be visualized by the organizational modeling tool. Organizational modeling can be applied to all types of organizations.

As already mentioned, VDML can discover outsourcing service possibilities through making up capability maps. But services can also be internal to the company and being delivered among internal company entities. Furthermore, a company can deliver services outwards. Whether services are internal or external to a company, they can be represented in a 'Service Oriented Architecture'. SOAs represent services among people, organizations and systems in a true holistic way. The SoaML modeling tool can be used to describe these service networks and the individual service characteristics. However, SoaML stops at the detail level of choreography representation among service providers and service consumers. The service processes themselves should be described using BPMN or CMMN, depending upon the service repeatability. In that way, SoaML is pure complementary towards BPMN and CMMN.

The whole story of value chains and value networks should be correctly aligned with a vision, mission and strategy definition to frame the context wherein the value chains and value networks operate. This can be achieved using a business context pyramid modeling tool, which is applicable for all types of organizations. The strategy part (together with goals and objectives) is a concrete action plan how to operate the business regarding to resource deployments, competitive advantages, value network interpretations, profit making, etc. Recognizing a value chain and value network is not enough, one needs to plan for it too.

One last business modeling tool remains not discussed: BIM. This is due to the fact that a business information model doesn't apply to specific business model functions. It is more general overview of important relationships among core business entities. However, this doesn't mean that a business information model isn't useful. One can use it as being a small business model for as well outsiders as

insiders in order to quickly understand core business relationships and entities. Beside the other more complex business modeling tools, this simple overview can be very useful.

Summarizing, all important business model functions, described under '1.2 Functions', are covered deeply enough by the business modeling tools represented in table 4.2. The next step in the discussion is to search for duplicated information among the different modeling tools and to remove that duplicated information in order to reach a full complementary set of business modeling tools per organization type. However, first a little note about the previous statement in this paragraph 'business model functions are covered deeply enough' will be presented.

4.4 Business modeling tools' adaptations

As was explained under '4.3 Business model functions' covering analysis', all business model functions can be covered deeply enough by the tools described in table 4.2 so no adaptations are needed in order to change certain modeling tools to cover more business model functions. However, this statement deserves a little discussion.

As is represented in Fig. 4.1, a firm can be seen as being a continuous entity in reality. However, people make subdivisions in an organization since they can't capture the complete organization's behavior at once. This phenomenon leads to the creation of different separate modeling tools which each describe different parts of an organization. The goal of these tools is that they together represent a complete business model of an organization but this is never reached since one uses discontinuous modeling tools in order to model a continuous entity.

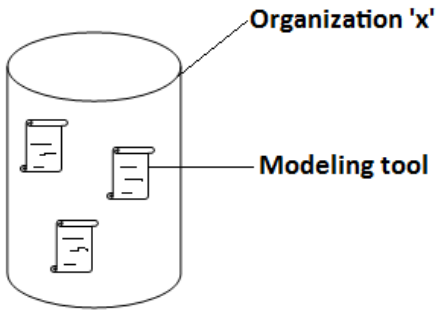

Fig. 4.1 Discontinuous business modeling for organization 'X'. Different modeling tools are used to model different parts of an organization but since an organization is a continuous entity, no single tool or set of modeling tools is capable to model the complete business in every detail.

Therefore, one continuously improves business modeling by searching for new tools which fill the gaps between the existing discontinuous tools and the real life continuous business. The 'Object Management Group' describes many more modeling tools than those covered in this thesis study (Business Motivation Model, Business Process Maturity Model, Knowledge Discovery Metamodel,…) to cover the gaps. However, no matter how many modeling tools are being created, they will never capture the business as a continuous entity.

So, stating that no adaptations are needed to the modeling tools presented in table 4.2 is a little bit too short to say. One can state the following idea: or no adaptations are needed to these modeling tools since one is satisfied with the detail level of their modeling capacity or one should adapt them until the point of detail level is reached which one wants to model. A perfect detail level, however, will never be reached.

The goal of this thesis is to understand a set of complementary modeling tools which model a business at different points of interest. The goal is not to purify these modeling tools into the deepest possible details. The strength of discontinuous business modeling tools is the fact that they are discontinuous and that they focus only on a certain part of business. This fact makes business modeling understandable. So discontinuity is also an advantage, not a restriction in itself.

4.5 Duplicated information

This section investigates whether there is duplicated information present among the business modeling tools presented in table 4.2 and whether some modeling tools are superfluous.

A first information representation to think about is the value proposition. The value proposition method was used in order to describe the value proposition towards customers. However, VDML describes value propositions towards both customers and other stakeholders since it recognizes a complete value network. So in fact, VDML encompasses all value propositions and the value proposition method can be neglected.

Secondly, organizational modeling was used in order to mention existing processes and their participants. However, the mentioning of processes is also covered by the strategic ecosystem of BPMN and CMMN, which in fact gives a better representation by making divisions among core, support and management processes. The participants which execute these processes are also stated by BPMN's and CMMN's operational levels and by collaboration definitions in VDML. Furthermore, VDML collaborations can also include external business participants (for example useful for case processes). So the organizational modeling tool brings no real advantage, unless a pure business hierarchy is needed to be represented. The organizational modeling tool will continue to be used in this thesis, but only as a pure hierarchical modeling tool, not as a business process representation tool.

Next, collaborations and roles among participants are shown in VDML, BPMN and CMMN models. However, this is no real duplicated information since differentiation exists. Collaborations and roles in BPMN and CMMN are necessary in order to know which participants execute which tasks. VDML adds an additional perspective to these collaborations and roles since it can define cross boundary collaborations with other stakeholders. BPMN and CMMN will define external processes as black boxes but it is still useful to know with whom one is interacting when working together with external stakeholders. That is where the value of VDML collaborations arises. Clear cross boundary collaborations, sub-collaborations and roles can be defined whereas this is less present in BPMN and CMMN.

4.6 Theoretical framework

Given the previous discussions about adaptations and duplications regarding the business modeling tools presented in table 4.2, table 4.3 presents the final adapted framework view on business modeling through stating complementary sets of business modeling tools per organization type. This is the framework one can use in order to model an organization's behavior, to plan or to innovate.

Table 4.3 Theoretical business modeling tools' framework. For every type of business, the proposed set of business modeling tools is a fully complementary one.

Firm 'X'			
Products		**Services**	
Repeatable (lane 1)	**Cases** (lane 2)	**Repeatable** (lane 3)	**Cases** (lane 4)
Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)
Context pyramid	Context pyramid	Context pyramid	Context pyramid
BIM	BIM	BIM	BIM
VDML	VDML	VDML	VDML
BPMN	-	BPMN	-
-	CMMN	-	CMMN
SoaML	SoaML	SoaML	SoaML

As was already said under '4.4 Business modeling tools' adaptations', completely modeling a continuous business is in fact impossible. However, a good theoretical representation exists in order to know where modeling tools can be discovered in an enterprise. This representation is the architectural framework of John Zachman, represented in Fig. 4.2. The idea of the framework is to represent a complex entity, such as an enterprise for example, by a matrix of individual sub-components. Since a human's mind is too poor to understand it at once, the sub-components should help to get an integrated understanding of that complex entity. Furthermore, the architectural framework allows people to look at an enterprise from different viewpoints (abstraction levels). The matrix is formed by combining two dimensions: interrogatives in columns (why, who, when, how, what and where) and a set of different perspectives (abstraction levels) in rows.

Even when each different matrix cell of the architectural framework could be modeled by a certain business modeling tool, the business is not modeled completely since that business model would consist of separate discontinuous business modeling tools and no continuous view would exist. However, if one could fully describe the architectural framework by using complementary modeling tools, a good business model would have been set up.

An interesting exercise is to check the degree in which the business modeling tools of the framework in table 4.3 cover the sub-components of the architectural framework of John Zachman. In fact, this is no simple thing to do since it is hard to define where one draws certain boundaries. BPMN covers for example process modeling but does BPMN deliver enough details in order to know how to exactly

execute those processes? Even operational models can be abstract in some or multiple ways! So the 'how' column of the architectural framework is certainly dealt with for example but the perspectives specified in the different rows are less obvious. This discussion is also valid for the other columns and rows.

	Why	How	What	Who	Where	When
Contextual	Goal List	Process List	Material List	Organisational Unit & Role List	Geographical Locations List	Event List
Conceptual	Goal Relationship	Process Model	Entity Relationship Model	Organisational Unit & Role Relationship Model	Locations Model	Event Model
Logical	Rules Diagram	Process Diagram	Data Model Diagram	Role Relationship Diagram	Locations Diagram	Event Diagram
Physical	Rules Specification	Process Function Specification	Data Entity Specification	Role Specification	Location Specification	Event Specification
Detailed	Rules Details	Process Details	Data Details	Role Details	Location Details	Event Details

Fig. 4.2 Architectural framework of John Zachman. Individual sub-components are used in order to describe any complex entity such as for example an organization or an airplane. The matrix consists of columns (interrogatives) and rows (perspectives). [19]

The most important thing to state is that the different business modeling tools of table 4.3 certainly cover the columns of the architectural framework of John Zachman. The rows or abstraction levels are maybe not fully covered but this is in fact also a cultural decision within a company. A complete model should provide multiple detail abstraction levels. However, company culture can state that two or three abstraction levels are enough for the business model users.

Summarizing, table 4.3 provides a complementary set of business modeling tools per organization type. Each set of modeling tools covers the architectural framework of Zachman sufficiently. The amount of detail abstraction levels is a cultural issue for the company and the modeling tools at hand can certainly be used to model business entities at different abstraction levels.

5. Business model planning

In this section about business model planning, different planning techniques will be analyzed which are suitable to be used by executives and other knowledgeable business people in order to plan for business evolution. One should remark that business model planning is placed within the strategy part of the business context pyramid, shown in Fig. 3.1. These planning techniques thus logically further influence business goals and business objectives. The link towards business modeling techniques is that these planning techniques shape the strategy of a business. When the business' strategy is adapted, adaptations in value chains and value networks are logically needed and thus VDML models need to be adapted. Since the complementary modeling tools BPMN and CMMN (complementary towards VDML and towards each other) show processes more detailed than VDML does, these BPMN and CMMN process models possibly need to be adapted too when the strategy is adapted through using planning techniques. When strategic planning issues lead to a change in internal or external business services, also SoaML models should be adapted. Thus, one can see that adapting a strategy by using strategic planning techniques leads to adaptations in VDML models and also in BPMN, CMMN and SoaML models, depending upon whether repeatable or case processes need to be reshaped and whether services are reshaped.

These strategic business planning techniques are rather abstract frameworks which can be interpreted at different detail levels so that they should provide useful information to all kinds of users of business planning techniques. Rather than being single truth versions of strategic business planning, they provide useful guidance mechanisms for strategic planning issues.

The planning techniques which are discussed in this section however come from strategic IT planning considerations, rather than from complete strategic business planning ideas. However, most of these techniques are not only applicable to IT issues but can be widely used for integrated strategic business planning. The different strategic business model planning techniques can be combined in all possible combinations in order to reach for valuable business planning ideas. No single technique is better than other ones, although it is true that some techniques are more suitable for certain purposes than others. Choosing among business model planning techniques and drawing useful combinations of them is again a business culture issue.

The eight planning techniques which will be discussed in this section are [20]:

- Critical success factors
- Three emerging forces
- Competitive forces
- Value chain analysis
- Stages of growth
- E-business value matrix
- Linkage analysis
- Scenario planning

5.1 Critical success factors

‘Critical success factors’ are the key critical entities of a business that must go right so that the organization will flourish. One can state that every entity in an enterprise is a key element in order to deliver value propositions but some elements are way more important or critical for the business to flourish. Knowledgeable business people generally use at most ten critical business success factors. Using higher amounts of critical success factors shows the lack of recognizing very critical elements in the business environment and will raise the complexity of the critical success factors planning technique.

The technique in itself consists of recognizing these critical success factors and using them as central concepts around which the planning of value chains and value networks should arise. Critical success factors are however no inert phenomena which reside valid for success in the future business environment. Reconsidering critical success factors is necessary in order to recognize the real success factors which are valid for the moment of planning. Critical success factors can and do surely vary from industry to industry, from organization to organization, from time to time and even from executive to executive.

Rockart identifies three main possible sources in order to discover these critical business success factors: the industry in which the company is active, the company itself (internal business environment) and the external business environment (politics, economy, etc.).

5.2 Three emerging forces

A second strategic planning technique consists of looking to three emerging business forces, as presented by Downes: digitalization, globalization and deregulation. These emerging forces can be used in order to adapt value chains and value networks and thus also the business model.

In all industries, digitalization is used in order to rethink businesses and to create competitive advantages. Computer supported supply chains were for example used to launch online stores which shifted the basis of competition.

Globalization deals with the continuous cost and speed improvement of telecommunications and logistics, making a global trade market possible. So considering the globalization idea, one can for example plan a value network in which the most interesting global partners are present. Focusing value chains and value networks on local entities is mostly no longer relevant anymore.

Over time, governmental control over trade decreased. This deregulation makes it possible for firms to be present anywhere at any time. Reconsidering value chains and value networks with this idea in mind, can lead to increased profits.

5.3 Competitive forces

Porter describes five competitive forces which firms need to or can have to deal with. A first competitive force is the appearing of new entrants in an industry, such as for example the entrance of new book shops in the book industry.

A second competitive force is the bargaining power of buyers. The Internet makes it possible for buyers to search for multiple suppliers and to quickly search for best prices and qualities. This increases the bargaining power of buyers.

A third force is the bargaining power of suppliers. The Internet makes it possible for rather small companies to compete with larger ones through bidding issues for example.

A fourth competitive force are substitute products and services. Online music shops for example deliver substitute products for common music stores.

The fifth and last competitive force is described by the intensity of rivalry among competitors. Rivalry among competitors is for instance different when they are competing as separated firm entities than when they work partially together in an alliance-based competition where they compete together towards other alliances.

Porter further describes three strategies which an organization can use in order to cope with these five competitive forces: differentiation, lowest cost production and niche products/services. Differentiating products and services removes competition by a certain degree. If one chooses to be the lowest cost producer, competitors are faced by providing low selling prices. Niche products and services provide high levels of differentiation and, if they are the only products or services available in the niche market, are produced at lowest production cost. These three strategies can thus be used in order to manage competitive forces and to build up value chains and value networks efficiently.

5.4 Value chain analysis

Another strategic planning technique to think about in order to adapt the value creating environment within a firm is looking to the value chains themselves. As presented in Fig. 1.1, the value chain of Porter consists of five sequential primary and four supporting activities.

A firm can discover value improvement possibilities for products and services by analyzing how the current primary and supporting activities are being performed. These value improvements can, beside internal solutions, also be reached through outsourcing certain activities to external partners. Outsourcing certain activities deals with looking at two factors: value and focus. Outsourcing is interesting when others can deliver the same activity at higher value (lower cost and/or better quality). But outsourcing can also be interesting to do when the outsourced activity lies not within the focus of the outsourcing company. Then, internal employee hours are saved which can be used to improve internal core activities for example.

5.5 Stages of growth

The introduction of a new information technology within a firm leads to four sequential steps through which the company goes. These four steps were developed by Nolan and Gibson. The value of recognizing these steps is to understand the phase in which a firm's technology currently resides in order to understand the degree in which the learning curve has been passed through. A learning curve represents the cost and time decrease to do a job based on a technology as a function of time or, in other words, the learning increase over time. Both the time and cost to do a job will get lower over time due to the fact that learning increases. This is represented in Fig. 5.1. Since learning effects eventually stop, also the cost and time do a job will stop to decrease.

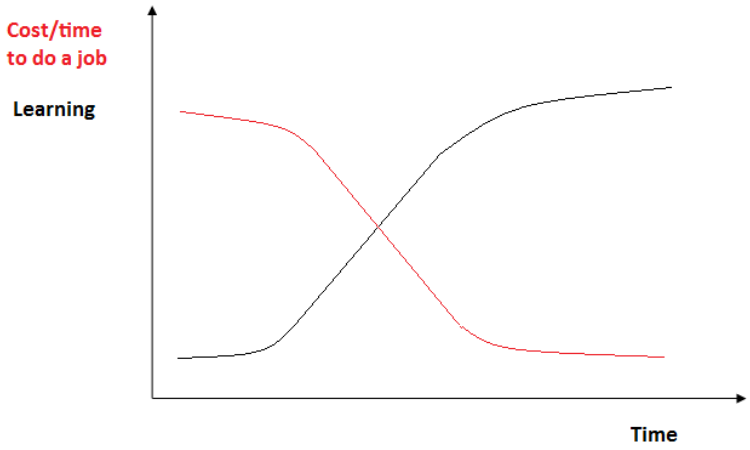

Fig. 5.1 Learning curve. Both the time and cost to execute a certain job, which is based on a technology, will decrease over time since one learns how to use the technology efficiently. Thus, the learning increases over time until everything about the new technology is known. There cost and time to do a job will go flat also. The curving characteristics of the curves are situation dependent.

The four sequential stages of growth are:

i. Early success
ii. Contagion
iii. Control
iv. Integration

During the first stage, early success, the technology is initiated and a lot of problems occur in using the new information technology but interest in experimentation rises due to early success of the new technology. Learning is low, which explains the initial flat curves in Fig. 5.1.

The second stage, contagion, is characterized by using the information technology in several ways due to the early success. The new information technology is used in different applications. Experimentation and trial-and-error are key elements here. Learning effects are reached.

During the third stage, control, a standard is made by deciding how the firm wants to use the new information technology. It is getting clear that the new technology will only be suitable to be used in certain applications. Learning is further gone through.

The last stage, integration, points to the fact that the new information technology is implemented in its final form. Learning effects are mostly heavily played out which explains the flat end of the curves in Fig. 5.1.

Summarizing, recognizing the stages of growth of a new information technology and their relationship towards learning curves, gives one interesting possibilities towards strategic planning issues since one recognizes the life cycle of an information technology and one can efficiently plan for it in the value chain and the value network.

5.6 E-business value matrix

Beside the stages of growth, which was especially meant for strategic information technology planning, this planning technique is also meant for strategic IT planning but it can be extended beyond IT for sure too.

The idea of this planning technique is that every company project can be placed into one out of four categories. These categories are based on two factors: the criticality of the project to the business and the newness of the project to the world. Table 5.1 shows the different business project categories, based on these two factors.

Table 5.1 Business project categories. The four categories are defined making use of two differentiation criteria: the criticality of the project to the business and the newness of the project to the world.

	Criticality to business	**Newness of project (to the world)**
New fundamentals	low	low
Operational excellence	high	low
Rational experimentation	low	high
Breakthrough strategy	high	high

The idea of this category separation is to make sure that a company uses a well balanced project portfolio. New fundamentals are projects which introduce a fundamentally new way of working in areas which are not critical to the business. Increasing the business productivity at low risk is key here. These projects are not new to the world. A good example here is the introduction of a new ERP system in a product producing company.

Projects which belong to the operational excellence type are neither new to the world but are very critical to the business. An example here is the implementation of improved laser cutting machines in steel industry to increase customer satisfaction for quality. Risks are medium.

Rational experimentations are projects which are meant to test new ideas. If these projects fail, this is no disaster since they were only meant as being experimentations. If they succeed however, competitive advantages can be set up. An example here is the experimentation of selling bread online. The baker undergoes low risk in such project but when it succeeds, a new market can pop up which increases the baker's profits.

Finally, a breakthrough strategy is a project which is as well critical for the business and has a high level of newness to the world. This is for example the case when one sets up a complete new type of business with complete new types of assets. Here, one invents projects which are critical for the business to operate and which no one else ever invented.
A well balanced project portfolio should always contain new fundamentals, operational excellences and rational experimentations. Breakthrough strategies are also good but are however very difficult to realize. Therefore, they are certainly not always present in a well balanced project portfolio.

Regarding to the topic of this section, strategic planning, one should have a well balanced project portfolio in order to spread project risks and to have a clear view where in the value chain and value network these projects should be planned and managed.

5.7 Linkage analysis

Linkage analysis planning is a strategic planning technique in order to discover the links between the firm of interest and its different stakeholders in the value network. The goal is to create electronic information channels between them and thus increasing the efficiency of their information sharing. Such linkage analysis planning techniques show where in the company's value chain adaptations can be made in order to improve information sharing.

5.8 Scenario planning

The last strategic planning technique, scenario planning, aims to build up different plausible future scenarios and to recognize the different forces that will lead to these scenarios. Given these forces and their scenarios, a firm can recognize when these forces arise and then take actions in order to cope with the future scenario. So the goal of scenario planning is not to predict the future in advance but to recognize forces that will lead to different plausible future scenarios.

Given these plausible future scenarios, one should implement enough strategic planning issues in the firm's strategy in order to be able to cope with all different plausible scenarios and to adapt the value chain and value network where needed when these forces materialize.

Summarizing this section about business model planning, different strategic planning techniques exist which one can think about in order to build up a strategy. These different planning techniques can and should certainly be combined in order to build up a strategy which covers different areas and concepts. Changes in strategy will lead to adaptations in VDML, BPMN, CMMN and SoaML models.

6. Business model innovation

This part describes the way in which organizations can innovate their current business models in order to withstand and be profitable in current and future business environments.

In some sense, innovating a business model is the same thing as planning for business model evolution. Thus, similarities should exist between business model innovation and the earlier dealt chapter '5. Business model planning'. Indeed, business model innovation can be done through thinking about some theoretical frameworks which can nurture innovation. Good frameworks were already given under '5. Business model planning'. Innovators can for example think about critical success factors, digitalization, globalization, deregulation, competitive forces, value chain structures, IT's stages of growth, portfolio planning, linkage analysis planning and scenario planning in order to reach valuable innovative ideas for the organization of interest and to reshape VDML, BPMN, CMMN and SoaML models.

6.1 Open and closed innovation

However, innovating a business model deserves a broader discussion than just providing theoretical frameworks which can nurture innovation. The traditional way of looking towards innovating a business model was about looking internally how an organization could innovate its business operations and structures by using internal assets and knowledge. This is somewhat the definition of closed innovation. Beside closed innovation, logically open innovation also exists and represents the current more holistic view of innovating business models. Since knowledge is becoming more and more distributed, companies don't have the best specialists in-house anymore. If they have these people anyway, tomorrow other and better specialists can pop up in other organizations. That is why open innovation is crucial: knowledge should be exploited in an external company view too. Open innovation can be further split up into inside-out open innovation and outside-in open innovation. Inside-out open innovation means pushing internal knowledge and/or assets to external companies for their innovation issues whether outside-in open innovation means using external knowledge and/or assets for internal company innovation.

Open and closed innovation can both be used in all different primary and supporting activities within the value chain of Michael Porter. The main purpose of innovation, whether being open or closed, is to deliver more valuable value propositions and to capture profit margins more effectively.

Now that open and closed innovation are explained, a framework can be established which gives an overview of the existence of six types of business models. As already explained under '1.3 Value proposition', open and closed business models exist. In a closed business model, the company creates the customer value totally on its own. This is for example the case for bakeries where bread is baked in-house. In an open business model, the customer value depends on other companies too. The value of mobile phones does not only depend upon the quality of the phone itself but also on the applications which are developed by external companies.

Table 6.1 shows the six possible business models, based on whether a company uses open innovation (inside-out or outside-in) or closed innovation and whether the company uses a closed business model or an open one. It is certainly possible that a company uses both open and closed innovation and that it has as well a closed business model as an open one. This is explained by the fact that a company can have several different value chains for different products and services.

Table 6.1 Different business model types. Differentiation criteria are based upon whether the business uses open or closed business models and whether it innovates in an open or in a closed way.

		Innovation		
		Inside-out (open)	**Outside-in (open)**	**Closed**
Business model	**Open**	Type 1	Type 2	Type 3
	Closed	Type 4	Type 5	Type 6

Open outside-in innovation does not necessarily mean that assets or knowledge of external companies are used in order to innovate the internal business. Three other open innovation practices exist:

- Lead-user innovation
- Crowd sourcing
- Free revealing

Lead-user innovation is innovation whereby certain customers are the drivers of the innovation practice. A lead-user has a high incentive to solve a problem and is ahead of the target market. A lead-user can be both a company or an individual. Lead-users are however not the same as early adopters. Lead-user innovation is done through a lead-user study where lead-users and (company) experts are brought together in workshops to create the innovative breakthrough.

Crowd sourcing means that a firm broadcasts a problem for innovation, mostly through the Internet. The problem is thus distributed and others (individuals or companies) solve the innovation problem or improve an existing solution to that problem.

Free revealing means that a company voluntary distributes its intellectual property so that others (individuals or companies) build further on that property. This speeds up innovation since companies are not working in parallel on the same innovation issues but are continuously working further on existing solutions. Open-source software is an example of free revealing.

6.2 Open service innovation

As already explained in multiple parts in this business model study, in order to remain competitive, companies should choose among three cultural strategies: differentiation, lowest cost and niche markets. However, copycats are present in the business environment more than ever. This means that differentiated products/services and lowest cost production techniques will be copied (patents are not valid forever). Also niche markets will become competitive markets when they seem to be enormously

profitable. So competitive advantages are restricted in time and one should think about innovation in a broader sense.

The basis of competition is changing over time. Since products are more and more copied and producing at lowest cost has become more and more difficult, a firm has to wrap services around their products which support them in order to remain competitive. Even these supporting services can be copied by competitors, so it is necessary to implement an open service innovation around products and services. Innovating in (supporting) services is somewhat the escape route towards the hard current competitive environment. The word 'open' in open service innovation points to the involving of customers in the service innovation. A good example to prove this phenomenon is the Xerox example. Whereas Xerox always focused on improving the printing technology, it has to focus on supporting services too nowadays since the printing technology has become a standard. Beside the standard printing products (which have true competitors), Xerox also provides document services and it innovates these document services in an open (customer involvement) way.

In order to remain competitive in the current business environment, a firm should generally best follow the next advices:

- If a firm provides products, it can best think to wrap services around these products
- Involve customers to co-create open innovation, regardless of the value delivering (products/services/products + supporting services), in order to build up new experiences that customers will value and pay for
- Try to build up a simple IT platform where customers can easily add solutions to problems and propose new ideas so that they are easily involved and stimulated to innovate in an open way current products and (supporting) services

Summarizing this chapter about business model innovations, firms are more and more shifting towards open innovation since knowledge is more and more distributed. Furthermore, remaining competitive is more and more done through involving customers to innovate products and services in an open way since the basis of competition is changing.

7. Conclusion

This part will focus on extracting a clear conclusion, based on the information given in all previous chapters. Furthermore, answers to the seven sub-questions, derived from the general problem statement, and to the problem statement itself will be formulated.

The objective of this thesis is to support firms in setting up a business model through providing each type of firm with a theoretical framework of complementary business modeling tools or business architecture sub-disciplines. Thus the problem statement of this thesis logically sounds: 'How does one set up an integrated business model for a specific type of organization?'. The seven derived sub-questions are:

1. What are the six business model functions really about?
2. What is the meaning of each of the eight business modeling tools and how do they work?
3. What types of organizations exist?
4. Which business modeling tools apply for all organizations?
5. Which business modeling tools are organization-type-specific?
6. Do the business modeling tools which are available for each type of organization fully cover the six business model functions? If no, can the existing business modeling tools for a certain type of organization be adapted to truly cover all six business functions and how?
7. Given the (possibly adapted) business modeling tools for each type of organization, are there multiple versions of the same information present among the different tools that can be filtered out in order to reach a full complementary business model without duplications?

Although these seven sub-questions were answered sequentially in the thesis in order to find the answer to the general problem statement, they won't be answered sequentially here because of readability reasons.

A business model encompasses six different functions. Value propositions (I) towards customers and stakeholders are the key elements within a business model. These customers are carefully targeted by market segmentation methods (II). Value chains (III) and value network (IV) representations show the structure of the firm and its business environment in order to show how value delivering and capturing are realized. Costs also need to be recognized in order to know how revenue streams can create business profits (V). A well structured strategy should deliver the context wherein all previous concepts take place (VI). (answer to sub-question 1)

Table 7.1 represents the framework with the complementary business modeling tools per organization type. So the answer to the general problem statement is in fact table 7.1 since one can use it in order to draw an integrated business model for a specific type of organization. The type of organization is based upon whether a firm delivers products and/or services and whether these products and services are repeatable and/or case specified (answer to sub-question 3). One can combine all different lanes in table 7.1 to reach a specific type of organization. Organizational modeling, context pyramids, VDML, BIM and SoaML can all be used for each type of organization in order to model the business (answer

to sub-question 4). BPMN can be used for organizations with repeatable processes whether CMMN is used for organizations where case processes exist (answer to sub-question 5).

The value proposition method (modeling tool) is not present within table 7.1 since value propositions are more efficiently dealt with within VDML modeling. So the value proposition method contained duplicated information towards VDML and was removed from the theoretical framework. Further, organizational modeling isn't used for process representations since this is better presented within VDML, BPMN and CMMN (answers to sub-question 7).

Table 7.1 Complementary business architecture sub-disciplines (modeling tools) per type of firm.

Firm 'X'			
Products		**Services**	
Repeatable (lane 1)	**Cases** (lane 2)	**Repeatable** (lane 3)	**Cases** (lane 4)
Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)	Organizational modeling (only for hierarchy)
Context pyramid	Context pyramid	Context pyramid	Context pyramid
BIM	BIM	BIM	BIM
VDML	VDML	VDML	VDML
BPMN	-	BPMN	-
-	CMMN	-	CMMN
SoaML	SoaML	SoaML	SoaML

From here on, the meaning and functioning of each business modeling tool will be described (answer to sub-question 2).

VDML provides the basis for each organizational business model. VDML recognizes the existence of the company's value chains within a value network. The focus is on value creation and value capturing respectively towards and from all business stakeholders within the value network. Also the perceived value gaps between the current value delivery and capturing and the delivery and capturing put forward, are of interest. The value chain activities and sub-activities, which handle these value creations and capturing within the value chains, are recognized. Capability models are set up for all activities in order to know if the firm is capable to handle these activities itself. VDML also focuses on merging similar capabilities among different value chain activities in order to obtain advantages such as fastened learning curve effects for example. Value chain costs are also incorporated into VDML models. Furthermore, risks are visualized in order to know where the value delivery and capturing can go wrong. Last, internal and external company collaborations among participants are defined.

VDML stops at the process description of activities. There BPMN (repeatable processes) and CMMN (cases) take over. Both BPMN and CMMN can be described at a strategic, a tactical and an operational level. BPMN and CMMN are thus both complementary tools towards each other and towards VDML.

In order to describe internal and external services (service oriented architecture), SoaML provides a good mechanism to do so. Service networks can be described to see the links among services and each separate service can be explained through defining service providers, service consumers, service capabilities and service choreographies among the service providers and consumers. The processes which make up the services are not within the scope of SoaML. There BPMN and CMMN take over, based upon the service repeatability. So again, these modeling tools are complementary ones.

The organizational business modeling tool is of low importance since the total business information is sufficiently dealt with in the previous explained modeling tools. However, organizational modeling can be useful when one wants to model pure business hierarchies among people or systems.

BIM is a little bit a stand-alone business modeling tool in the sense that it does not supply full complementary information towards other business modeling tools. BIMs are used to model the relationships among core business entities and their most obvious goal is to provide a simple quick hit business model to understand the business very quickly. So zooming BIMs in and out can provide a quick understanding of core business entities for as well firm outsiders and insiders. A BIM thus certainly doesn't model the business in a complete way, but its simplicity makes it possible to get a quick view on the business for different business model users.

The context wherein the business value chains and networks operate, is defined by the business context pyramid tool. There the firm's vision and mission are defined and planning issues are captured within the strategic plan. Goals and objectives are further derived from this strategy.

The question however remains whether the complementary business modeling tools within table 7.1 truly cover the need to cover a complete business model. The architectural framework of John Zachman, represented in Fig. 7.1, shows a business as being a matrix which consists of different matrix cells. The columns of the matrix define interrogatives (what, how, who, when, where, why) whether the rows define perspectives (abstraction levels). In that way, the matrix splits up a business in separate concepts (how for processes, who for executing people, etc.) and each concept has different abstraction levels. So the architectural framework of Zachman provides a tool to understand an organization through dividing it into separate entities.

The complementary business modeling tools of table 7.1 cover the different concepts (equivalent to business model functions) of the architectural framework of Zachman deeply enough and they provide enough possibilities in order to define these concepts at different abstraction levels, so the answer to sub-question 6 is yes. However, more advanced business modeling tools are already developed and are being developed in order to model the architectural framework of Zachman in a better way. Nevertheless, the strength of a business model is also its simplicity, thus having a rather restricted amount of complementary business modeling tools is no restriction, but an opportunity to model a business relatively easily and to capture it quickly, without too many sub-modeling tools. The complementary set of business modeling tools per organization type, as represented in table 7.1, is thus meant for organizations whose company cultures are defined by choosing a simple set of complementary modeling tools to model their businesses.

	Why	How	What	Who	Where	When
Contextual	Goal List	Process List	Material List	Organisational Unit & Role List	Geographical Locations List	Event List
Conceptual	Goal Relationship	Process Model	Entity Relationship Model	Organisational Unit & Role Relationship Model	Locations Model	Event Model
Logical	Rules Diagram	Process Diagram	Data Model Diagram	Role Relationship Diagram	Locations Diagram	Event Diagram
Physical	Rules Specification	Process Function Specification	Data Entity Specification	Role Specification	Location Specification	Event Specification
Detailed	Rules Details	Process Details	Data Details	Role Details	Location Details	Event Details

Fig. 7.1 Architectural framework of John Zachman. An organization is split into separate concepts by looking at different abstraction levels for each subject which is represented by an interrogative (why, how, what, who, where, when). [19]

So until now, the mechanisms to model an organization's current business are dealt with. However, a business is a dynamic entity that one should plan for. So business model planning is also dealt with within this thesis study. Different strategic planning techniques exist. Each planning technique provides a framework to think about how planning can be incorporated within a business' strategy. These strategic planning techniques can all be combined in order to reach for a well established planning. The planning techniques are used to reshape a business strategy and consequently also to reshape VDML, BPMN, CMMN and SoaML models. The eight strategic planning techniques are:

- Critical success factors
- Three emerging forces
- Competitive forces
- Value chain analysis
- Stages of growth
- E-business value matrix
- Linkage analysis
- Scenario planning

These eight planning techniques also provide a framework to think where innovation can be implemented since innovation is also more or less equivalent with planning for business evolution.

Last, an important remark to remember when innovating a business model is that the trend is to use open innovation (outside-in and/or inside-out) instead of closed innovation since companies don't have the best specialist in-house anymore and knowledge is becoming more and more distributed. Furthermore, firms should wrap services around their products and stimulate open service customer innovation since the basis of competition is changing. Competitive advantage lies not necessarily anymore in differentiating products or services or in producing at lowest cost since copycats arise faster than ever. By wrapping services around products and innovating these services together with the

users, a firm can discover means to keep customers happy and to capture profits from them. In this way a firm can remain competitive in the current business environment.

8. Case study: ‘Super Cars’

This part describes an hypothetic case example concerning a car rental company, called ‘Super Cars’. The goal of this case study is to clarify the theoretical concepts of VDML, BPMN, CMMN and SoaML, which were discussed earlier in this thesis study. Concerning table 7.1, one should remember that the organizational modeling tool, the business context pyramid and the BIM tool are also needed in order to draw a complete business model but they won’t be used in this case example since drawing pure company hierarchies, formulating textual visions, missions and strategies and drawing stand-alone BIMs are not within the interest of this clarification part. The goal is to describe and to link the visual complementary business modeling tools of VDML, BPMN, CMMN and SoaML.

‘Super Cars’ is an independent car rental company which offers cars of different brand types. The firm has an internal car repairing team and it has its own fuel storage tank in order to be able to store gasoline and diesel, needed for the cars. It can thus buy and store fuel when prices are low. The buying of fuel at relative low price and the internal repairing of cars add to the company’s strategy of low cost/price car rental.

8.1 VDML modeling

It is wise to start the VDML-BPMN-CMMN-SoaML discussion with the VDML modeling tool.
Table 8.1 shows the presence of the value chain of ‘Super Cars’ within its value network. The value chain represents the five primary activities (inbound logistics, operations, outbound logistics, marketing and sales, customer service) and the four supporting activities (firm infrastructure, HR management, technology development, procurement) which are needed in order to deliver and capture the value streams. The value proposition towards the customers of ‘Super Cars’ is good car rental at low price. Each of the primary and supporting value chain activities in table 8.1 is further divided into three sub-activities or in fact business processes. However, many more sub-processes exist but for simplicity only three of them are shown. All these business processes contain a subscript ‘C’ or ‘R’ which points to the fact whether the process is a repeatable process (R) which can be described by BPMN or a case process (C) which can be described by CMMN.

Table 8.1 also includes different stakeholders in order to represent the value network wherein the value chain of ‘Super Cars’ operates and which influences the value delivery to and the value capturing from customers. The most obvious stakeholders are the customers themselves, the suppliers and the competitors of ‘Super Cars’. Suppliers can further be divided into car suppliers, fuel suppliers and the suppliers of mechanical car parts. Also regulatory entities are stakeholders since they influence tax paying for example. Banks give loans and determine interest rates on these loans and thus also influence the value network. Individual car producing companies can be seen as suppliers but also as complementors (the better a car is produced, the more a customer is willing to rent one at ‘Super Cars’ thus car producing companies complement the rental service at ‘Super Cars’) and co-opetitors (‘Super Cars’ buys cars from car suppliers but there is also a competition force between them since if a third party buys a car from a car producer, he/she won’t probably often rent a car).

Table 8.1 Value network of 'Super Cars'. The five primary and four supporting value chain activities each contain different sub-processes. (R) stands for repeatable processes whereas (C) stands for case processes. Stakeholders define the value network wherein the value chain of 'Super Cars' operates. These stakeholders exchange products, services, money, knowledge, information and influence with 'Super Cars' and also with each other (not shown in the model).

Value chain 'Super Cars'				
Firm infrastructure	Developing infrastructure strategy (C)	Creating governance structure (C)	Creating IT architecture (C)	…
HR management	Setting up profiles (C)	Recruiting personnel (R)	Training personnel (C)	…
Technology development	Creating technology vision (C)	Searching for technology gaps (C)	Implementing new technology with change management (C)	…
Procurement	Purchasing cars (R)	Purchasing fuel (R)	Purchasing supplies (R)	…
Inbound logistics	**Operations**	**Outbound logistics**	**Marketing & sales**	**Customer service**
Receiving cars back from customers	Checking quality of cars (R)	Adapting availability list (R)	Accounting financial results (R)	Checking customer satisfaction (R)
Storing substitution parts	Repairing cars (C)	Putting cars in showroom (R)	Negotiating marketing contracts (C)	Resolving car problems (C)
Distributing substitution parts to technicians as required	Renting cars (R)	Driving cars to customers' houses (R)	Adapting pricing strategy (C)	Integrating learning issues in company's functioning (C)
…	…	…	…	…

products/services/money/knowledge/ information/influence

customers / suppliers(cars, fuel, car parts) / banks / regulatory entities / competitors / complementors / co-opetitors

All these stakeholders can exchange products, services, money, information, knowledge and influence with 'Super Cars' and also with each other. However, the internal exchange of these entities among stakeholders themselves is not shown in table 8.1, but it truly exists.

Now that the value network is properly defined, the VDML tool can further be explored by drawing capability models of the processes present within the value chain. Not all processes will be dealt with here for drawing capability models, since it will be too much work. Two processes will be chosen in order to draw capability models: 'Checking quality of cars' and 'Negotiating marketing contracts'. One should however remember that each process should have a capability model.

Table 8.2 Capability map of process 'Checking quality of cars'. Capabilities are put in a hierarchy and are judged on their performance.

	Checking quality of cars			
Importance	**Capability**	**Amount**	**Performance**	**Comment**
1	Technicians (high knowledge)	2	Ok	
2	Technicians (low knowledge)	6	Ok	
3	Testing materials	800	Ok	
4	Department	200 m²	Ok	
5	Education sessions	1/year	Not ok	2/year required
6	…	…	…	…

Table 8.2 shows the capability map/model for the process 'Checking quality of cars'. Five capabilities are mentioned (however there are much more) in order to keep the representation simple. The capabilities are put in a hierarchy structure meaning that having good technicians is the most important whereas education sessions are also necessary but less important to fulfill a quality checkup. One can notice that only the performance of the education sessions is negatively commented on. The conclusion of this capability map is that the process can be executed in-house in 'Super Cars' since the capability model gives a good result. Outsourcing quality checking is not required.

Table 8.3 Capability map of process 'Negotiating marketing contracts. Capabilities are put in a hierarchy and are judged on their performance.

	Negotiating marketing contracts			
Importance	**Capability**	**Amount**	**Performance**	**Comment**
1	Marketers	2	Ok	
2	Financial marketing advisors	0	-	-
3	…	…	…	…

Table 8.3 shows the capability map for the process 'Negotiating marketing contracts'. One can see that two internal marketers are present in 'Super Cars', executing their jobs properly. So these marketers come up with good ideas in order to position and promote 'Super Cars' and they evaluate the marketing effects. However, the capability map indicates that no full time financial marketing advisors are present within the company so that it is hard for 'Super Cars' to negotiate marketing contracts,

such as for example the negotiation of placing a weekly advertisement in a big newspaper. The capability map thus indicates that outsourcing is needed for the process 'Negotiating marketing contracts'. 'Super Cars' can for example hire consultants when they want to negotiate certain marketing contracts with external parties.

Now that capability models are sufficiently explained within the VDML modeling tool, a little discussion about capability consolidation/merging is good to mention here too. Consider two processes in the value chain presented in table 8.1, 'Checking quality of cars' and 'Repairing cars'. Each of these two processes should have a capability map. In each of these two capability maps, the capability 'Technicians' will be present since technicians are needed for both checking the quality of cars and for the repairing of cars. Consolidation of the capability 'Technicians' is suitable here. Since the quality checking and the repairing of cars are two processes which are closely related to each other, it is wise to let a technician, who discovers certain problems in a car by quality checking, repair the car since this technician is the most knowledgeable about the problems. Two different technicians for quality checking and repairing could be chosen and information could be exchanged between them by talking to each other and/or by a quality check document, but the danger always exists that implicit information is never able to travel from the technician who did the quality check to the technician who does the repairing. This problem is solved by merging the capability 'Technicians' in the two capability maps. This research and implementation of capability consolidation among processes should be carefully done for all processes. Beside advantages such as better information sharing, also faster learning curves and advantages of economies of scale could be reached by discovering possibilities of capability merging.

Beside looking to the capabilities of the different processes, VDML also focuses on recognizing the different cost drivers for each process. Since the competitive strategy of 'Super Cars' is to provide car rental at low price, recognizing and using cost drivers in each process to decrease costs is very important. Although cost drivers should be investigated for all different processes in the value chain of 'Super Cars', only the cost drivers related to the process 'Repairing cars' will be investigated here in order for simplicity.

Table 8.4 Possible cost drivers for the process 'Repairing cars'.

Cost drivers 'Repairing cars'
Economies of scale
Economies of scope
Learning
Timing
…

Possible cost drivers for the process 'Repairing cars' are given in table 8.4. Economies of scale can be understood by stating: the more cars that are repaired with the same repairing materials, the lower the fixed repairing material cost will be per unit of repaired car.

Economies of scope can be understood by using the example that if the department infrastructure for repairing cars is both used for repairing cars as well as for checking the quality of cars, the fixed building costs per unit of car are lower than when separate buildings are used. So when a building remains unused for a certain period of time, considering executing other processes in this building during that time can lower fixed costs per unit since less building area is needed.

The cost driver 'learning' can be understood by stating that the more experience is gained by technicians in repairing cars, the faster the repairing is done and thus for example less electricity is used for repairing a car. Furthermore, if cars are being repaired faster due to learning effects, more cars can be repaired per hour and thus less technicians are needed in order to repair a certain amount of cars, which decreases wage costs.

The timing aspect is also a cost driver for the process of repairing cars since electricity costs are for example different at different points in time. Furthermore, timing can also relate to the fact that technicians are more motivated in the morning than during the evening so planning to repair most of the cars during the morning can have multiple advantages such as faster work and electricity savings.

VDML for 'Super Cars' can further be explored by executing a risk analysis for each process in the value chain. These risk analyses are very important in order to discover the dangers which can lead to a bad value delivery towards customers (or a bad value capturing from them). Table 8.5 gives an overview of the risks associated with the processes 'Purchasing fuel' and 'Repairing cars'.

Table 8.5 Risk analysis. Shown are the risks associated with the processes 'Purchasing fuel' and 'Repairing cars'.

Process' risk analysis	
Purchasing fuel	**Repairing cars**
Single fuel supplier	Critical tools/machines
Buying fuel too late	Critical people
Buying fuel too early	Missing substitute parts
…	…

A first danger for purchasing fuel can be explained by the fact that if a contract is signed with only one supplier, a bottleneck in the supplier's firm can lead to serious problems in guaranteeing fuel delivery. Furthermore, 'Super Cars' can buy fuel too early and prices can drop afterwards. However, 'Super Cars' can also buy fuel too late and run out of fuel because it waits too long for prices to drop.

The repairing of cars can fail and thus it is possible that a customer doesn't get his/her car on time and that he/she has to choose another one. Risks here are that critical machines or tools to repair cars break down, that critical technicians become ill and that necessary substitute parts are not present in-house and need to be ordered from an external parts supplier.

Finally, to close the discussion about VDML modeling for 'Super Cars', collaborations among people, machines and systems need to be clarified. Certainly not all collaborations within 'Super Cars' will be mentioned here since this will again lead to an enormous complexity. Furthermore, it is a business culture choice whether one models collaborations very detailed or rather abstract, as it is also the case

for the other aspects which were modeled earlier in this VDML model for ‘Super Cars’. Here, only a simple snapshot will be shown of some possible collaborations and roles among participants.

Table 8.6 Snapshot of collaborations among people and systems within ‘Super Cars’.

Participant	**Participates in**				
	Engineer in repairing team	Engineer in quality checking team	Head of pay rolling	Member of ethical committee	Information deliverer for purchase team
Technician 1	v	v		v	
Technician 2	v				
…					
Accountant 1			v	v	
Accountant 2				v	
…					
Repairing team					v
ERP system					v
Supplier X				v	

The simple snapshot presented in table 8.6 shows participants and the roles which they fulfill in certain collaborations. Participant ‘Technician 1’ fulfills for example the role of engineer within the collaborations ‘repairing team’ and ‘quality checking team’. Technician 1 however has also the role of ‘member’ within the ethical committee collaboration. Also systems can be participants. The ERP system is for example an information deliverer within the purchase team. The snapshot also indicates that cross boundary collaborations exist: the ethical committee is not only composed of internal company participants. Also a supplier is present in the committee. Furthermore, the repairing team is in itself a sub-collaboration within the bigger collaboration ‘purchase team’.

8.2 SoaML modeling

Now that a VDML model is described in many aspects in order to model ‘Super Cars’, the complementary SoaML modeling tool can be explored within this case study. One can use SoaML here in order to describe a service oriented architecture network in which different participants work together in order to provide and consume services which are linked to one another.

In fact, a distinction can be made between two kinds of service collaboration networks. On the one hand a visualization can be made of services between ‘Super Cars’ and its stakeholders and on the other hand a visualization can be made of services between internal participants of ‘Super Cars’.

Fig. 8.1 gives an overview of the service collaboration network among ‘Super Cars’ and some of its stakeholders. A car rental service exists between ‘Super Cars’ (service provider) and its customers (service consumers). Further, purchase services exist between ‘Super Cars’ (service consumer) and the

vendors of cars, fuel and mechanical car parts (service provider). Also a transport status service exists between these vendors (service provider) and 'Super Cars' (service consumer).

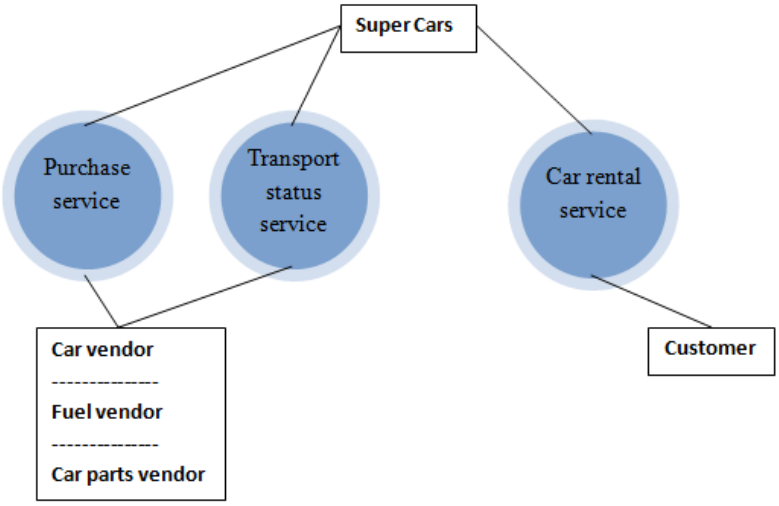

Fig. 8.1 Service oriented architecture network among 'Super Cars' and its stakeholders. Shown are car rental services among 'Super Cars' and its customers and purchase services and transport status services among 'Super Cars' and its suppliers.

The second possibility, services among internal participants of 'Super Cars', is shown in Fig. 8.2. Certainly not all internal services are shown but it gives the reader a good view of how 'Super Cars' can model its internal services. Fig. 8.2 shows three internal participants: the purchase team, the ERP system and the repairing team. The ERP system and the repairing team each provide a purchase information delivery service towards the purchase team.

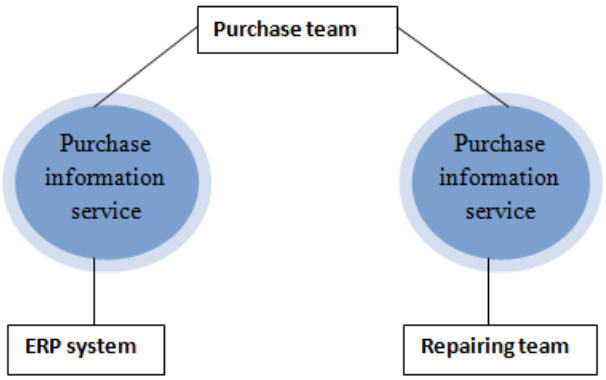

Fig. 8.2 Service oriented architecture network among internal participants of 'Super Cars'. The ERP system and the repairing team each deliver an information service towards the purchase team.

Fig. 8.1 and 8.2 can each be accompanied by service capability maps showing which capabilities service providers must have in order to deliver the service to the service consumer. Considering Fig. 8.1, 'Super Cars' must have for example suitable internal capabilities present in order to deliver the car rental service towards its customers. However, no capability maps will be shown here since capability maps were already explained and given under '8.1 VDML modeling'.

Added value towards Fig. 8.1 and 8.2 can still be presented: choreography representations can be made in order to describe the communications which are sent between service providers and service consumers. Table 8.7 shows the communications which are exchanged between 'Super Cars' and its customers in order to fulfill a car rental service, as shown in Fig. 8.1. One can notice that this will lead to double information since later on in this section about modeling the business of 'Super Cars', BPMN and CMMN models will have to be made where these choreographies are also present in. However, one should not forget that showing only choreographies without their processes contributes to the architectural framework of Zachman (Fig. 4.2) since different levels of abstraction are used. Independent choreographies are rather abstract, processes with these choreographies are rather concrete.

Table 8.7 Choreography representation for car rental service. Shown are the communications sent between 'Super Cars' (service provider) and its customers (service consumers).

Car rental service		
Super Cars	**Communication**	**Customer**
	Advertisements →	
	← Car rental request	
	Order confirmation→	
	Satisfaction check→	
	←Satisfaction response	

As shown in table 8.7, 'Super Cars' sends marketing information towards its customers (advertisements in newspapers, advertisements on radio, etc.). When interested, a customer makes a request for renting a car which is later on answered by 'Super Cars' (in table 8.7 it is assumed that the order was confirmed by 'Super Cars'). During or after the car rental, 'Super Cars' checks the satisfaction level of its customers which on their turn respond to the satisfaction check.

8.3 BPMN and CMMN modeling

This part will focus on the description of processes, making use of BPMN and CMMN modeling tools which are both pure complementary modeling tools towards VDML and SoaML and to each other. One repeatable process will be modeled making use of BPMN: 'Renting cars'. The process of renting cars is situated in the operations part of the value chain, presented in table 8.1. Further, also a case process will be modeled making use of CMMN modeling concepts: 'Resolving car problems'. The process of resolving car problems is situated in the customer service part of the value chain, presented in table 8.1. The modeling of these two processes will be executed at three abstraction levels: at a strategic level, at a tactical level and at an operational level.

In order to start modeling these two processes, a common strategic level can be modeled which divides these processes among core processes, support processes and management processes. Table 8.8 shows the strategic level for these two processes but it also shows some other processes which were present in the value chain of table 8.1.

Table 8.8 Process modeling for ‘Super Cars’ at the strategic level. Beside the processes ‘Renting cars’ and ‘Resolving car problems’ also other business processes from the value chain of table 8.1 are shown here.

Super Cars					
Core processes	***Stakeholders***	**Support processes**	***Stakeholders***	**Management processes**	***Stakeholders***
Renting cars	*Competitors Suppliers*	Accounting financial results	*Regulatory entities*	Adapting pricing strategy	*Competitors*
Resolving car problems		Creating IT architecture		Creating governance structure	
Repairing cars	*Suppliers*	Recruiting personnel		Creating technology vision	
…	...	…	...	…	...

Table 8.8 also shows some stakeholders which are directly connected towards executing certain business processes of ‘Super Cars’. Although these stakeholders were already shown in the value network of table 8.1, it is also wise to connect them to specific processes in the value chain, not to the value network in general. In that sense, connecting stakeholders to processes, adds extra modeling value. Table 8.8 only shows a few stakeholders connected to certain processes but in fact every process has stakeholders connected to it. Regulatory entities determine every process in an organization for example and the creation of the IT architecture will also depend on how outsourcing IT partners see IT issues. Only the most obvious process-stakeholder connections are shown in table 8.8. Here again, the discussion can be made of the abstraction levels of the architectural framework of Zachman: the company culture decides the detail level for connecting stakeholders to processes.

Now that the strategic level is determined, the tactical and the operational level for ‘Renting cars’ (repeatable process, BPMN) and ‘Resolving car problems’ (case process, CMMN) should be determined. The tactical and operational levels for ‘Renting cars’ are respectively shown in Fig. 8.3 and Fig. 8.4 whether the tactical and operational levels for ‘Resolving car problems’ are respectively shown in Fig. 8.5 and Fig. 8.6. Tactical levels show processes rather at an abstract level whether operational levels show processes rather at a concrete level. However, please notice that even in the operational level representations, abstractions are made in order to simplify the model and its visibility.

One can see that for the repeatable process ‘Renting cars’, both the tactical and operational levels are fully describable. The case process ‘Resolving car problems’ is fully describable at the tactical level, but the operational level is not fully describable since the detail level is rather concrete here and at-process-runtime-planning is required in order to describe the case process activities.

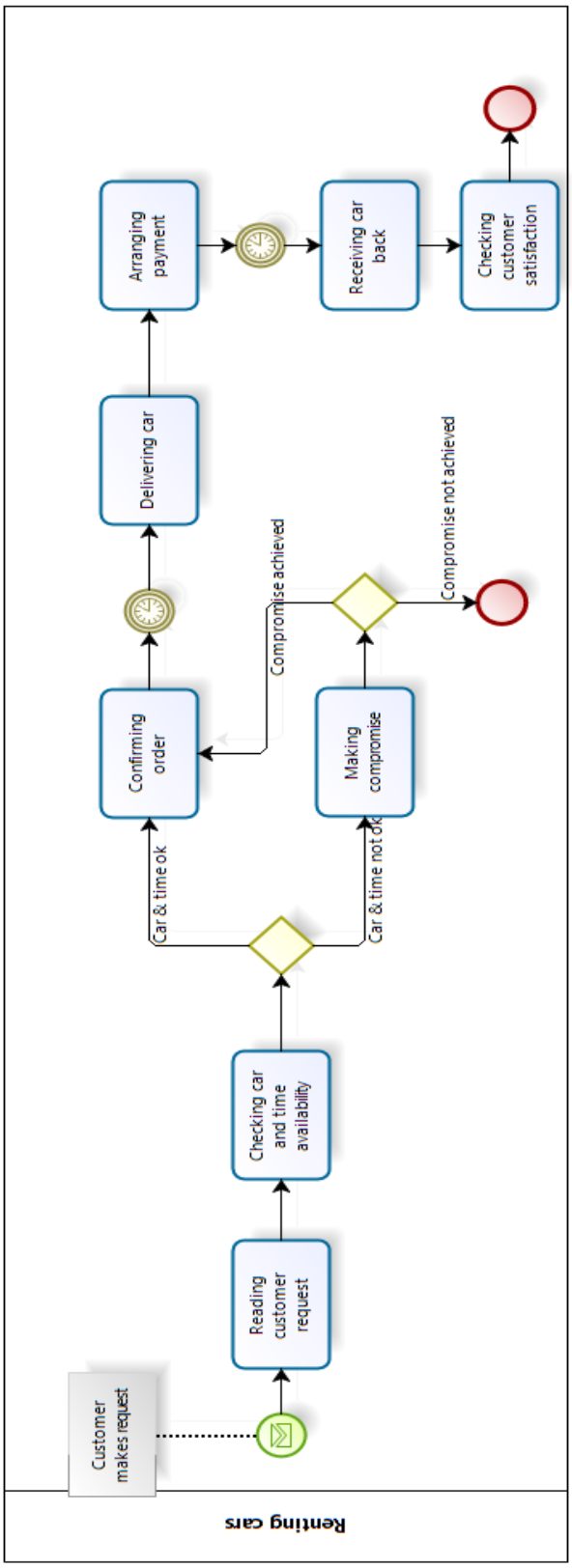

Fig. 8.3 Tactical level for the repeatable process ‘Renting Cars’.

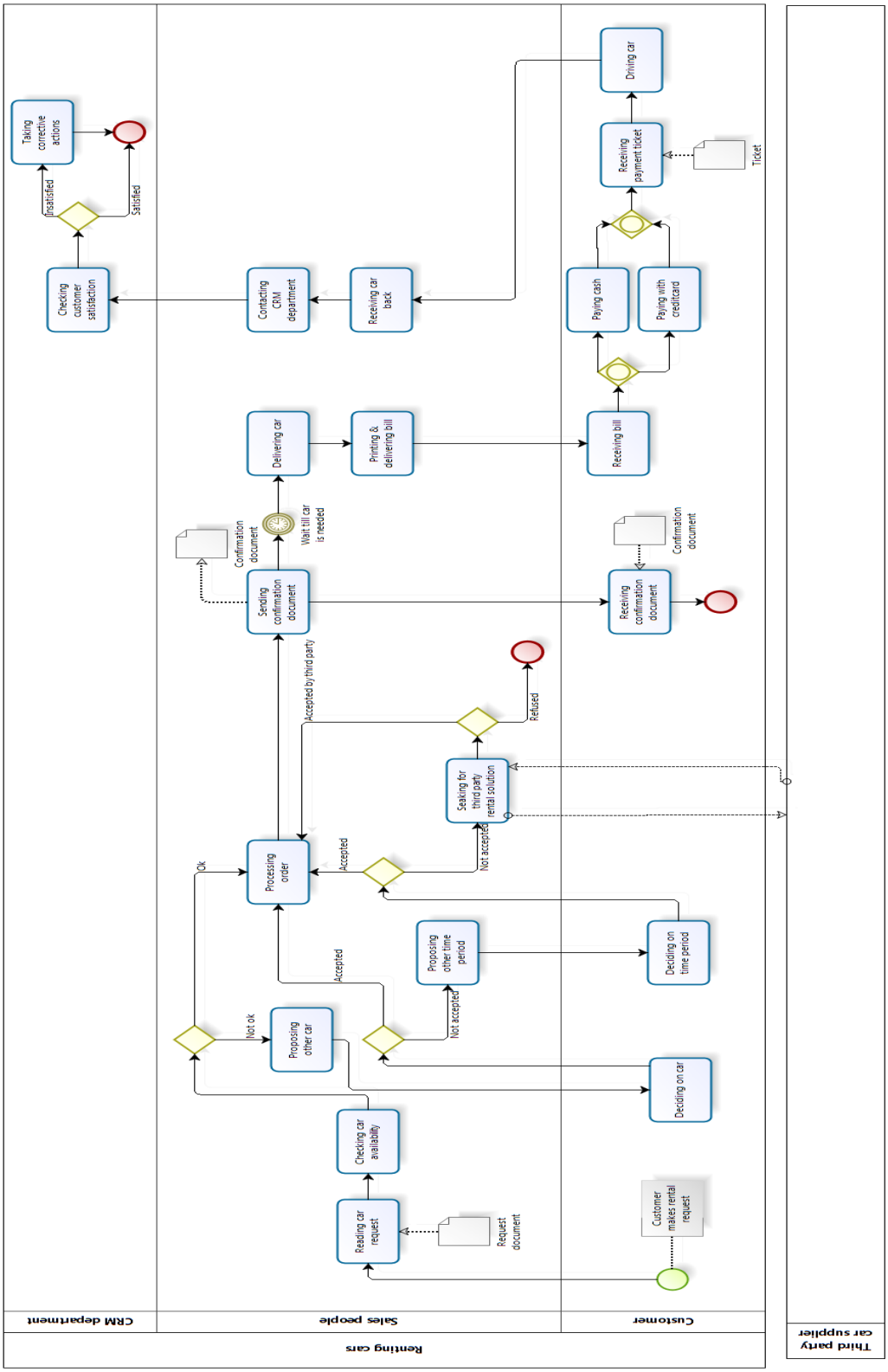

Fig. 8.4 Operational level for the repeatable process ‘Renting Cars’.

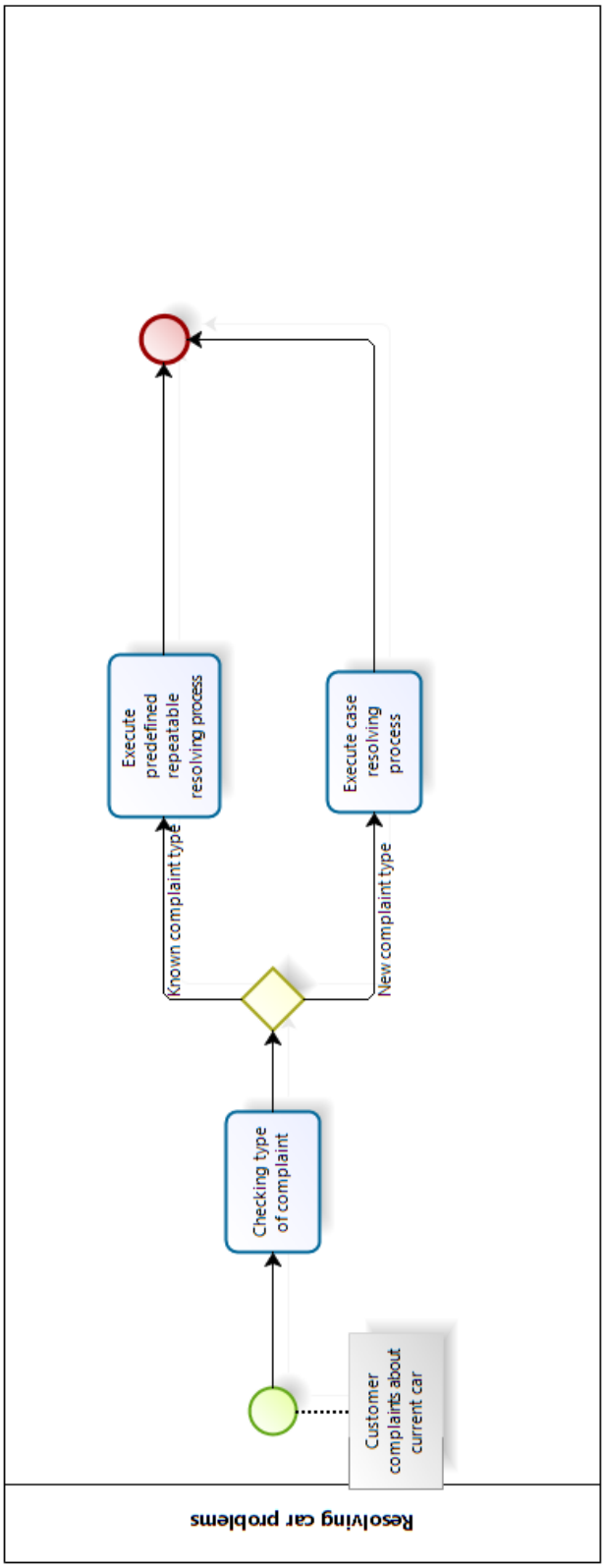

Fig. 8.5 Tactical level of case process ‘Resolving car problems’.

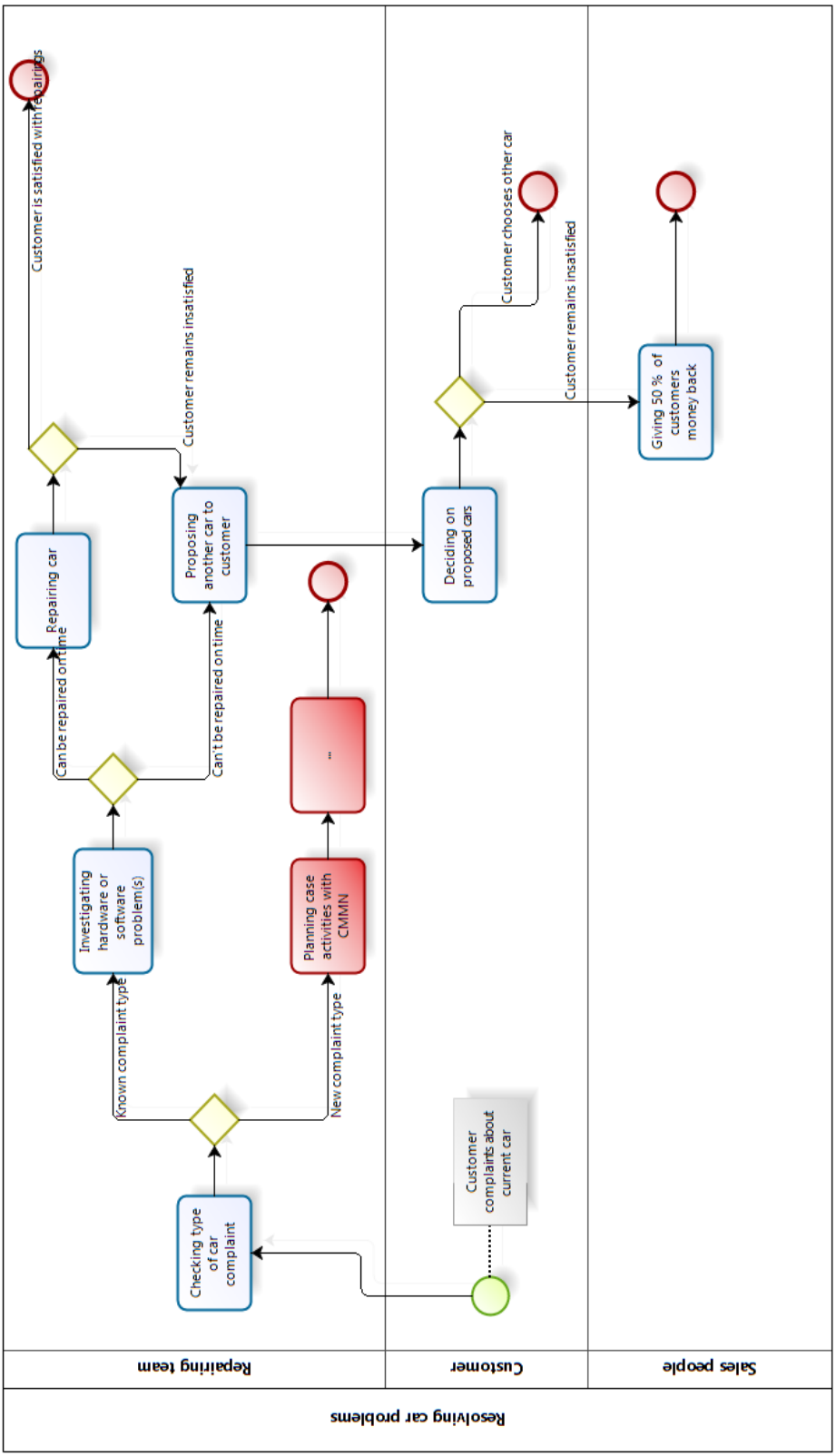

Fig. 8.6 Operational level of case process 'Resolving car problems'. The red boxes indicate that planning is needed at process runtime (CMMN).

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