CENTRE DE RECHERCHE PUBLIC
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Business Models
State of the Art

Deliverable 1.1: Report on the state of the art in business modelling and Business/IT alignment

September, 2006

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Abstract

This report provides a state of the art in business modelling and languages for designing and reasoning about business models. Although there are a variety of languages, methods and modelling frameworks in this field of research, we consider only such languages that link business with business process or transaction models; this is motivated by the context of the report, which is meant to be a first step towards the selection of a business modelling language that fits the requirements of the Swift standards development group. This report aims at depicting the landscape of business modelling.

Diffusion

Swift:	Frank Vandamme, Martine Bouvy
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Preface

This work is based on the competencies developed at CRP Henri Tudor in the domain of business modelling through two main projects:

- The Efficient project, a five year's R&D project funded by the Luxembourg Fonds National de la Recherche (FNR). The Efficient project aims at developing an open-source platform for the design and the validation of electronic business transactions modelled in UML. More information about the project, its objectives and achievements can be found at http://efficient.citi.tudor.lu

- The NoE Interop project: Within the context of this EU FP6 Network of Excellence (NoE) grouping more than 120 researchers in the field of Interoperability, CRP Henri Tudor is coordinating of working group on the theme of "Business/IT" alignment where the topics of Business modelling and Business Process modelling are emphasized.

As far as we understand it, SWIFT would like to use a business modelling language (as well as a modelling method) to both document the business motivation behind an electronic business collaboration and to integrate the business motivation into the design process for the development of standards. In the terms used in the present document, it means to improve the current SWIFT methodology at the level of business analysts concerns (herein called Business Model and Value Model) and at the level of business design (namely Business Process Model).

With regards to these application fields, this state of the art groups and describes a set of formal languages, modelling frameworks and modelling initiatives that all aim at justifying a business process from a business perspective.

Each language is briefly described in terms of its focus and scope, the type of business situations it is meant to address and the available tools and methods that are based on it. In order to be able to compare the different languages, we suggest an intermediate conceptual model (an ontology) onto which we map the different languages so as to identify common areas and differences.

Our work has been guided by three design principles: simplicity, efficiency and applicability, as follows:

- Simplicity for the reader, who does not need to have a background din formal languages or business modelling in order to read this report.
- Efficiency by simplification and putting an emphasis on the key ideas of the respective topics.
- Applicability to every-day businesses.

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Introduction

Electronic business collaboration can take many forms: Business Service Networks (BSN), Supply chain management (SCM), Electronic Market Places, E-Government and Collaborative Networked Organizations(CNO) are just a few examples of joint value creation by a group of business parties.

Such collaborations deal with those processes that coordinate the flow of goods, financial resources and information among a network of business partners to create value for their customers, where a main objective being to maximize value creation and efficiency while minimizing costs. The latter involves cost-effective integration of each party's business activities, which relies on information sharing, common coordination and planning processes. In order to enable multi-partner business collaboration, several challenges must be addressed:

- On a tactical level, the common planning and coordination of business activities pre-supposes that all parties involved have the same understanding of the business model. They need to agree on which customers they will address and understand their respective needs. They need to have a common view on the products and services they produce to meet those needs, and they need to clarify who adds what to the value creation and what each party expects in return.
- On an operational level, the business processes of each partner in the supply chain must be aligned with those of its suppliers, intermediaries and customers. This involves a fairly detailed conception of the ideal flow of goods, financial resources and information between the supply chain parties throughout the value creation process. The question that must be answered in this phase is "how do we organize ourselves in terms of our value creation activities, the information exchange needed to support them and the rules that help us coordinate and manage our collaboration?"

While the first level of collaboration focuses on whether *what we do is the right thing* and that every actor involved understands and buys into the business idea, the second challenge is about *doing things right*, that is, to structure and organize the business activities of each actor in a way that we achieve our common goals, i.e. to produce a maximum of value for our customers while keeping costs as low as possible. The SWIFT methodology may cover all of these aspects in a near future, including the concerns of business analysts (tactical level) and at the stakes of business design (operational level).

In order for us to deal with both of these levels of collaboration and to keep them in coherence, a necessary prerequisite is to consider the whole value creation process (*end-to-end transactions*) as opposed to a viewpoint where there are only two business actors that coordinate their respective value activities.

There are several approaches concerning the modelling of an enterprise and its business processes, each of which differs in terms of its *purpose* and *scope*. The following is an enumeration of some prominent examples. It serves the purpose to delineate the notion of business modelling, which is central to this state of the art report.

According to [Vernadat, 1997], Enterprise modelling is the process of building models of whole or part of an enterprise from knowledge about the enterprise,

previous models and reference models using representation languages. “An enterprise model should describe the rationale, organisation and behaviour of some business entity to support decision-making regarding its engineering, control and maintenance. Due to the complexity of the reality described, the enterprise model is in fact a collection of models representing various facets of the business entity. It is not a static view, but contains a representation of the core knowledge about what the enterprise is, how it is organised, what it does and how, along the various stages of the enterprise life cycle. It must be kept up-to-date and is therefore a dynamic entity.”

Enterprise modelling focuses on decision-making. An integral part of an enterprise models are therefore the decision-making processes, decision flows and decision centres of the enterprise.

Another modelling conception is that of [Porter 1985] who focuses on an enterprise's value chain. The idea of the value chain is based on the *process view of organisations*, according to which an organisation is seen as a system, made up of subsystems each with inputs, transformation processes and outputs. Inputs, transformation processes, and outputs involve the acquisition and consumption of resources - money, labour, materials, equipment, buildings, land, administration and management. How value chain activities are carried out determines costs and affects profits. Value chain activities can be classified as either primary or support activities.

According to Porter, the primary activities are:

- Inbound Logistics - involve relationships with suppliers and include all the activities required to receive, store, and disseminate inputs.
- Operations - are all the activities required to transform inputs into outputs (products and services).
- Outbound Logistics - include all the activities required to collect, store, and distribute the output.
- Marketing and Sales - activities inform buyers about products and services, induce buyers to purchase them, and facilitate their purchase.
- Service - includes all the activities required to keep the product or service working effectively for the buyer after it is sold and delivered.

While the value chain model is about processes and how the business processes of business partners are linked to each other, in the late 80's John Zachman proposed a framework for the modelling of an enterprise that emphasises the various *relationships* that hold *between an enterprise's strategic goals* and objectives *and the underlying information technology* that helps to meet and realise these objectives. The Zachman framework is based on two dimensions, an axis that differentiates the various perspectives from a stakeholders point of view – depending on the role one has in an enterprise, the level of abstraction and the questions one has will differ - , and an axis describing the focus or key questions one may have when looking at an enterprise: the what?, how?, where?, who?, when? and why? [Zachman, 1987].

The Zachman framework is depicted in Illustration 1, where for some focus and perspectives examples of the objects under investigation are provided for illustration purposes.

The present *State of the Art* focuses on such modelling frameworks that describe

the business case, that is, the rationale behind a business collaboration. Subject of this perspective is the economic reasoning that explains and justifies the value chain processes (red arrows down from the scope to the process, in Illustration 1) in a business-to-business collaboration. The overall objective being to favour the design of such value chain processes that match best the enterprise's operational business context (namely its logical system model), as shown by the yellow arrows starting from the logical perspective and pointing to the process perspective. These concerns are referred to as the problem of *business/ business process and business/IT alignment.*

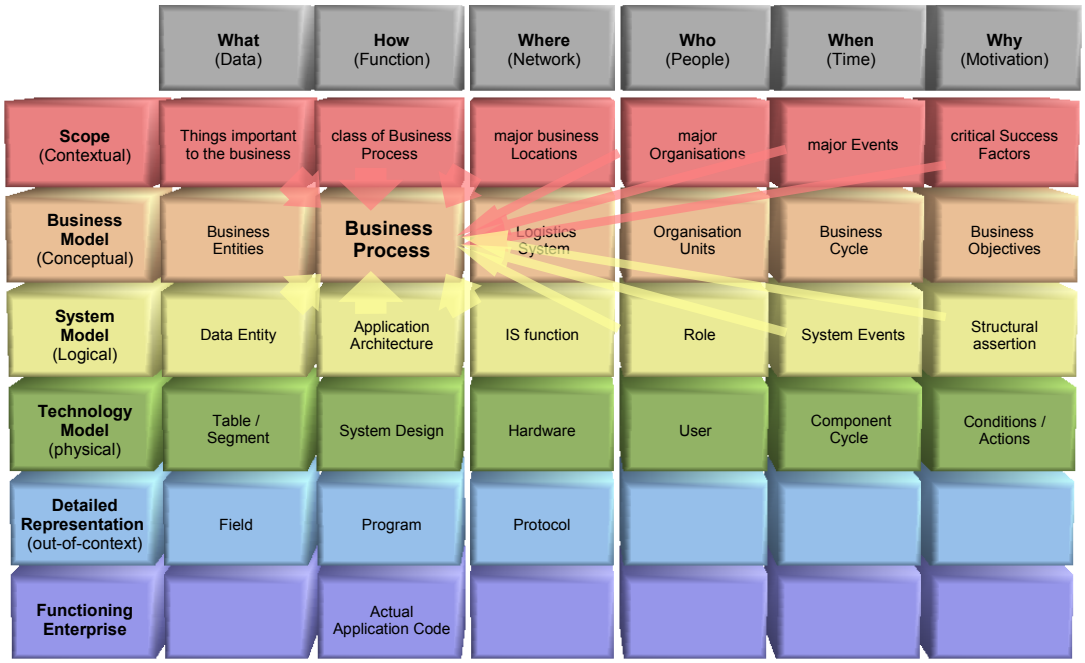


Illustration 1: Enterprise Architect Framework (John Zachman, 1987)

The next sections discuss this problem from both its main perspectives, the business model and the business process model.

Business process models vs business models

Business Processes (BP) are an integral part of an enterprise's value creation. Processes describe the way that the enterprise conducts business. A business process consists of a set of activities that require a series of inputs (resources, knowledge) and that create as result something of value to the customer [Hammer, Champy, 1993]. The definition provided by [Gadatsch, 2003] goes beyond and comprises the processes' goal-orientation and their alignment with the strategic goals of the enterprise: a business process is a goal-oriented, chronological or logical sequence of tasks, which aim at meeting a set of process goals that are derived from the enterprise strategy. " The management of business processes, therefore, is a management task of strategic importance for the enterprise.

When comparing business processes with the actual business, [Gordijn et al., 2000] points out that while a business process describes what *an enterprise's*

activities are whereas the business case itself (the why?), that is, *the who does what, and above all, why,* is not well described by a process model. A *business process*, therefore, does not support the reasoning about the business idea, but facilitates the understanding about how an enterprise operates and creates value to its customers. Another term that is often mentioned in the context of a business process is that of a business transaction. For us, a *business transaction* (or shorter: a transaction) is an operational instance of a business process, that is, one possible implementation (how things are actually done), whereas the business process itself stays on a declarative description level (what is to done).

There are many languages and tools to model and represent business processes; some examples are the ARIS toolset of IDS Scheer, MEGA Process and the business process modelling notation (BPMN) proposed by the Object Management Group. For this report, we have chosen the Integrated Definition Methods (IDEF) defined by the Computer Systems Laboratory of the National Institute of Standards and Technology [NIST, 1993] in the early 90's. Their conception of a process is consistent with [Hammer, Champy, 1993]: a Process[1] is a set of Activities that transform Inputs into Outputs, which are of greater value to the customer. This transformation is realised under certain Control - this can be associated with the responsibilities of the Role, who controls it- , and it may require additional Mechanisms -or more generally speaking Resources. A common way of representing business processes in a graphical way is the IDEFØ method, shown in Illustration 2.

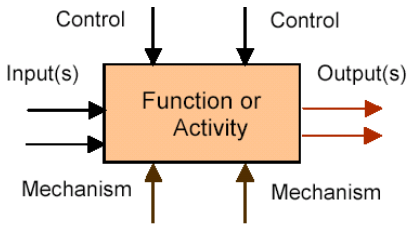


Illustration 2: graphical representation of a process with IDEFØ.

IDEFØ is a method designed to model the decisions, actions, and activities of an organization or system. It was derived from a well-established graphical language, the Structured Analysis and Design Technique (SADT). While IDEFØ is designed to produce function models, IDEF3 is designed to help document and analyse the business processes and activities by capturing descriptions of how a particular system operates; it adds upon IDEFØ concepts the idea of a sequence of activities, as depicted in Illustration 3.

To uniform the representations in the various modelling languages that are treated in this report, we map them onto a UML Class Diagram (see Illustration 4), where the main concepts are shown as classes (boxes) and their relationships as associations (lines). More detailed information about the type of relationships can be expressed by the generalization or "a-kind-of" associations (both the Input and Output are a kind of Product) [OMG, 2003] and by aggregation associations that express a part-of relationship between classes (e.g. a Process *comprises one or more* Activities).

1 To improve the readability of this report, we have chosen to mark important concepts in a different font (e.g. Activity) so as to emphasise them as compared to the main text.

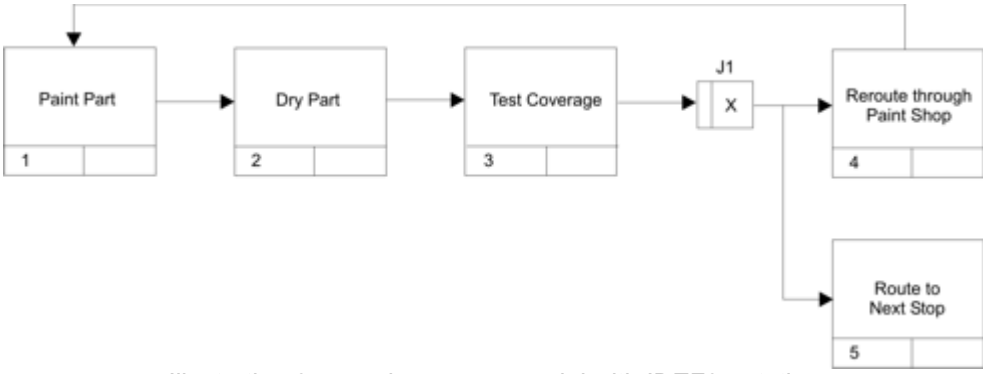


Illustration 3: sample process model with IDEF3 notation

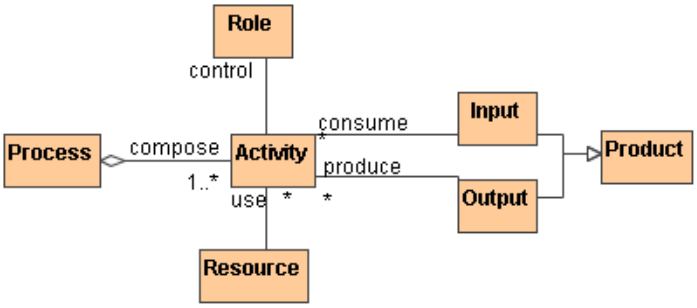


Illustration 4: Conceptual model of IDEF-3 (adapted)

The notion of business model (BM)

A research in google shows that there are many definitions for the term "Business model", each one being associated with a different meaning. A common element is that business models are subject of considerations about the success of an enterprise, by making explicit the reasons that make some firms prosper while others drop out of the market. In contrast to the definition of process models, that were described in the previous section, we consider business models as more high-level, management models of the business case, that is, a business model provides at least a description of *what the company offers* to the market, *how it differs* from its competitors and *what core ingredients* (partners, activities, resources, competencies) *it employs* to provide its offering.

Theoretical foundation of Business Modelling

An important aspect of the definition of a business model is the idea of reciprocity of economic exchange (see [McCarthy, Geerts, 2000]). Each service or good provided by an economic actor must be complemented by a reward or incentive flowing in the opposite direction. This entails that the profitability and sustainability of a business model depend not only on its value creation potential but also on the attractiveness of the benefits and incentives it offers to its participants. e.g. refer to a lack of attractive benefits in their explanation why many of the electronic marketplace providers were not able to sustain their initial success.

So far, we have identified the creation of economic value and the benefits structure as core elements in the notion of business models, but we have not explained how a business model differentiates from competition, nor how the firm plans to reach its customers and on which cost and revenue models it plans to earn money from value creation. In this respect, [Timmers, 1999] complements our definition by taking into account the potential sources of revenue. He considers a business models as "architecture for product, service and information flows including a description of the various business actors and their roles, along with a description of potential benefits for the actors and a description of the sources of revenue". However, such as point of view focuses on elements internal to the value creation network and does not discuss the various relationships and dependencies that hold with the external world: customer segments and market segmentation, promotion and customer care, law compliance and the structure of competition.

[Gordijn et al., 2000] point out that while process models focus on the *how* business is conducted, business models describe *what* the business is about. A business model explains "*who* provides *which object* of service of value *to whom*, and *what* he expects in return". It summarizes from a management perspective the way that the enterprise creates value, and on the basis of which resources, partnerships and value creation activities.

In this broad sense, a business model would cover the *scope* perspective of the Zachman framework (introduced on page 3); it answers the questions concerning the motivation (why?), the data and content (what?) as well as the people involved (who?).

Different BM Perspectives

When capturing an enterprise's business model, the modeller can take two distinct perspectives:

- The *perspective of the Enterprise modeller* puts the enterprise in the centre of attention. In this case, the business model depicts a single enterprise and how it creates value for its customers. The value creation activities are those that are internal to the company; the boundaries of this view are the purchasing of resources from suppliers on the one side, and the sales of products and services to the customer. Such a perspective requires on the process level a detailed understanding of the internal business processes.
- The *perspective of the value chain* or transaction (such as in the ebXML initiative and the ISO Open-Edi model) puts the overall value configuration in the centre of attention. In this case, the business model shows all business parties involved in the value creation, the suppliers of raw materials, product and component manufacturers, service providers and the end customer, in fact, all entities that are part of the supply chain. Here the internal transformations (business processes) of inputs into outputs of each business partner are hidden while the focus is on the external exchanges, that is, what one business partner delivers and receives from the others. [Haugen, Fletcher 2002]) define supply chains as networks of business processes that alternate internal transformations and external exchanges.

In the remainder of this report, we shall refer to the first of these perspectives of business modelling as the *business model*, or *independent* view (as it expresses the point of view of a single actor independently of the others), and the second perspective we shall call *value network*, or *value model,* following our former work in this domain (see [Schmitt et al., 2004]).

The components of a Business Model

[Afuah, Tucci, 2001] postulate that an (enterprise-centric) business model needs at least provide the answers to the following questions:

- *what value* is offered by the firm and
- *which customers* it provides the value to,
- *how* the value proposition is *priced* compared to the offerings of its competitors,
- *what is needed* to provide the value proposition conceived and
- *what strategies* it identifies to *sustain* any competitive advantage derived from its activities.

[Osterwalder, 2004] defines in his "Business Modelling Ontology" a comprehensive set of concepts that the Enterprise modeller needs to take into account when describing the value creation of an enterprise. His modelling framework integrates the questions above and outlines the business of an enterprise from four strategic perspectives which he refers to as pillars: customer interface pillar, a product component pillar, an infrastructure and a financial pillar.

In the context of the Efficient project, we have designed a business modelling framework([Schmitt et al., 2004]) that is based on the work of Osterwalder, but confines itself to the essential characteristics of an enterprise business model and provides a somewhat simplified but easily readable view. The main concepts of our notion of business model are shown in Illustration 5.

The ultimate goal of a business model is to document how an enterprise creates value for a customer. A good starting point for the analysis is therefore the Customer Interface, which details the actual Demand that the enterprise satisfies, the Distribution Channels and promotional means it uses for the different customer segments (Target Customer). Having identified the needs of the customer, the Product component of the model contains the various Value Propositions the enterprise offers to the customers to meet their needs. Note that a value proposition may consist of both products and services. The Infrastructure component of the business model contains the key Capabilities, Resources and strategic alliances (Partnerships) that are at the heart of the value creation, and without which the Value Proposition could not be furnished. The Financial component ties the other components together by associating the Resources, Capabilities and business activities with their respective Costs and confronting them with potential sources of Revenue. The Environment component, finally, describes the various interrelationships that hold between an enterprise and its environment; it lists up potential threads and opportunities that arise from Competition as well the legal constraints and rules (Regulation) that must be respected in order to be compliant with the market regulation.

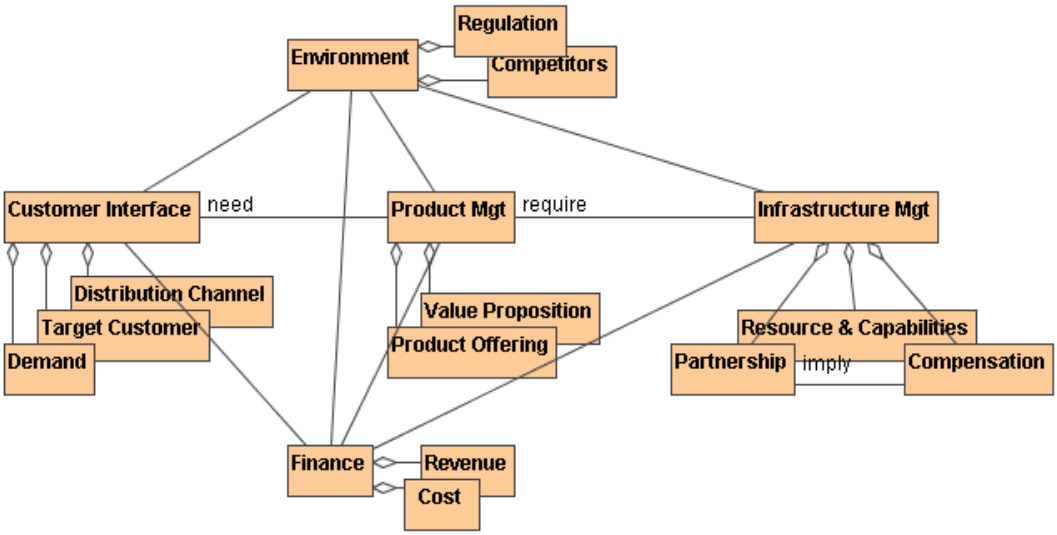


Illustration 5: (main) elements of a business model

The components of a Value Model

With regards to value models, the e3-value approach from [Gordijn, 2004] can serve as a reference model. Gordijn puts forward a graphical modelling notation, which he refers to as a value network. A value network basically is a network of enterprises (actors) that exchange objects of economic value between each other to create value for a customer. Note that each value object exchange is by definition bidirectional in that each enterprise expects a compensation for its products and services. In this report, we use a simplified version of the e3-value modelling language to represent and trace the economic meaning of a business process, which we define as the subset of the value model (set of value object exchanges between business parties) it supports.

In the conceptual model of Illustration 6, an Actor is an economically independent entity. An Actor is often, but not necessarily, a legal entity, such as enterprises or end-consumers. A Value Object is something that is of economic value for at least one actor, e.g. cars, Internet access, a stream of music, a service or business information. A Value Exchange represents one or more potential trades of Value Objects between Actors. A Value Activity is an operation that is carried out by an actor in a way that it creates economic profit for him (and possibly for others).

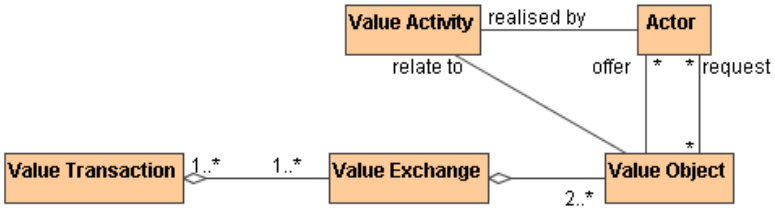


Illustration 6: (main) elements of a value network

The basic rationale of the language evaluation

The comparison between conceptually different frameworks throws up the question about the structure and the criteria for the comparison of the frameworks, especially especially when the scope and the purpose of the frameworks do not match or overlap completely. This section presents our main structuring principles that we used for the comparison and the evaluation of the different modelling languages for business modelling.

We base our comparison on the following criteria:

- The *purpose* of a language shapes its field of application.
- The *expressiveness* in terms of the number and range of *concepts covered* by the language, impacts on the *usability in a specific business context*
- Other structuring criteria are the *simplicity* (ease of use) and *adequacy* (applicability in a given context) as well as
- the *existence of tools* and their integration into an IT architecture.

The notion of the coverage of a concept refers to the question whether the language in question is capable of expressing a given semantic concept. Generally speaking, a concept A1 in a language A covers a concept B1 in language B if and only if A1 and B2 are synonyms. Note that the semantics of A1 may subsume the semantics of B2, in that A1 can be a super-type of B1 so that the super-type covers all subtypes (just as "Child" *covers* "Daughter" and "Son"). If only some occurrences of a concept B are covered by A, but not all, we call the coverage a partial coverage.

Our comparison is aligned to existing studies (as [Andersson et al., 2006]), on which we build on and select a subset of criteria which are relevant for our purposes.

Integration of different domains

The modelling languages under examination in this report have more or less the same focus and there are overlaps in some areas. However, there are also differences, which prevent us from making a direct comparison between them. The most significant differences are due to the use of different terms (alphabet of the

language) to refer to the semantic concepts, that is, the same semantic concept (e.g. an enterprise) is called differently in the different frameworks (e.g. actor, role, entity). In such

While ontologies suit perfectly the need to formalise conceptual relationships, there is hardly any IT support that provides a user-friendly and graphical interface. We shall therefore use a simple UML Class Diagram as an intermediate representations to express the differences and similarities that hold between the formal languages for business modelling.

Digression: Ontologies

Ontologies have been studied for long by philosophers in their search for a systematic explanation of existence, trying to identify what kind of things exist. More recently, they have been "rediscovered" as a major research topic in the fields of artificial intelligence and knowledge management where they address the content issue: "What kind of things should we represent?"

The answer to that question differs with the scope of the ontology. Ontologies that are subject-independent are called upper-level ontologies, and they attempt to define concepts that are shared by all domains, such as time and space. Domain ontologies, on the other hand, attempt to define the things that are relevant to a specific application domain. Both types of ontologies are becoming increasingly important in the era of the Internet where consistent and machine-readable semantic definitions of economic phenomena become the language of e-commerce.

excerpt of [McCarthy, Geerts, 2000]

Formal languages for business modelling

The language selection in this section is based on the research on business modelling and business/IT alignment that was done in the context of the Efficient R&D project (see [Schmitt et al., 2004] and [Andersson et al., 2006]). The description of languages is by no means meant to be an exhaustive analysis; rather it opens up a panel of existing approaches, to illustrate the different perspectives.

For each language or modeling framework, a short overview of its purpose and context is provided, followed by a meta-model of the main concepts covered by the modeling approach. Next, the available tools are commented. The last section evaluates the language with regards to its expressiveness for both the business model and the value network perspective, so as to enable a comparison of the language in question to the others of the same domain.

Business Modelling Languages: quick index

Resource-Event-Actor (REA)

Overview

The Resource-Event-Actor (REA) framework was originally presented in [McCarthy, 1982]; since then, it has been developed further both with regards to the concerns of Enterprise Modelling [Geerts, McCarthy, 1999] and with respect to the modeling of end-to-end transactions rather than treating each value exchange on an individual basis [TMWG, 2003]. Its conceptual origins can be traced back to business accounting where the flow of resources (physical, financial) between an enterprise and its customers and suppliers are documented in the company's accounting records in the form of a ledger (book of accounts). According to the principle of double-entry bookkeeping, every business transaction is recorded as a double entry, both on the asset and the liability side.

The core concepts in the REA ontology are the Resource, Event, and Agent . The intuition behind the REA view on a business transaction is that it can be described as an economic Event where two Agents exchange one or several Resources. To receive a Resource, an Agent has to give up some other Resource(such as money). This is shown in Illustration 7.

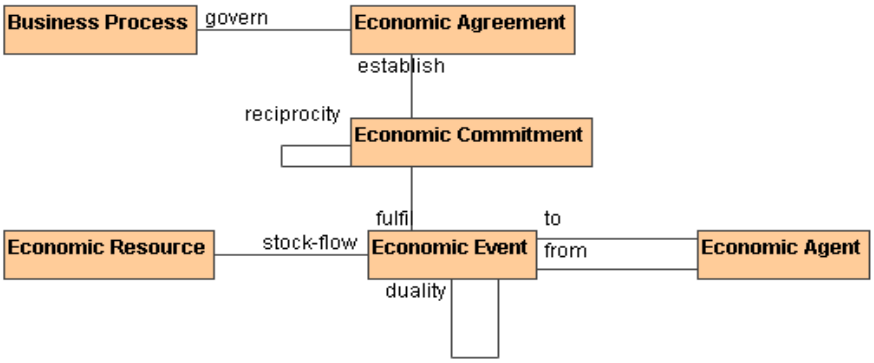


Illustration 7: Simplified REA ontology

For example, in a purchase transaction, a buying Agent must give up a sum of money in order to receive goods from the other Agent. The amount of money available in the cash account of the first Agent is decreased, while the amount of goods on the asset side of the ledger is increased. Two Events take place at the same time: one event that decreases the amount of money on the cash account and another where the amount of goods is increased. This is referred to as the Duality principle. Note that on the seller's side, the same principle applies, but with opposite impacts (increase of the amount of money, decrease of the amount of goods). An economic exchange is defined as a situation where one Agent receives economic resources from another Agent and gives back to that Agent some resources;

[Hruby, 2006] recently extended the REA ontology by adding the notion of an

economic Conversion, which he defines as a situation where an Agent consumes Resources to produce other Resources, such as in a manufacturing context. He further points out that Events often occur as consequences of existing obligations of an Agent; in other words, Events fulfil the commitments of Agents. A Commitment is defined as "an agreement to execute an event in a well-defined future that will result in either an increase or a decrease of resources" available to an agent. Thus, Events are the consequence of and triggered by Commitments that hold between Agents; The Duality relationship between Events can be explained by the principle of the Reciprocity of Commitments. It is an Agreement that defines which Commitment is related to which Event .

Method & tools

Different methods are based on the REA language, among of which is the Unified Modelling Methodology (UMM, [UNTMG, 2001]) that builds upon REA by adding a complete methodological guideline to break down a set of economic events into a full business process collaboration. More details on UMM are given on page 16. REA is supported by commercial tools (e.g. a Microsoft's Visio[2] stencil) and academic prototypes, such as e.g. a plug-in[3] for the UML Case Tool "Enterprise Architect", developed at the University of Vienna.

Evaluation

Business Model perspective

REA's scope is the exchange of economic resources between actors. It is rather strong concerning the modelling of value chain concepts, however, when it comes to the mapping of a business model perspective (see page 7), that is, the value creation from a company-centric viewpoint, it turns out to be rather weak. Illustration 8 exemplifies REA's capacity of expressing business modelling concepts, where such concepts that REA covers are shown in green and those that is covers partially are in white. The dark brown concepts are those that are not addressed by REA.

The Partnership and Compensation elements can be expressed in REA by the Agent concept and the Duality relationship between Events. The other highlighted concepts (in white) are those that are only *partially covered.* REA accounts only indirectly for the Revenues and Costs induced by an economic Event; the same holds true for Resources that are involved but not essential, that is, secondary to an Event.

2 A REA stencil for MS Visio is available from http://www.phruby.com/.
3 The UMM plugin for Enterprise Architect can be downloaded from http://untmg.org/.

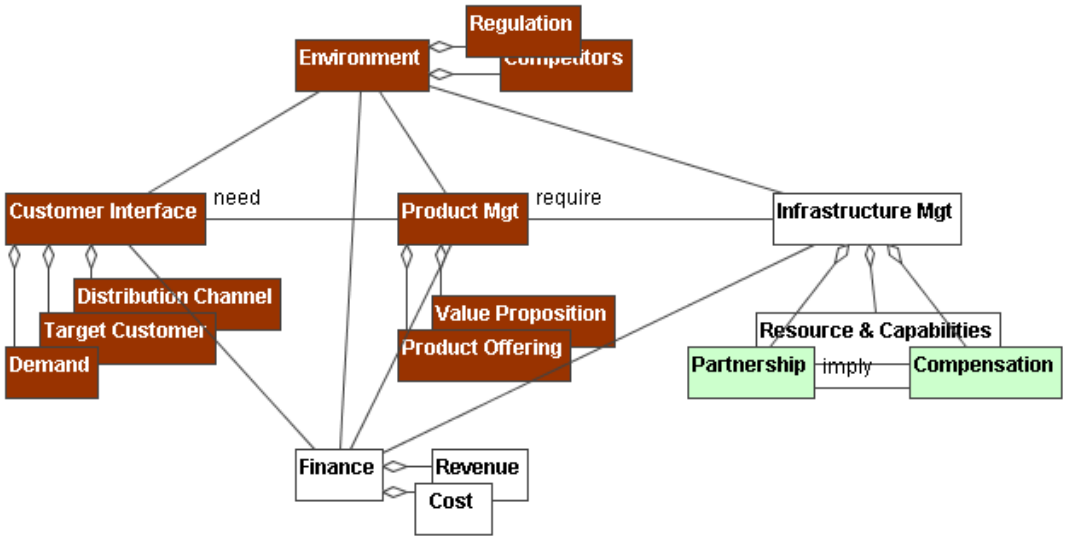


Illustration 8: Independent-level concepts covered by the REA framework

Value network perspective

From an ontological point of view, REA shows many similarities with the e3-value ontology and is therefore well suited to express the core concepts of the value perspective, as described on page 8.

REA refers to Actors as Agents. Agents offer or request economic Resources (which are synonym to Value Objects) in the context of economic Events. Events are related to Agents by economic exchanges that correspond to notion of Value Exchanges. Finally, the Events an Agent is involved in are by definition in a Duality relation which implements the concept of reciprocity of value exchanges – this is exemplified in the meta-model by the offer and request relations. As shown in Illustration 9, a concept that is difficult to express in REA is that of the Value Activity, which are activities that require one or more Value Objects as input and transforming them into a set of outputs of higher value. One may argue that the idea of a Value Activity is indirectly contained in REA, in that the different events of an Actor are grouped by a single Agreement; that is why we have chosen to represent the Value Activity as a *partial coverage*, that is, in white colour. Other researchers (see [Gordijn, 2004]) take a different viewpoint on that aspect.

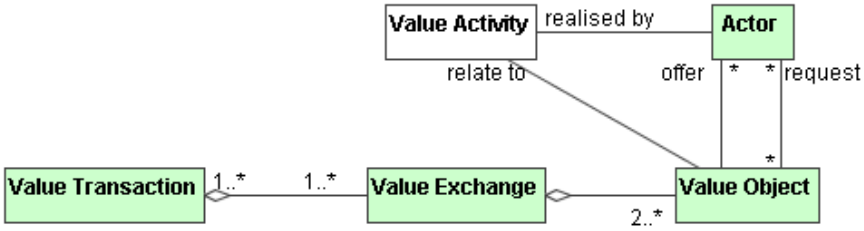


Illustration 9: Value-level concepts covered by the REA framework

Process alignment

The mapping of REA onto the elements of our business process meta-model (that is, Role, Input, Output and Resources, as defined on page 3) is straightforward. Illustration 10 gives an overview of REA's expressiveness in terms of business process models. It turns out that REA seems not suited to express the concept of a process Activity , at least there is no direct mapping between the core concepts of REA (see page 12) and a process activity, which is an activity that transforms inputs (Products)into outputs. However, a recent extension of the REA language by [Hruby, 2006] adds the concept of Conversion which he defines as the "place" where an Agent consumes Resources in order to produce other Resources, and that definition comes close to an Activity in a business process.

Illustration 10: Process-level concepts covered by the REA framework

UN/CEFACT Modelling Methodology

Overview

The UN/CEFACT Modelling Methodology (UMM, [UNTMG, 2001]) builds on the REA language (described on page 12) a business-driven methodology to refine a set of economic events modelled in UML, step by step, into an operational business process.

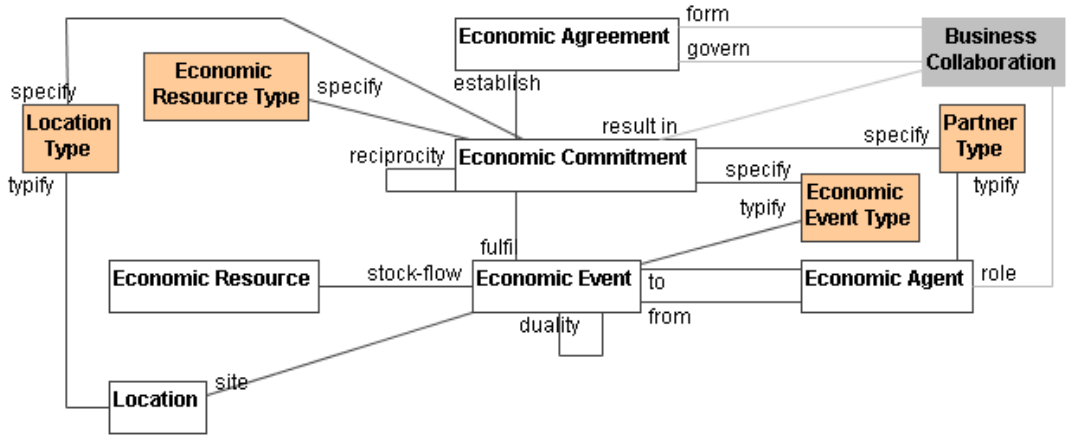


Illustration 11: UMM extensions to the REA concepts

The concepts used in REA (see Illustration 7) are primarily of descriptive purpose in the sense that they illustrate what the commercial agreement (commitment) is about and which resources are concerned by an economic exchange between two business partners. In the UMM, these descriptive components are complemented by *prescriptive* components, which allow the specification of control policies and collaboration patterns. These prescriptive components are enabled by *typing* the descriptive components. The class diagram in Illustration 11 shows these additional concepts in orange, with the core elements of REA in white colour.

The REA ontology has a three-level architecture that is explained in [Geerts, McCarthy, 1999]. In the UMM, the three levels of the architecture are taken up by the notion of views. REA differentiates the Business Domain View (BDV) on the top level, the Business Requirements View (BRV) and the Business Transactions View (BTV) which makes the latter concrete.

The partial integration of the elements of the REA ontology with the components of the UMM business collaboration framework is shown in Illustration 11. We added a class for Business Collaboration (in grey) and depict (again by grey lines) the associations there are with the classes of the REA language.

The version of REA that is used in this analysis is based on UMM [TMWG, 2003]. This version does not explicitly distinguish between the notions of conversion and transfer, as described by [Hruby, 2006].

Methods and tools

A recent academic prototype is available as a plug-in[4] for the UML Case Tool "Enterprise Architect" that fully supports the UMM approach and drives its user into formalizing the right artefacts while answering the conceptual questions driven by the methodology. This plug-in is developed in collaboration with the University of Vienna.

4 The UMM plugin for Enterprise Architect can be downloaded from http://untmg.org/.

Evaluation

Business Model perspective

Since UMM's scope is close to that of REA (described on page 12), this framework is equally strong at modelling value chain concepts; it does not supersede REA with regard to handling a business model perspective (shown on page 14, in Illustration 8).

The Partnership and Compensation elements can (possibly) be expressed in UMM by the Agent, Partner Type concept and the Duality relationship between Events.

Value network perspective

Regarding the ability of UMM to express value chain concepts, UMM is equally strong as REA at expressing the core concepts of the value perspective, as described in Illustration 9 (on page 15).

The one concept that was less well-covered by REA (the Value Activity), is better described by UMM as a part of business collaborations, namely a Business Transaction, where it improves the coverage of UMM concerning value network concepts with regards to its roots.

Process alignment

As we mentioned earlier, the present analysis is based on UMM [TMWG, 2003] and does not explicitly distinguish between the notions of conversion and transfer, that were recently proposed by [Hruby, 2006]. This extension to REA (and hence UMM) adds the concept of Conversion which is defined as the "place" where an Agent consumes Resources in order to produce other Resources, that comes close to an Activity in a business process... with this extension the covering of Process concepts by the UMM framework would be complete.

e3-value

Overview

The e3-value ontology ([Gordijn et al., 2000]) aims at identifying exchanges of Value Objects between the Actors in a business collaboration. More to this, e3-value supports an analysis of the economic profitability of a business case.

The basic concepts of e3-value, as shown in Illustration 12), are Actors, Value Objects, Value Ports, Value Interfaces, Value Activities and Value Exchanges.

An Actor is an economically independent entity. An Actor is often, but not necessarily, a legal entity, such as enterprises or consumers. A Value Object is an object of economic value for at least one Actor, e.g. a car, access to the Internet,a stream of music, or some valuable business information; basically, any tangible or intangible object can serve as Value Object, as long as Actor, is willing to pay for it.

A Value Port is used by an Actor to exchange (send, receive) Value Objects with other Actors. A Value Port has a direction. The direction can be ingoing or outgoing indicating whether Value Object flow in (receiving from other Actors) or out (sending

them out) through the Value Port. A Value Interface groups the Ports that belong to the same Actor. Value Interfaces are used to model the reciprocity of economic exchanges.

A Value Exchange is based upon a pair of Value Ports with opposite directions that belong to two different Actors[5]. It represents one or more potential trade activities of Value Objects between the two Value Ports.

A Value Activity finally is an operation that can be carried out in an economically profitable way for at least one Actor.

e3-value focuses on modelling value networks of cooperating business partners and provides additional instruments for the analysis of the profitability of the business cooperation, so as to distinguish between business cases that are sound and sustainable and others that are unlikely to be sustained (see [Gordijn, 2004] for a detailed account of the notion of profitability in a networked business scenario).

There are couple of extensions of e3-value that link e3-value models with the corresponding business process models that implement them ([Bergholtz et al., 2005]), ([Schmitt, Grégoire, 2005], [Weigand et al., 2006]). Recent extensions of e3-value incorporate a more detailed analysis of the transfer of a value object between two actors in an economic event. [Weigand et al., 2006]) distinguish three aspects of an Event (so-called Transfer), depicted in Illustration 13, in terms of

1. the transfer of the rights (ownership, use..) of the object.
2. The (potential) transfer of any evidence that entitles the new owner of the right to use it.
3. The (physic) transfer of the custody to the object, that is, providing the recipient with physical access to the value object).

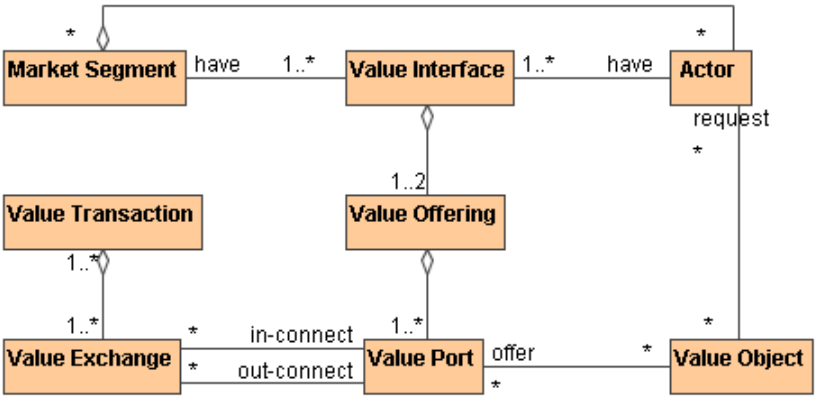


Illustration 12: e3-value concepts (simplified)

5 This definition of Value Exchange is incomplete, and only converse case of e3-value models without actor compositions; where actor compositions are allowed in the model, the value exchange construct is also used to relate value ports of a composite actor to value ports of actors being part of the composite.

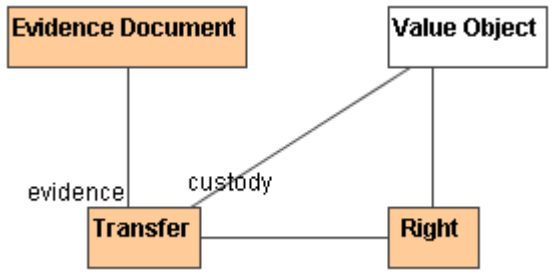


Illustration 13: Transfer refinement in e3-value.

Method & tools

From a methodological point of view, e3-value provides a methodology for business development, which supports the progressive design and improvement of value models. It supports the business developer by a series of tools that are freely available[6]. An e3-value editor can be downloaded to graphically design and check e3-value models. The tool generates so-called value-flow sheets from the value models which can be used to assess the profitability of the latter.

Evaluation

Business Model perspective

e3-value models depict the essence of a business collaboration. They are hence much closer to the value model viewpoint and do not provide a comprehensive account of the value configuration of a single enterprise. Although some information the potential benefits of the participation of an Actor in a business collaboration can be gained, in terms of the Revenues he can achieve, e3-value models do not incorporate Cost-related information, as can be seen from the model in Illustration 14.

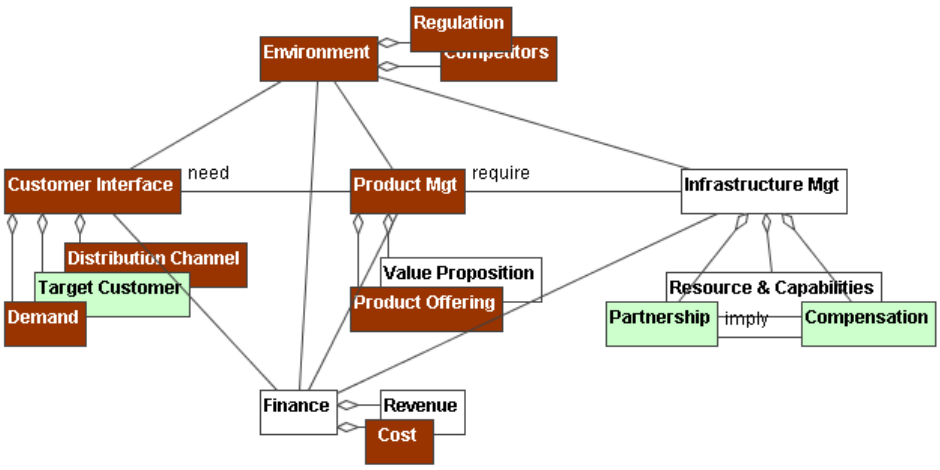


Illustration 14: Independent-level concepts covered by the e3-value framework

e3-value turns out to be rather good in the development of new business ideas, by

6 the e3value toolset can be found at http://www.e3value.com/

identifying possible Market Segments and showing *who* brings in *what* into a business collaboration and *what* he gets in return. It is rather easily to represent the benefits and added-value of all participants. Although there is no explicit mapping, we have therefore chosen to mark the Value Proposition concept as *partially covered*.

Value network perspective

As far as the as the value network view is concerned, e3-value is a 100% fit (Illustration 15). In fact, our meta-model of page 8 is based on e3-value.

Process Alignment

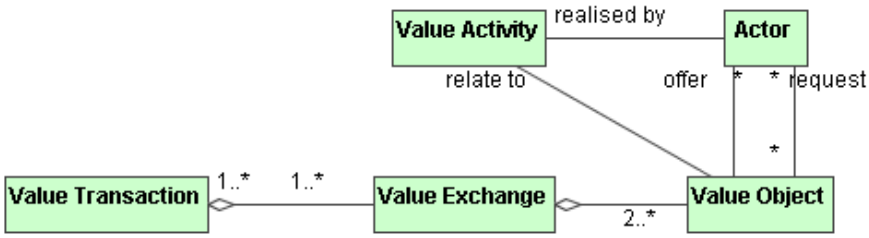


Illustration 15: Value-level concepts covered by the e3value framework

e3-value is well-suited to describe the process view of a business collaboration: Roles, Inputs and Outputs map onto the concepts Actors and Value Objects Note that the mapping for Resources is only partial, in that a value object in e3-value may be associated with a set of resources in a business process, as well as some resources may not occur at all on the value model; this is the case, when a resource has a mere support function and does not provide an object of value itself.

The notions of Process and Activities are not exactly covered by e3-value, however, one may consider a set of value exchanges as a Process. As this interpretation is quite a strong approximation, we state this mapping in Illustration 16 as partial coverage (in white).

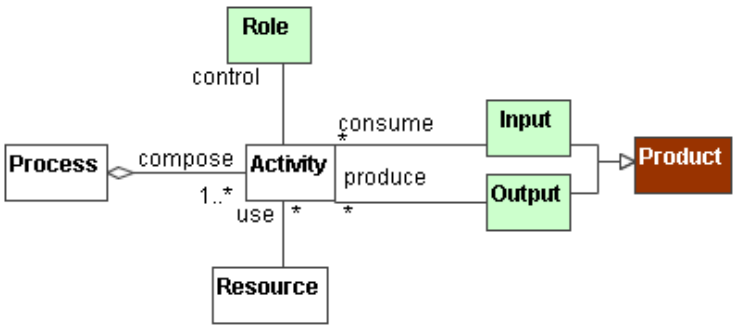


Illustration 16: Process-level concepts covered by the e3value framework

Business Model Ontology

Overview

The Business Model Ontology (BMO) (see Illustration 17) was defined by [Osterwalder, 2004] in the context of his PhD thesis at the HEC Lausanne. BMO is an ontology that focuses on the business model of a single firm or enterprise. It consists of nine core concepts that are organised in four categories (or "pillars" as they are called). These pillars are the Product component, Customer Interface, Infrastructure Management, and Financial Aspects. The starting point for the analysis of the value creation of an enterprise is the Customer Interface . It is made up of a set of elements that describe the customers (Target Customer,) of the enterprise along with their needs and preferences, and the Distribution Channels used by the enterprise to get in touch and maintain a trusted Relationship with customers.

The most important concept in the Product component pillar is that of the enterprise's Value Proposition. A value proposition is an overall view of the bundle of products and services that the enterprise offers and that are of value to the customer.

Infrastructure Management contains three concepts; Value Configuration, Capability, and Partnership. A Value Configuration describes the mix of resources (tangible, intangible, human) and activities that are necessary to create value for the customer, that is, to provide him with the Value Proposition. The link between Infrastructure Management and product component is assured by a set of capabilities, which are defined as the ability to execute a repeatable pattern of actions without which the enterprise would not be in a position to create value for the customer. A capability, in fact, resides upon a set of resources and activities.

A partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the Target Customer. A partnership is needed when an enterprise cannot provide the required capabilities and resources and hence needs to team up, i.e. collaborate with or purchase from them from an external business partner.

The Financial Aspects pillar is made up of concepts; Cost Structure and Revenue Model. Cost structure is the representation in money of all the capabilities, resources and partnerships of the infrastructure component of the business model. Revenue Model describes the way a company plans to gain money. It lists up the potential sources of revenues.

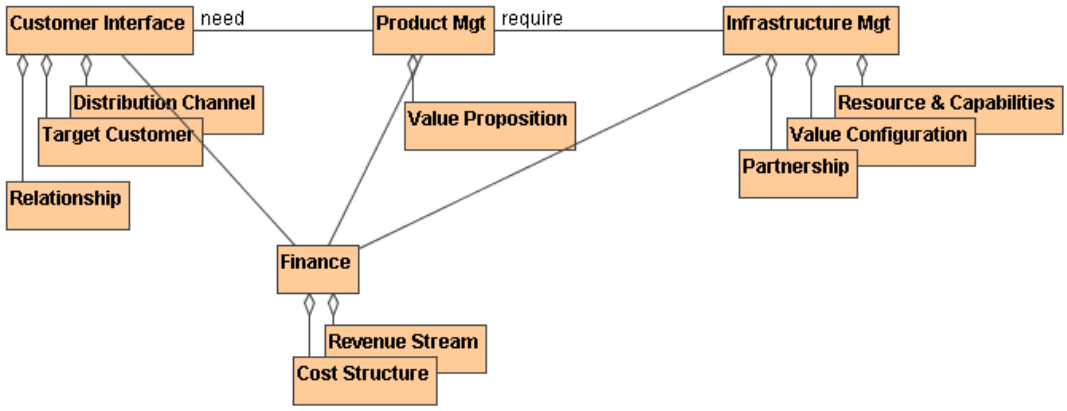


Illustration 17: Business Model Ontology (BMO) concepts (simplified)

Method and tools

BMO is a business modelling ontology, that is, its primary purpose is to provide the modeller with a comprehensive set of concepts and relations to describe the business model of an enterprise. BMO lacks a convenient way to visualize business models, however, a tool that is to support both entry and display is currently being built. Recently, an integrated business design method has been developed by [Pigneur, Osterwalder, 2006], which integrates both (goal-based) requirement engineering and the strategic alignment between business goals and IT.

This method, still under development, builds upon BMO as a core and enables the use and the integration of BMO together with goal-oriented requirements analysis, Scorecards for the management of an enterprise, cost analysis and budgeting.

Evaluation

Business Model perspective

BMO covers about 90 percent all concepts of the business model view, in fact BMO has served us as a conceptual basis for the business modelling considerations in this report. In order for BMO to be able to describe the interfaces a company has with its suppliers and customers, especially with regards to a supply chain viewpoint, we added some new concepts: These new concepts include on the hand hand the socio-economic Environment of the enterprise, as no enterprise exists in a vacuum and the rules and regulations of the market in which it operates impact on its value creation. On the other hand, each business exchange with suppliers, manufacturers or service providers in a transaction (or a long-term Partnership) must be bi-directional, where one partner provides the other with a value object and will expect a Compensation.

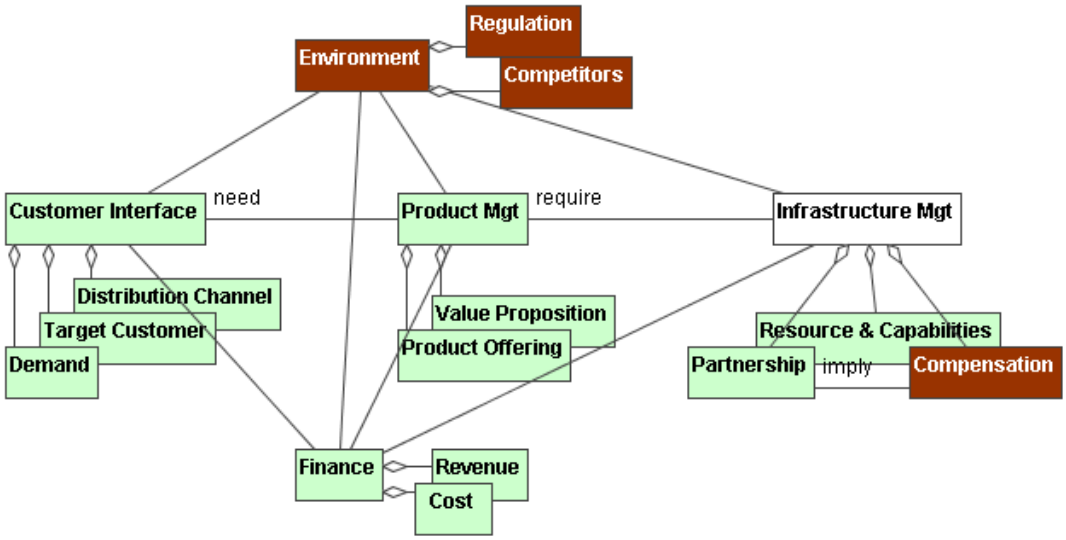


Illustration 18: Independent-level concepts covered by the BMO framework

BMO has not been developed with the aim to model a supply-chain scenario or the value creation of a network of business partners. Its focus is on the individual enterprise and what it offers to its customers and how. In consequence, there is no Actors concept in BMO; a collaboration with other business partners is covered only to the extent that a partnership relationship with an external partner exists, for several reasons: a partnership may be motivated by complementary strengths which the business partners can bundle to either minimize costs or to maximize profit. Other reasons are a customer-supplier relationship, where one party provides a resource that the other needs in its value creation, or a joint operation is built in order to jointly manage business risks, e.g. when entering new markets for the first time. What we refer to as Value Objects, is covered in BMO, at least to a large extent, by the Resources concept. Resources are in general provided by the business Partners, or they are available in the enterprise. A flaw in BMO is that the customer is not sees as a business partner, so that the resources (know-how, personnel, money, commodities etc.) are not covered. Furthermore, BMO's Value Activity is not perfectly aligned with the Value Configuration, which explains why we marked this as a *partial coverage* in Illustration 19.

Process alignment

BMO covers the following process concepts of the meta-model shown on page 3: The Infrastructure pillar describes the enterprises business Activities along with their main Inputs and Outputs, which are represented as Resources. As already mentioned, a weakness is that the list of Roles and Resources may not be complete; BMO does not have a Process element, however, a business process view can be generated from the Infrastructure Management component of the ontology.

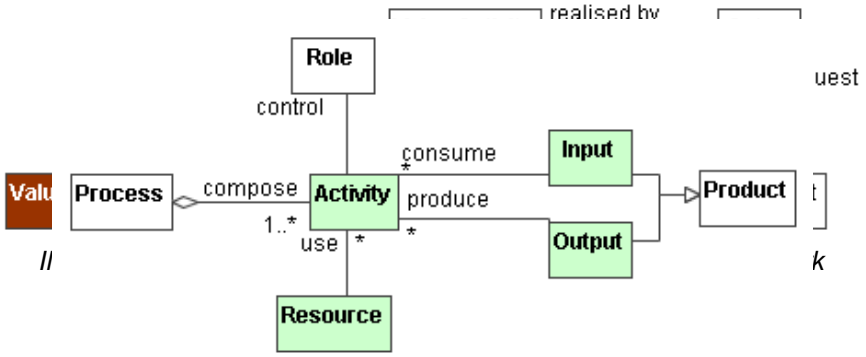


Illustration 20: Process-level concepts covered by the BMO framework

Business Motivation Model

Overview

In September 2005 the Business Motivation Model (BMM), developed by the Business Rules Group (BRG), was confirmed as a de-facto standard for justifying the operational behaviour of enterprises.

The Business Motivation Model (BMM) is a meta-model tailored for the business governance. BMMs do explain *why* enterprises run their businesses the way that they do; its underlying principle can be described as "Businesses are driven, not by change, but by how they decide to react to change".

The BMM aims at complementing the OMG's business modelling scope by addressing the following questions:

- what the business is trying to achieve (its goals and objectives),
- how it intends to achieve its goals (its strategies and tactics),
- what it plans to use to govern its approach (its business policies), and
- why it is doing what it is doing (its assessments of the impacts of influencers).

To reach its goals, the BMM defines a *vocabulary* for governance including such concepts as "influencer", "assessment", "business policy", "strategy", "tactic", "goal", and the *logical relationships* that hold between them, such as "business policy governs course of action". Besides, the BRG plans to define a high-level structure for the BMM, based upon the following three aspects of business models:

- Business Processes – the "Business Process Definition Meta-model"[7])
- Business Rules – the "Semantics of Business Vocabulary and Business Rules"[7])

7 Work under progress at the time of writing (2006, July), recent material available from OMG website: http://www.omg.org

- Organization Roles - the "Organization Structure Meta-model"[7])

The main concepts of the BMM are illustrated in Illustration 21 where an End is defined as something that an enterprise wants to achieve or accomplish; An End is described as a fact, it does not include any indication of how the enterprise plans to achieve it. Ends include the Vision, Goals and Objectives of the enterprise (see [BRG, 2005] for a more detailed definition).

Whatever the enterprise uses to achieve its Ends is called a Means: a device, capability, regime, technique, restriction, agency, instrument, or method. Means do not indicate the steps (business processes and workflow) which are necessary to exploit it; they only list up the capabilities needed to do so. Missions, Strategy and

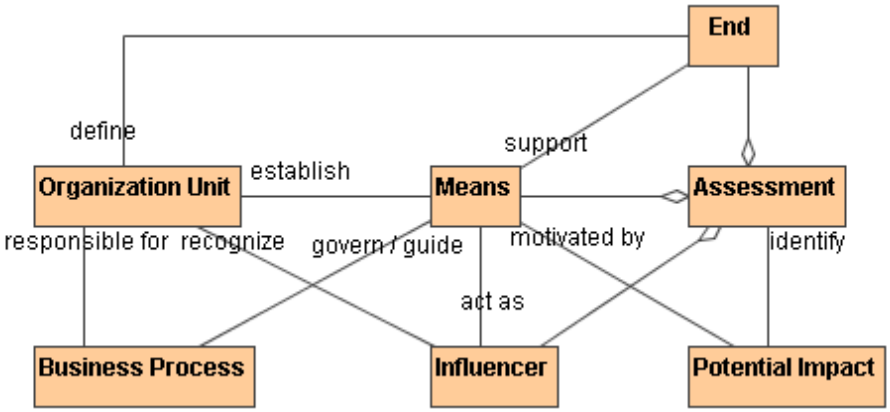


Illustration 21: Business Motivation Model concepts (simplified)

other Directives (including Business Rules) are usually referred to as Means.

The above elements are shaped by Influencers, that can be anything that has the capability to "produce an effect without apparent exertion of tangible force or direct exercise of command, and often without deliberate effort or intent." The actual impact of an Influencer on an End or Means is evaluated in an Assessment. Influencers can be the Environment, the Policies or the Habits of work.

The Business Motivation Model does intend to to describe a full business model. As with a business plan, the BMM focuses on the what the enterprise wants to achieve and on the basis of which means; it does not prescribe how the enterprise needs to organise their business processes and workflows.

Method

[Berkem, 2006] proposes a goal driven and top-down approach based on the BMM for business / IT alignment, which he calls GDDP (*Goal-Driven Development Process)*.

The GDDP differentiates three phases:

1. discover use cases that meet the requirements. The use cases must be derived from the the business goals of the enterprise.
2. establish a bridge between the goals of the enterprise and the components

of its IT architecture which are used to achieve the goals.

3. trace the impacts of changes of the requirements, down to the software implementation level, so as to improve the agility of an organisation to react to the need for change.

Evaluation

Business Model perspective

BMM seems the most accurate framework for the description of the Environment in which an enterprise operates. It gives a comprehensive account of the various types of External Influencers that an enterprise has to deal with, such as its Competitors, Customers, Partners, Regulators, Suppliers, and the Technology it uses in its value creation. Note that BMM does not provide a closed list of influencers but allows an enterprise to adapt and extend the existing types.

With regards to the internal value creation of an enterprise, The Business Motivation Model covers (see Illustration 22) by and large the Infrastructure management of the business-model perspective, where external Partners can be modelled as External Influencers, while the Resources, Capabilities and Compensations can be captured best as Internal Influencers. As for the Product management pillar, BMM does not address the concept of the value proposition in a direct way.

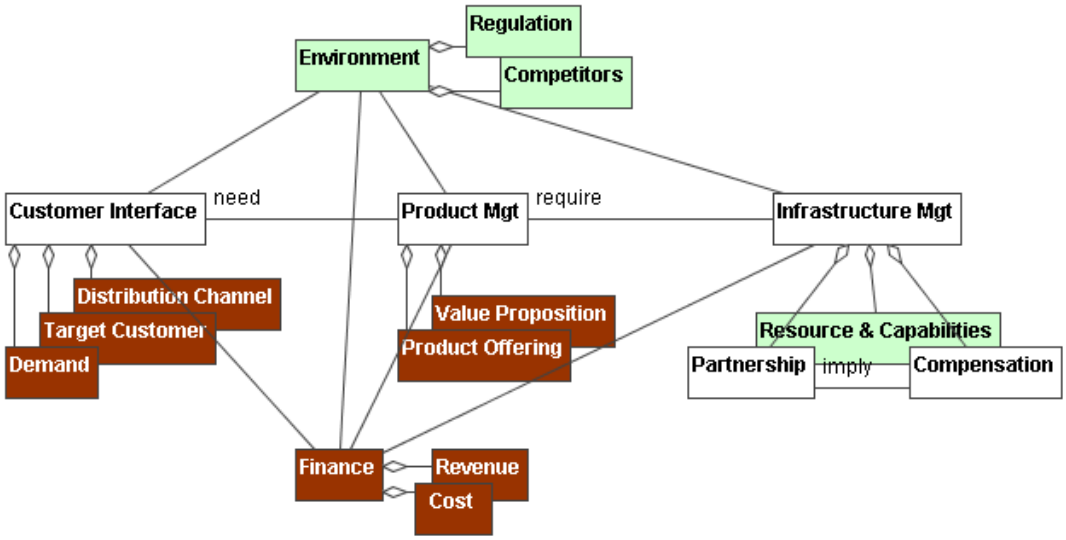


Illustration 22: Independent-level concepts covered by the BMM framework

Value network perspective

The BMM focuses on the internal value creation of an enterprise and is not intended to model a supply chain or a network of business partners with the ways in which the actors interact. Nevertheless following [BRG, 2005] and [Berkem, 2006],

we can derive that a BMM includes all of the Actors involved, and the notion of a Value Transaction can be approximated by the BMM notion of a tactical Means , which is described as a method, technique or device to reach the enterprises' Ends, as depicted in Illustration 23.

Process alignment

The BMM does not support on its own the modelling of business-process related aspects of an enterprise's value creation, however, according to its authors, the Business Rule Group, it can be easily integrated with other OMG models and

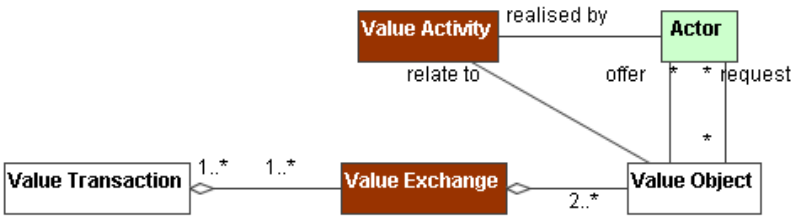


Illustration 23: Value-level concepts covered by the BMM framework

ontologies, which would describe the process view (see [BRG, 2005] for more details).

This mapping between BMM and the business processes of the enterprise can be eased by (as indicated in Illustration 24) the use of UML artefacts for the modelling work in both views,as promoted by the OMG standardisation initiative. However, a detailed analysis needs to be performed to define the actual mapping.

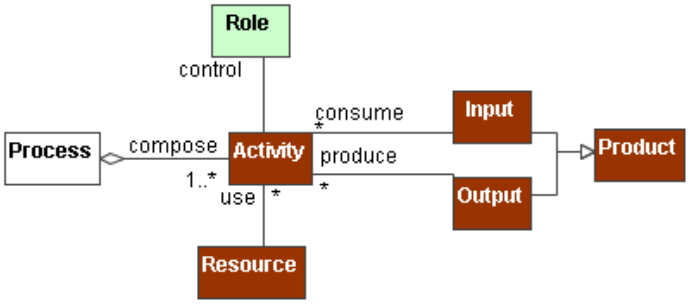


Illustration 24: Process-level concepts covered by the BMM framework

Strategic Map and Balanced Scorecards

Overview

A scorecard is a tool that translates an organization's strategy and mission into a set of performance measures (associated with Key Performance Indicators or KPI) that provide the framework for a comprehensive strategic management system.

The performance of an enterprise depends on a series of factors, some of which are linked to tangible, physical assets and financial control, while others are more of a qualitative nature. Examples include the capacity to innovate and change, the flexibility and the trust and loyalty of the customers. Financial performance can be seen as the result of good performance on other levels or perspectives.

A good scorecard is hence more than an enumeration of targets (outcomes) and KPIs. It is an explicit sequence of hypotheses about the cause and effect relationships between outcome measures and performance drivers of those outcomes. For example, a financial measure could be return on capital. A driver for that could be a repeat and constant sales from existing customers, for which customer loyalty is a measure. A driver of loyalty might be the rate of on-time delivery. To achieve on-time delivery, the business processes of the enterprise must show a quick cycle time, and to achieve this, each employee must be well-trained on the business activities he carries out.

The Balanced Scorecards (BSC), a management instrument developed in the 90's by Kaplan and Norton, describes an enterprise in terms of a set of Perspectives. The enterprise will be successful, if it meets the Goals associated with the perspectives.. In order to ensure and control that the goals can or are achieved, each goals is linked to a set of Measures. The basic structure of the BSC approach are stated in Illustration 25.

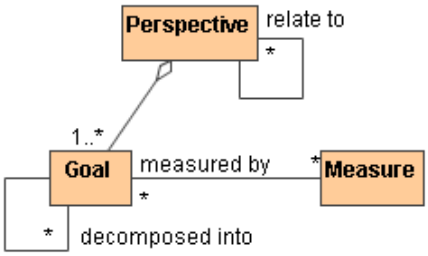


Illustration 25: Balanced Scorecard concepts (simplified)

The perspectives chosen by an enterprise to control manage its performance can be freely chosen by the management of the enterprise [Kaplan, Norton, 1996], however, some typical perspectives include the financial dimension, a customer and business process as well as a learning or people dimension, where the performance of the enterprise on a dimension is depends upon its performance in the other dimensions, that is, the financial results are a function of customer satisfaction, which depends on the delivery of a value proposition that retains or wins customers. This again is based on the enterprise's investment in the right people, technologies and systems. Illustration 26 shows a typical structure of a

scorecard.

However, the selection of the set of perspectives depends on the enterprise and its strategic objectives. A public-service enterprise such as as a regional bus transportation company must ensure the best possible availability and service hours for their buses, and this even in less dense areas of the region where there is a lower demand. As such, it is less driven by financial objectives, but more by quality objectives, which must be defined in-line with those of the geographic region in which it operates. A possible scorecard for such an enterprise is given in Illustration 27 which hypothesises that the quality of the transportation service is a function of the so-called *work sphere* (employment stability, driver's security feeling, manpower increase,...), which characterises the relationship between the enterprise ad its employees. The latter again, is limited by the economic stability and financial sustainability of the enterprise (profitability, state support) without which a suitable work sphere cannot be maintained.

Method & tools

The original proposal by [Kaplan, Norton, 1996] is a top-down approach that breaks down and aligns the strategic objectives and the mission statement of an enterprise

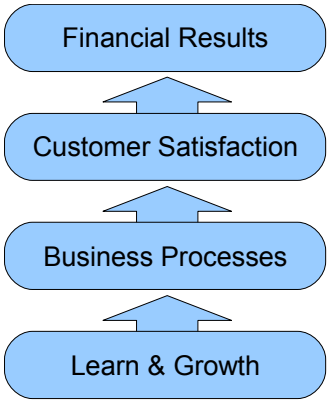
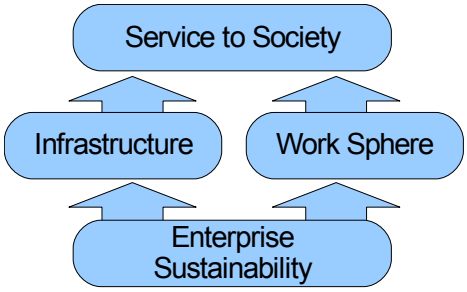


Illustration 26: Classical proposal of Balanced Scorecards pillars

Illustration 27: Strategic Pillars of a public-service company



with a set of measurable and achievable targets for each substructure (and employee) of the enterprise, associated with performance indicators to so as to use the scorecard as a management instrument. The side effects of the application of the BSC approach are equally important:

- Clarify and update strategy
- Communicate strategy throughout the company
- Align unit and individual goals with strategy
- Link strategic objectives to long term targets and annual budgets
- Identify and align strategic initiatives
- Conduct periodic performance reviews to learn about and improve strategy

There are many tool sets available that implement the BSC approach, most of which come from the business process domain ; they link the AS-IS and TO-BE business process models of the enterprise with a set of strategic objectives, for which the enterprise can define some measurable performance indicators (e.g ARIS, ADONIS, IEM). A free software implementation for the BSC approach has been developed by the sourceforge project. [8]

Evaluation

Business Model perspective

The BSC approach covers the majority of the concepts of the business model perspective. In fact, the four perspectives of a balanced scorecard correspond directly to the components (or pillars) of the business modelling ontology: the Customer perspective includes both Demand and Product concepts, the Infrastructure pillar refers to the internal business process perspective, and the Financial pillar is identical with the financial perspective of the BSC, as shown inin . As for those concepts which are only partially covered, those include the environment and the Market Segmentation, which may or may not be taken in to consideration in the BSC approach, depending on their importance for the success (and hence the strategy) of the enterprise.

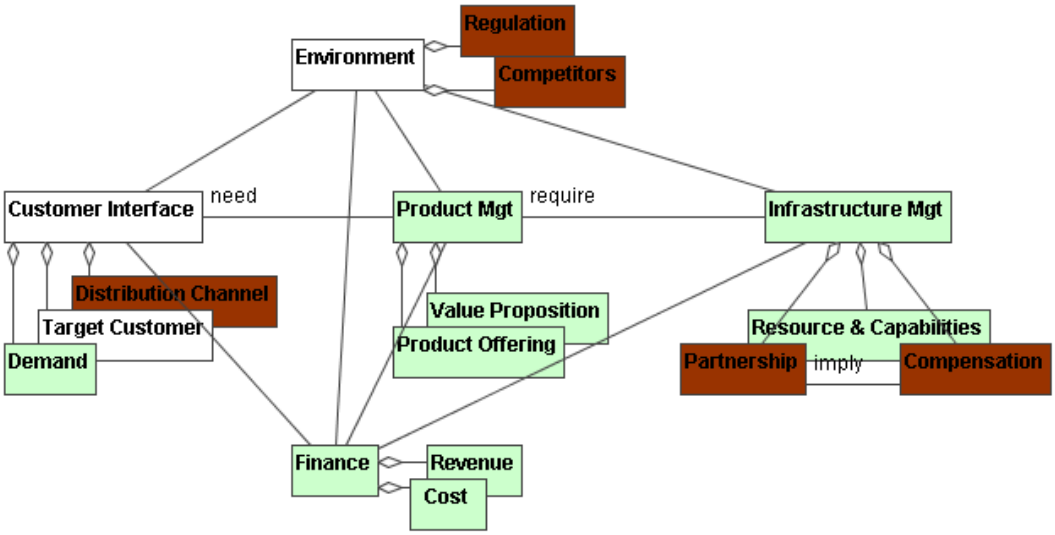


Illustration 28: Independent-level concepts covered by the BSC framework

The concepts in brown colour are seldom or not at all dealt with, as they are, in general, not directly related to the strategy of the enterprise but more important for the operational management.

Value network perspective

The Balanced Scorecard approach does not cover the value network perspective. It

8 the open-source BSPG tool, for instance, provides a complete Balanced Scorecards-based management environment: http://bspg.sourceforge.net/

takes the viewpoint of a single enterprise and the factors that impact its value creation and performance.

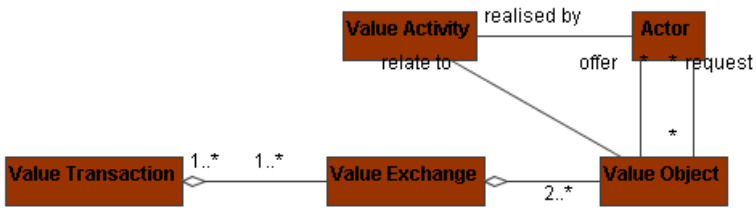


Illustration 29: Value-level concepts covered by the BSC framework

Process alignment

One of the side-effects of the application of the BSC approach is that it aligns the business processes of an enterprise with its strategic goals and associates them with a set of performance measures. Therefore, all concepts required to express efficiently how to realise a process are, on a general level, covered by the more "operational" perspectives of a balanced scorecard. All concepts of the process-level model in Illustration 30 are hence fully covered (in green).

Related Works

A characteristic of business models is that they focus on concepts related to the enterprise's value creation for its customers. This makes their scope different from that of enterprise model ontologies (e.g. TOVE [Fox, 1992] or EO [Uschold, Gruninger, 1996]), which describe organisational structures, activities and the management of the enterprise. Nevertheless, we provide a quick summary of these efforts, in order to broaden the field of thoughts.

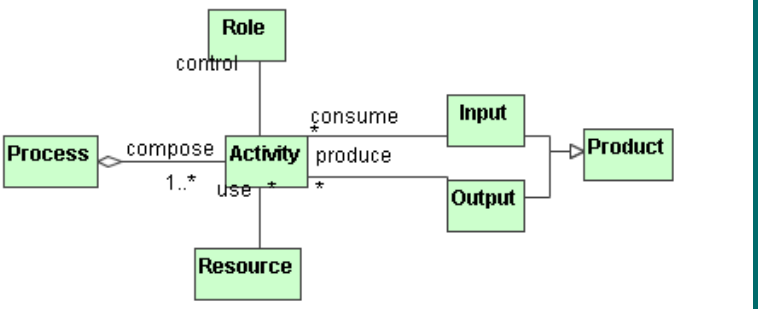


Illustration 30: Process-level concepts covered by the BSC framework

TOronto Virtual Enterprise ontology

The TOronto Virtual Enterprise ontology (TOVE) ([Fox, 1992]) identifies concepts for the design of the *agile enterprise*.

An agile company integrates its structure, behaviour and information. The TOVE

ontology currently comprises knowledge about activities, time and causality, resources, cost, quality, organization structure, products and agility. However, the interfaces an enterprise has with its environment (customers, regulators, competitors, suppliers) are missing in TOVE. Generally speaking, the notion of the creation, distribution, and consumption of value in a network of business partners is not covered by the TOVE ontology. TOVE concentrates on the internal workflow of the enterprise.

Tropos and agent-oriented methods

Agent-oriented methodologies have been used to guide software engineers with the development of conceptual models, which are then stepwise refined and extended in increments to decompose a set of requirements into to system design artefacts and finally to code (a system, that is). The *Tropos* methodology ([Castro et al., 2002]), in particular, uses a modelling language based on a multi-agent paradigm named i*, knows the concepts of an actor, goal, plan, soft goal, resource and capability and states (goal-)*dependencies* between a set of actors.

The dependencies that hold between the actors in a value chain are a powerful instrument to make explicit the interests, goals and needs of each actor as well as potential conflicting interests. Such goal-based modelling may be a good complement to business models in that they emphasise the risks and incompatibilities that may impact on the sustainability of the collaboration.

Business Action Theory

The Business action theory (BAT, [Axelsson, 2003]) divides business processes into six generic phases encompassing generic, interactive actions carried out by a seller and a buyer.

The Business Action Theory is a generic action logic, which has its origin in the domain of linguistics and communication theory. The fundamental idea in BAT is that a commercial activity refers always to a kind of customer-supplier relationship where both actor types perform a series of communicative and material actions. Each of these actions has a physical component (an utterance, a document being send, a phone call, a goods shipment) and an intention component, that is, the intended meaning or impact of the action: transferring the ownership of a good, ordering a good, complaining about its quality or negotiating its price. For each intention, there is a set of typical interaction patterns that characterize the behaviour of the actors. For example, a negotiation usually starts by one actor making a proposal, which is accepted or rejected by the other. The other actor makes a counter-proposal and so forth.

The BAT is well suited to model the different types of interactions and relationships between a network of actors. It seems not a good candidate to model the internal view on an actors value creation.

Business modelling map

The Illustration 31 gives a rough orientation about the different languages discussed in this report. It is meant to be a quick reference about the which key questions and perspectives each of the languages can express, where their respective strengths and weaknesses are.

All the investigated frameworks obviously cover some concerns of the "business process" cell of the Zachman Enterprise Architect framework, and the extent to which they contribute in detailing this particular topic has been thoroughly discussed for each of them.

	What (Data)	**How** (Function)	**Where** (Network)	**Who** (People)	**When** (Time)	**Why** (Motivation)
Scope (Contextual)	REA, UMM, e3, BMO, BSC			REA, UMM, e3, BMO, BSC	REA, UMM, BMM	e3, BMO, BMM, BSC
Business Model (Conceptual)	REA, UMM, e3, BMO, BSC	**Business Process**		REA, UMM, e3, BMO, BSC		e3, BMO, BSC
System Model (Logical)	REA, UMM, BSC			REA, UMM, e3, BMO, BSC		
Technology Model (physical)						
Detailed Representation (out-of-context)						
Functioning Enterprise						

Illustration 31: Mapping of the business modelling languages to the Zachman framework

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