5th International Workshop on

Business/IT Alignment and Interoperability

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In conjunction with the CAISE'10
22nd International Conference on Advanced Information Systems Engineering

Workshop Proceedings

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Preface

The BUSITAL'10 workshop is the 5th edition of the BUSITAL workshop dedicated to business/IT alignment, and interoperability of information systems. Previous editions occurred in Luxembourg, Trondheim, Montpellier and Amsterdam.

Scope and Purpose

Organizations are today becoming more and more dependent on their information systems and IT-based support systems to realize their business strategies, building value networks with partners, and managing their resources effectively. But ensuring that their IT investments are well aligned is not easy. Such alignment is a critical "early stage" activity to understand how information systems contribute to business strategy and to set directions for the development and maintenance processes that follow. Its requires a good understanding and solving of issues at all levels ranging from information technology issues, through organizational issues up to business and strategic issues, and the ability to rapidly, smoothly and consistently adapt all these.

A number of frameworks and methods have been designed to help managers in aligning business and IT. Recently, novel methods and techniques based on conceptual and enterprise modeling have been proposed to support mutual alignment between business needs and IT solutions.

The overall objective of the workshop is to bring together a large community (both Information Systems and Information Management) contributing to exploring the benefits, challenges and solutions of business and IT alignment.

Topics

BUSITAL 2010 topics are well connected to the CAiSE 2010 ones since enterprise models (including strategy and process models), enterprise architecture, and methodological aspects may play a central role in alignment. BUSITAL concentrates on topics related to the business strategy and to the methods and tools for ensuring alignment, including:

- Frameworks, techniques and methods for capturing, understanding and representing business strategy and its impact on information systems landscapes;
- Systems methodologies and frameworks for guiding information system design using relevant information in business strategy models/definitions, including traceability issues;
- Models, methods, and tools for indicating, analyzing, and measuring alignment;

- Solutions for guiding information systems evolution and adaptation using relevant information in business strategy models/definitions, including IT governance;
- Case studies and empirical reports on the benefits and costs of alignment;
- Business/IT alignment in organizational networks, including co-creation of value through global networks;
- Alignment issues in Service-Oriented analysis and design.

The presented papers have been grouped in three sessions:

- Motivations and quality-based approaches for Business-IT Alignment;
- IT governance, Business-IT Alignment management and evaluation;
- Business ontologies and models for Business-IT Alignment.

We would like to thank the authors and the members of the Program Committee for their effort in making this 5th edition a success.

May 2010

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Quality Evaluation for Strategic Alignment Engineering:
An eGovernment Application

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Abstract. This article explores the role of quality evaluation to measure strategic alignment and support strategic IT requirements. In particular, the focus is on eGovernment context that presents a set of characteristics asking for different evaluation metrics from the ones adopted for business in the private sector (usually more investigated in terms of IT strategy alignment). The proposal approach implements a subset of a quality framework on a real scenario for the purpose of quality evaluation. It exploits real-life data from interviews and questionnaires filled by a first sample of non-EU foreign researchers and students in the scope of the Computer Science department where the authors are affiliated, who have applied their residency permits within the past three years. Finally, a probability-based analysis is carried out in order to elicit quality dimensions with priority among the ones considered.

1 Introduction

In this article, we propose to explore the role of quality evaluation to measure strategic alignment and support strategic IT requirements. In particular we focus on the eGovernment context that presents a set of characteristics asking for different evaluation metrics from the ones adopted for business in the private sector which are usually more investigated in terms of IT strategy alignment. Indeed, it is worth noting that, in the context of eGovernment, strategy is not oriented to obtain a competitive advantage and shareholder value as in the private sector; on the contrary, eGovernment value heavily depends on political and social objectives, such as trust in government, social inclusion, community regeneration, community well-being and sustainability [1]. In general terms, in the context of eGovernment, value relies mainly on pubic value. As stated by Grimsley and Meehan [1] on the basis of Moore's conceptualization [2], public value can be interpreted as the value that citizens and their representatives seek in relation to strategic outcomes and experiences of public services.

Due to these issues, we need to consider value not only from an economic perspective, but also as the degree to which public policies improve the quality of life of constituencies - namely citizens and businesses - by improving the quality of public services and of the public administration organization and processes. Therefore, a systemic perspective on quality is required. Among the available frameworks for eGovernment projects assessment [3], in this paper we consider GovQual [4] for its focus

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on quality dimensions and their mutual relationships for the different facets involved in eGovernment projects (i.e. economic, social, organizational, legal, and technological facets).

In this paper we consider a scenario focused on the Italian context, in which the chosen quality dimensions result from a preliminary analysis of online available eGovernment strategy documentations and we assume that they implement the political-vision-related choice; while the scenario process is modelled on the basis of direct observation over a one-year period from September 2008 to September 2009. The corresponding quality evaluation exploits real-life data obtained from interviews and questionnaires filled by a first sample of non-EU foreign researchers and students in the scope of our Computer Science department, who have applied their residency permits within the past three years. Finally, a probabilistic simulation and analysis based on the sampled data have been carried out in order to elicit quality dimensions with priority among the ones considered.

The paper is organized as follows. Section 2 discusses related work. Section 3 describes the scenario for the application of the proposed approach, with a focus on the Italian context. Specifically, the considered administrative process is detailed in Section 3.1, while qualities considered in the scenario are modelled in Section 3.2. Finally, a prior computation for quality dimension evaluation is detailed in Section 3.3, based on which we present probabilistic analysis with Monte Carlo simulation in Section 3.4. Section 4 states conclusions and future works of the paper.

2 Related Work

IT Strategy alignment has been considered as a major issue for management of information systems [5, 6] in order to provide competitive advantages to IT enabled businesses. Strategic IT requirements engineering [7] aims to model alignment in order to elicit strategy related requirements, the most appropriate (among other facets) for the operational level of the considered domain of intervention [8]. To this end business modelling represents an emerging effort providing a set of frameworks for an explicit link between system requirements and the objectives of business strategy [9].

The most comprehensive and well-defined languages and frameworks for business modelling are the *Resource-Event-Actor (REA) framework*, the *e3value framework*, and the *Business Model Ontology (BMO)*. The *REA framework* [10] is focused on representing increases and decreases of value in organizations, which has its origins in business accounting. The core concepts in REA are *Resource*, *Event*, and *Actor*, where every transaction can be described as two events in which two actors exchange resources. *e3value framework* [11] explicitly focuses on resources exchange as value objects. Basic concepts in the e3value ontology are *actors*, *value objects*, *value ports*, *value interfaces*, *value activities* and *value exchanges*. The *BMO* [12] provides a framework that consists of nine core concepts classified under four categories, as described in the following: the category *product* as a single concept, that is *value proposition*; the category *customer interface* has three concepts, namely *target customer*, *distribution channel*, and *relationship*; the category *infrastructure management* has three concepts, namely

value configuration, *capability*, and *partnership*; the category *financial aspect* has two concepts, namely *cost structure*, *revenue model*.

Besides these frameworks which support a value-based documentation of the business model to be implemented in the systems, other models and approaches have been proposed in the literature, focusing more on strategies to model and measure the alignment as a source for requirement engineering, such as the Business Rules Group Motivation Model (BRG-Model) [13], the B-SCP framework [14], INSTAL method [15] (based on the Map Model [16] and exploiting quality metrics [17]), and the e3alignment model [18] as an extension of the e3value framework.

Considering now the operational level, *i** [19] allows to model organizational goals and tasks together with actors and resources. Business process modelling is necessary as a representation of how the operational level works and is managed - in this paper we consider administrative processes as business processes - by means of the state of the art tools and concepts such as the Business Process Modelling Notation [20]. In particular, process models are the basis of the development of specific workflow applications. The models describe the process structure and logic on a type level, whereas workflow applications support the execution of single processes on the instance level.

In this paper we discuss a quality evaluation framework in order to explore its role in providing metrics which support the alignment of operational level with the strategy to be implemented in the eGovernment initiatives. Moreover, we focus on operational level representation by means of process models. Whereas is relevant that we discuss here the state of art models and frameworks for business modelling, this topic will be considered in future work.

3 Residency Permit for Study Reason: A Scenario

In this section, we use the residency permit application process as a scenario to evaluate strategic alignment with respect to quality dimensions and to help analyzing relationships among them, in order to identify evolution requirements that lead to a better strategic alignment. The scenario is focused on the Italian context. According to the agreement signed by the Italian Ministry of Internal Affairs and Poste Italiane SPA (the major Italian company for postal services and mail), non-EU foreign students should present applications for residency permits in Italy annually. The residency permit for study reasons may only be applied and renewed if the entry visa was issued to attend a study course of more than one year in length. The first application, valid for one year, should be made within 8 days upon applicants' arrival in Italy and renewed annually. But in any case, it cannot be renewed for more than three years above the duration of the study course. In the following, we first introduce a workflow system, METEOR, to model the residency permit application process, and then two quality dimensions, efficiency and effectiveness, are mainly modelled w.r.t. different layers in GovQual framework; based on which we present quality computation methods and finally we use Monte Carlo simulation tools to analyze dependencies among quality dimensions.

3.1 Process of Applying Residency Permit for Study Reason

Workflow Structure Existing workflow systems provide a set of indispensable functionalities that manage and streamline business process. Yet, few research groups have concentrated their efforts on enhancing workflow systems to support workflow Quality of Service management. Most of the research carried out in order to extend workflow systems' capabilities to include project management features has mainly been done for the time dimension [21–23]. In this paper, we adopt a workflow management system named METEOR [24] in which, not only is time considered, but also other dimensions associated with workflow executions, such as cost and efficiency. To compute quality of service dimensions, METEOR has developed both a model for the specification of workflow QoS and methods to analyze and monitor QoS, which can be exploited to evaluate different quality dimensions in the following scenario.

As defined in [24], a workflow is composed of tasks and transitions. Tasks are represented using a circle, networks (sub-workflows) using rounded rectangles, and transitions are represented using an arrow. Transitions express dependencies between tasks and are associated with an enabling probability $(p_1, p_2, .., p_n)$. When a task has only one outgoing transition, the enabling probability is 1. In such a case, the probability can be omitted from the graph.

Residency Permit Workflow Description Residency Permit process is composed of four sub-processes (sub-workflow): *Document Preparation*, *Application Identification*, *Fingerprint Collection*, and *Permit Release*. Detailed process goes as follows (seen in Figure 1):

- In the stage of *Document Preparation*, interested parties (non-EU foreign students) ask for related application kit available at certain post offices and fill the forms. Signed application forms together with other required documents must be sent by post to the Police Office (Questura) of their province of residence for the first issue of residency permit. A collection of documents include:
  - Complete photocopy of passport or other equivalent document;
  - Photocopy of the statement certifying the course of study to be taken, certified by the Italian Diplomatic/Consular mission when the entry visa is issued;
  - Photocopy of insurance policy, valid throughout the country and for the entire period of validity of the residency permit, against the risk of illness and injury;
  - Photocopy of the documentation certifying to the availability of adequate financial resources for the validity period of the residency permit.
- In the stage of *Application Identification*, related immigration offices in Italy will check the completeness and correctness of received application documents, and publish the identification result on Internet, where applicants can query their application statements by a user ID and password assigned to the application receipt;
- In the stage of *Fingerprint Collection*, once application documents are identified, in about three months or even longer applicants will receive a registered letter from the Immigration Office summoning them to be fingerprinted (the same information is sent to applicants by SMS as well). Meanwhile, each applicant can inquire his/her application statement physically to related immigration offices according to their application statements published on Internet.

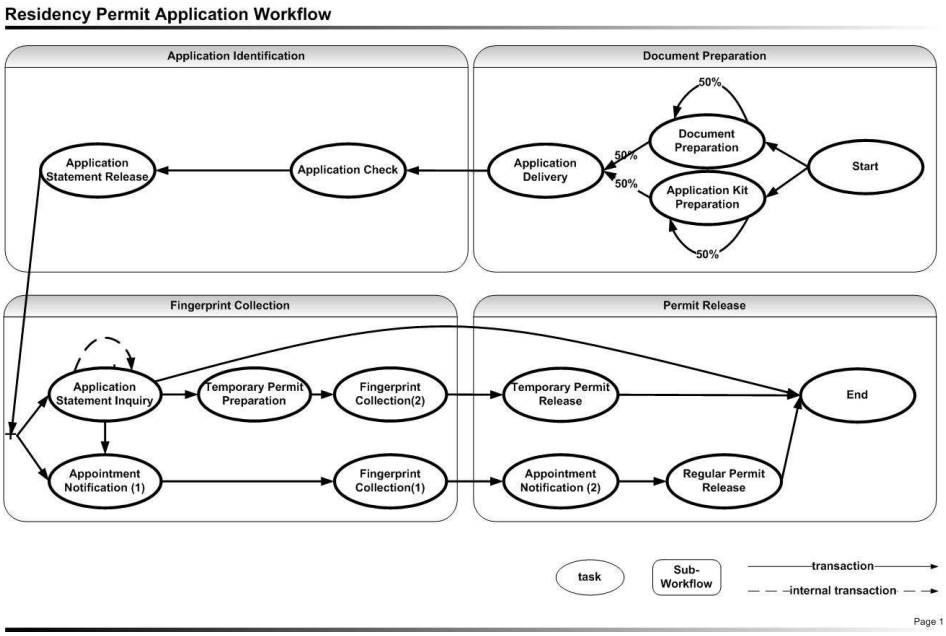


Fig. 1: Business Process of Applying "Residency Permit for Study Reason"

– In the stage of *Permit Release*, after the collection of fingerprint, applicants will have another appointment (the same information is sent to applicants by SMS as well) to release their regular residency permit. In other cases, they will get temporary permits valid for three months or no permit.

3.2 Quality Modelling

As shown in Figure 2 (text in bold), in this paper we mainly focus on the assessment of a limited set of quality dimensions: efficiency, which can be mutually influenced by other dimensions, such as effectiveness. Concerning efficiency, we distinguish between temporal, economic, and procedural efficiency. Temporal efficiency refers to efficient use of time in service production and provision. Temporal efficiency is significant in two layers. At the process/service layer it is classified in terms of two dimensions: the user time (the average time spent by users to obtain the service) and the service provision time (the average time spent by organizational units to produce the service). Temporal efficiency at the ICT infrastructure layer results in response time, the usual dimension considered for hardware and network infrastructures. The measure is simply the time span that the resources need to execute transactions and respond to queries. Economic efficiency concerns the costs sustained for service provision and their trends in time.

The procedural efficiency concerns the level of bureaucratic simplification of the administrative processes, meaningful for the organizational system layer. Procedural

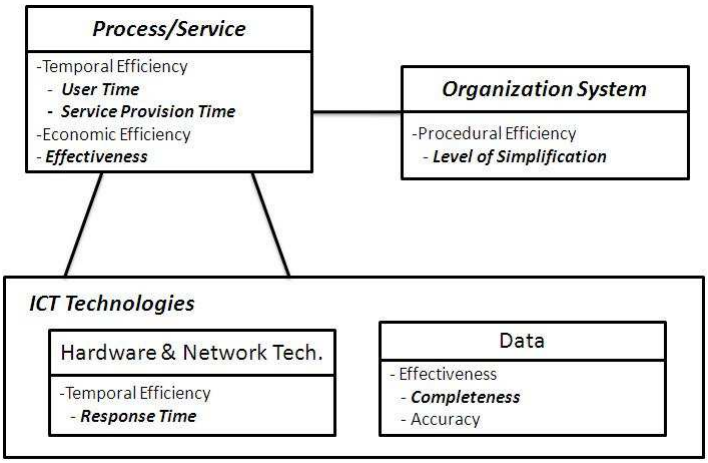


Fig. 2: Quality Dimensions in different layers of GovQual Framework

efficiency refers to the obligations and constraints that laws impose on the administrative processes and on the interactions between administrations and citizens. We associate procedural efficiency with a metric consistent in the level of simplification. This is measured in terms of the number of interactions required by users to provide useful information in order to complete the service.

On the other hand, effectiveness is meaningful at the process/service layer and at the data layer. At the process/service layer it can be expressed in terms of the achievement of the users' expectations. At the data layer, effectiveness results in two dimensions: accuracy and completeness. In this paper we evaluate completeness in the data layer. We use both qualitative (user comments) and quantitative (number of complaints) indicators as metrics for effectiveness assessment in process/service layer. User complaints/comments reflect the users' perception of the accuracy and reliability of service provision, and the evaluation of the service-oriented attitude of personnel in charge of the service within organizational units. Table 1 shows a mapping from qualitative indicators (user comments) to quantitative indictors (number of complaints). Data com-

Table 1: Effectiveness Assessment

User Comments	**Number of Complaints**
Unacceptable	$\geqq 16$
Poor	$\geqq 8$
Satisfactory	$\geqq 4$
Good	$\geqq 2$
Perfect	$\geqq 0$

pleteness is the extent to which data is of sufficient breath, depth and scope for the task at hand. In most service execution processes, as in the residency permit scenario, the execution is incapable to proceed if data is not completely provided. In this sense we measure data completeness with a boolean $< yes, no >$ domain. According to the above definitions of efficiency and effectiveness in different layers of GovQual framework, we can specify temporal and procedural efficiency, process/service and data effectiveness in residency permit application workflow as follows (Table 2):

Table 2: Current Values for Different Quality Dimensions in Residency Permit Workflow[7]

Quality Dim.	**Layer**	**Task**	**Current Value**	**Prob. Dist.**
User Time	Process/Service	Documents Preparation	1 - 2 days	$N(1.5, 0.03)$[4]
		Application Kit Preparation	0.5 - 1 day	$N(0.75, 0.01)$
		Application Delivery	3 - 5 hours	$N(4, 0.11)$
		Application Statement Inquiry[3]	3 months	1
		Appointment Notification (1)[1]	2 - 13 months	$H(2, 13)$[4]
		Fingerprint Collection (1)[2]	20 - 30 days	$N(25, 2.78)$
		Regular Permit Release	20 - 30 days	$N(25, 2.78)$
Service Provision Time	Process/Service	Application Kit Preparation	1 - 5 mins	$N(3, 0.45)$
		Application Delivery	1 - 2 days	$N(1.5, 0.03)$
		Application Check	3 - 7 days	$N(5, 0.45)$
		Application Statement Inquiry[3]	1 - 2 hours	$N(1.5, 0.03)$
		Temporary Permit Preparation	1 - 2 hours	$N(1.5, 0.03)$
		Fingerprint Collection(1)(2)[2]	0.5 - 1 hour	$N(0.75, 0.01)$
		Appointment Notification (2)[1]	0.5 - 1 hours	$N(0.75, 0.01)$
		Temporary Permit Release	1 - 2 hours	$N(1.5, 0.03)$
		Regular Permit Release	0.5 - 1 hours	$N(0.75, 0.01)$
Response Time	ICT Infrastructure	Application Statement Release	1 - 3 hours	$N(2, 0.11)$
		Appointment Notification(1)(2)	1 - 2 days	$N(1.5, 0.03)$
Level of Simp.	Organization System	Application Statement Inquiry	in Section 3.4[5]	in Section 3.4[5]
Effectiveness	Process/Service	Residency Permit Application	in Section 3.4[6]	in Section 3.4[6]
Completeness	Data	Document Preparation	Yes	0.5
			No	0.5
		Application Kit Preparation	Yes	0.5
			No	0.5

1. *Appointment Notification* (1) refers to the first appointment for fingerprint collection and original document check; Appointment Notification (2) refers to the second notification for regular permit release.
2. *Fingerprint Collection* (1) refers to the fingerprint collection and original document check for regular permit processes, while Fingerprint Collection (2) refers to the fingerprint collection and original document check for temporary permit processes.

3. Since there are internal loop transactions within the task of *Application Statement Inquiry* (Figure 1), in Table 2 we only consider time spent for a single task of Application Statement Inquiry.
4. *Probability distribution* of each task is assigned on the basis of a few interviews. Currently we consider two distributions, normal distribution $N(\mu, \sigma^2)$ and histogrm distribution Histogrm$(min, max, \{p_1, p_2, ..., p_n\})$ (in this scenario, Appointment Notification (1) follows a distribution of $Histogrm(2, 13, \{0.5,\ 2.5, 2, 1\})$). In the future stage, we plan to present more precise distributions by exploiting surveys over larger amount of application cases. In addition, due to the complexity of relationships among quality dimensions, for certain dimensions we will present their joint distributions instead of marginal distributions, i.e., joint distribution of process/service effectiveness and efficiency.
5. *Level of Simplification of residency permit* is dependent from other quality dimensions. Since interactions are fixed for other tasks in the workflow, the most flexible part is related to the task of Application Statement Inquiry. Considering that applicant/staff interactions for Application Statement Inquiry are subjective to applicants, we fix the frequency for inquiry in this scenario, which is also reasonable and practical in real life: suppose in the ideal case, applicants will get appointment notifications (both by post and by SMS) in 3 months after their applications have been identified. If not the case, applicants will wait for another 3 months and inquiry their application statements at related Immigration Offices physically for the first time, and once every 3 months if still necessary. Since in 12 months after the first application - which means maximally three interactions for application statement inquiry - applicants are obliged to renew their permits, the workflow will result in the following consequences: within one interaction, applicants may get their regular permits of stay; after two interactions, applications may get temporary permits; after three interactions applications may get no permits. Distributions of number of interactions and permit types will be analyzed in Section 3.4 where we observe a strong correlations between the two factors.
6. Effectiveness in Process/Service layer is presented by a probability distribution of user complaints (also considered as user comments) with respect to different results they get at the end of permit application workflow. Distribution of this quality dimension and the factors which have significant impacts on it are deduced from several interviews we made together with Monte Carlo simulations in Section 3.4.
7. Two simple observations can be achieved from Table 2. Different quality dimensions influence each other in two levels: (i) within single task among the same/different layer(s); (ii) over the whole service process among the same/different layer(s). A more statistic analysis of the above observations will be presented in Section 3.3.

3.3 Prior Computation for Quality Dimension Evaluation

In this section we compute overall time used for residency permit workflow, in order to evaluate relationships among different quality dimensions, i.e., efficiency and effectiveness, and to optimize quality requirements. Overall time for the whole workflow can be computed in three steps: (i) first we present formulas to calculate time spent for each atomic task; (ii) based on which we reduce complex task structures, including (1)

sequential, (2) parallel, (3) conditional, (4) fault-tolerant, (5) loop, and (6) network, into atomic ones; in the following we show three complex structure reduction examples, for *Document Collection*, *Application Kit Collection* and *Application Statement Inquiry*, respectively; (iii) finally, according to the above modelings, we present the overall time spent for residency permit workflow in a more abstracted level.

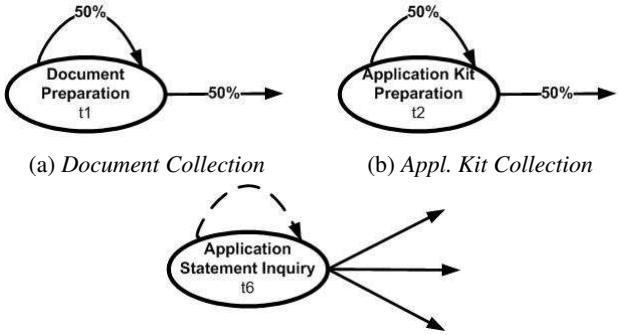
Atomic Task Time Computation In Table 3, computation details for all tasks involved in residency permit application is presented, in which we assign an task ID, t_i, to each task in the workflow. For each task t_i in a service, the overall task time $T(t_i)$ is computed as the sum of user time $UT(t_i)$ and/or service provision time $PT(t_i)$ and/or Response Time $RT(t_i)$, all of which are considered as the main indictors to evaluate efficiency of a service. The overall task time is also effected by other quality dimensions in different layers. Relationships among them will be the focus of the next sections.

Table 3: Atomic Task Time in Residency Permit Application Workflow

ID	**Task**	**Task Time**
t_1	Document Preparation	User Time $< 1-2 > days$
t_2	Application Kit Preparation	User Time + Service Provision Time $< 0.5-1 > day+ < 1-5 > mins$
t_3	Application Delivery	User Time + Service Provision Time $< 3-5 > hours+ < 1-2 > days$
t_4	Application Check	Service Provision Time $< 3-7 > days$
t_5	Application Statement Release	Response Time $< 1-3 > hours$
t_6	Application Statement Inquiry	User Time + Service Provision Time $3months+ < 1-2 > hours$
t_7	Appointment Notification (1)	User Time + Response Time $< 3-6 > months+ < 1-2 > days$
t_8	Temporary Permit Preparation	Service Provision Time $< 1-2 > hours$
t_9	Fingerprint Collection (1)	User Time + Service Provision Time $< 20-30 > days+ < 0.5-1 > hour$
t_{10}	Fingerprint Collection (2)	Service Provision Time $< 0.5-1 > hour$
t_{11}	Temporary Permit Release	Service Provision Time $< 1-2 > hours$
t_{12}	Appointment Notification (2)	Service Provision Time $< 0.5-1 > hour$
t_{13}	Regular Permit Release	User Time + Service Provision Time $< 20-30 > days+ < 0.5-1 > hour$

1. Since applicants will get Appointment Notification (2) for regular permit release at the end of their fingerprint collection task, we mainly consider the service provision time as time used for completing this task. Meanwhile, applicants will get the same reconfirmation information by SMS, which is measured by Response Time in ICT Infrastructure layer. However we consider such a process structure as a fault tolerant sub-workflow, and for the sake of simplicity, response time for Appointment Notification (2) is kept in Table 2 but omitted in the overall time calculation.
2. Fingerprint Collection (2) for temporary permit processes is executed at the end of Application Statement Inquiry task, thus we mainly consider service provision time as time spent for completing this task.

Complex Task Time Computation In the following we present complex structure reduction computations for three atomic tasks respectively: *Document Collection*, *Application Kit Collection* and *Appointment Statement Inquiry* (Figure 3). The loop structure



(a) *Document Collection* (b) *Appl. Kit Collection*

(c) *App. Statement Inquiry*

Fig. 3: Complex Task Time Computation

of t_1 Document Preparation is influenced by data completeness in Data layer. Let t_{l1} be the reduced loop task of t_1, then time spent for completing t_{l1}, denoted as $T(t_{l1})$, is calculated as follows:

$$T(t_{l1}) = T(t_1)(1 + f_1(d)) \tag{1}$$

In which, $f_1(d)$ is the frequency of document preparation and is inversely proportional to data completeness:

$$f_1(d) = \begin{cases} 0 & DataCompleteness := Yes \\ 1 & DataCompleteness := No \end{cases} \tag{2}$$

Since data completeness for t_1 is uniformly distributed (see Table 2), its probability distribution P_1 is:

$$P_1(d) = \begin{cases} 0.5 & f_1(d) = 0 \\ 0.5 & f_1(d) = 1 \end{cases} \tag{3}$$

Similarly for Application Kit Preparation t_2, of which we will not present details due to the reason of space.

As for Application Statement Inquiry t_6, let t_{l6} be the reduced loop task of t_6 and random variable X as the number of interactions in fulfilling t_6, in which $\{x = 0, 1, 2, 3\} \in X$. $T(t_{l6})$, denoted as time spent for completing t_{l6}, the task is calculated as follows:

$$T(t_{l6}) = xT(t_6) \tag{4}$$

As similarly to t_1 and t_2, t_6 influences different quality dimensions. However the impact is not only within single task but also involved a higher abstract level, in this scenario as Fingerprint Collection sub-workflow. Therefore we will focusing analyzing probability distributions in Fingerprint Collection sub-workflow in the following sections.

Sub-Workflow Time Computation Based on the above modelling, we abstract tasks involved in the residency permit workflow into four sub-workflows: *Document Preparation*, *Application Identification*, *Fingerprint Collection*, and *Permit Release*. We first compute time spent to fulfill each sub-workflow, and use the results for final overall time calculation.

As shown in Figure 1, time spent for the sub-workflow of *Document Preparation*, denoted as $T(sw_1)$, is computed as follows:

$$T(sw_1) = \max\{T(t_{l1}), T(t_{l2})\} + T(t_3) \tag{5}$$

Time spent for the sub-workflow of *Application Identification*, denoted as $T(sw_2)$, is computed as follows:

$$T(sw_2) = T(t_4) + T(t_5) \tag{6}$$

Before computing time spent for the sub-workflow of *Fingerprint Collection*, let's first recall that random variable X is defined as the number of interactions in fulfilling t_6, in which $\{x = 0, 1, 2, 3\} \in X$. Similarly, we define random variable Y as permit types applicants will get at the end of residency permit application workflow, and random variable Z as user complaints / comments.

$$Y = \begin{cases} 1 & RegularPermit \\ 0 & TemporaryPermit \\ -1 & NoPermit \end{cases} \tag{7}$$

$$Z = \begin{cases} 2 & Perfect \\ 1 & Good \\ 0 & Satisfactory \\ -1 & Poor \\ -2 & Unacceptable \end{cases} \tag{8}$$

Time spent for Fingerprint Collection sub-workflow, denoted as $T(sw_3)$, is computed as follows:

$$T(sw_3) = \begin{cases} T(t_7) + T(t_9) & \{y = 1\} \\ T(t_{l6}) + T(t_8) + T(t_{10}) & \{y = 0\} \\ T(t_{l6}) & \{y = -1\} \end{cases} \tag{9}$$

The time spent for the sub-workflow of *Permit Release*, denoted as $T(sw_4)$, is computed as follows:

$$T(sw_4) = \begin{cases} T(t_{12}) + T(t_{13}) & y = 1 \\ T(t_{11}) & y = 0 \\ 0 & y = -1 \end{cases} \tag{10}$$

Finally, the overtime spent for completing the whole workflow of residency permit, denoted as T, is computed as follows:

$$T = T(sw_1) + T(sw_2) + T(sw_3) + T(sw_4) \tag{11}$$

In the next section, we will use the above quality modelling results as input for Monte Carlo simulation, in order to get a deeper and statistical analysis of quality evaluation for strategic alignment, and to further improve requirement re-engineering in business processes.

3.4 Adopting Monte Carlo Simulation for Quality Assessment

With the residency permit scenario modelled into the above workflow and sampled real-life data at hand, the idea of adopting Monte Carlo simulation for quality evaluation is inspired with no surprise. Specifically, the simulation iteratively runs over the workflow which imitates real-life residency permit application processes, where we can benefit from two aspects: (i) it overcomes our limited sample size and extends our observation with user-defined number of iterations; (ii) it enables statistic analysis and predictions over the underlying scenario which is complex, nonlinear and involves more than just a couple of uncertain parameters.

Based the above reasoning, we initialize the Monte Carlo simulation scenario (in Table 4) with our sampled real-life data as input parameters (in Table 2 and 3) and equations in Section 3.3 as uncertain functions. The expected outputs include a subset of efficiency and effectiveness indicators we will explicitly discuss in the following text.

Table 4: Monte Carlo Simulation Settings

Simulation Runtime	
Number of Iterations	5000
Number of Simulations	1
Data Sampling	
Sampling Type	Monte Carlo
Generator	RAN2I
Initial Seeds	Randomely

Simulation Results and Discussion Among several simulation statistics, the one of our interest is *sensibility*, i.e., analysis of which input factor having the most significant impact on the output. Sensibility of the model shows the relationships and dependencies of different quality dimensions of multiple layers in this underlying eGovernment application. Detailed sensibility statistics is available in Figure 4.

Focusing on temporal efficiency of the residency permit process, in sub-workflow 1 and 2, *Data Completeness* (Effectiveness in ICT layer) and *Service Provision Time* have strong influence on the sub-workflow time. However focusing on the total time spent for the overall workflow, we discover *User Time* (in this scenario, user time of Appointment Notification(1)) affecting the overall temporal efficiency.

On the other hand, the level of simplification of the considered scenario depends on the number of inquiries applicants made for application statement check, which is affected by the time applicants wait for their first appointment notifications. The analysis points out that *User Time* of Appointment Notification (1) has a strong impact on level of simplification (with correlation coefficient value of 0.949 in the range of $[-1...1]$, meaning that the longer the user time for appointment notification (1) is, the more interactions the process has). Since level of simplification is a joint distribution of X (the number of interactions) and Y (permit type), we also simulate the sensibility factor of the latter (permit type). Resulted data shows that the type of permit an applicant gets at the end of the process is also affected by user time of the first appointment notification (with correlation coefficient value of -0.818, meaning the longer the user time for appointment notification (1), the permit type resulted from the process can vary from regular, temporary to no permit released). The above analysis indicates a strong dependency between X and Y.

Furthermore, sensibility analysis of *effectiveness* in process/service layer (in the form of user comments, denoted as Z) is an interesting observation. We categorize Z according to the overall time spent for residency permit for the following reasons: (i) overall time spent directly covers temporal efficiency in different layers; (ii) it is also affected by data completeness; (iii) different types of permit result in different overall time spent, which in turn is affected by level of simplification in organization system layer. In another words, the output of overall workflow time can be considered as a representation of all input quality dimensions in the scenario, and therefore it is reasonable to assume that sensibility analysis of effectiveness can be observed from the correlation between overall workflow time and Z. Statistic result in Figure 4 shows that, among all possible factors, process/service effectiveness is again heavily influenced by user time (with correlation coefficient value of -0.712, meaning the longer applicants wait, the less effectively they could benefit from the underlying service).

4 Conclusions and Future Work

In this article, we have explored the role of quality metrics to measure strategic alignment and support strategic IT requirements. In particular we have focused on the eGovernment context. To this end we have adopted a framework for systemic quality assessment, considering qualities for the different facets of the subject domain (process/service, organizational system, and ICT technologies). Values for different qual-

Name	X	Y	Z	sw1	sw2	sw3	sw4	Residency Permit Workflow Time
Appointment Notification (1) / User Time	0.949	-0.816	-0.712	n/a	n/a	0.923	-0.667	0.832
Application Statement Inquiry / User Time	n/a	n/a	0	n/a	n/a	0	n/a	0
Fingerprint Collection (1) / User Time	n/a	n/a	-0.054	n/a	n/a	0.031	n/a	0.052
Application Statement Release / Response Time	n/a	n/a	0.049	n/a	-0.013	n/a	n/a	-0.052
Application Delivery / Service Provision Time	n/a	n/a	-0.048	0.268	n/a	n/a	n/a	0.053
Fingerprint Collection (1) / Service Provision Time	n/a	n/a	-0.041	n/a	n/a	0.036	n/a	0.035
Application Kit Preparation / User Time	n/a	n/a	0.04	0.046	n/a	n/a	n/a	-0.019
Application Statement Inquiry / Service Provision Time	n/a	n/a	0.038	n/a	n/a	0.005	n/a	-0.041
Regular Permit Release / Service Provision Time	n/a	n/a	-0.034	n/a	n/a	n/a	-0.044	0.028
Temporary Permit Preparation / Service Provision Time	n/a	n/a	0.025	n/a	n/a	-0.043	n/a	-0.043
Documents Preparation / Data Completeness	n/a	n/a	-0.022	0.866	n/a	n/a	n/a	0.092
Application Kit Preparation / Data Completeness	n/a	n/a	0.022	0.008	n/a	n/a	n/a	-0.036
Temporary Permit Release / Service Provision Time	n/a	n/a	0.018	n/a	n/a	n/a	0.002	0.008
Application Check / Service Provision Time	n/a	n/a	-0.017	n/a	1	n/a	n/a	0.057
Appointment Notification (1) / Response Time	n/a	n/a	0.013	n/a	n/a	0.014	n/a	0.013
Appointment Notification (2) / Service Provision Time	n/a	n/a	0.013	n/a	n/a	n/a	0.052	-0.029
Fingerprint Collection (2) / Service Provision Time	n/a	n/a	-0.007	n/a	n/a	0.032	n/a	0.008
Documents Preparation / User Time	n/a	n/a	0.007	0.36	n/a	n/a	n/a	-0.011
Application Kit Preparation / Service Provision Time	n/a	n/a	-0.006	-0.005	n/a	n/a	n/a	0.018
Regular Permit Release / User Time	n/a	n/a	-0.002	n/a	n/a	n/a	0.473	0.021
Application Delivery / User Time	n/a	n/a	-0.001	-0.005	n/a	n/a	n/a	-0.017

Fig. 4: Sensibility Statistics of Residency Permit Scenario

ities have been defined on the basis of results from interviews. We have then applied a probabilistic model to identify relationships and dependencies between the quality dimensions. In particular, we have identified that i) user time of appointment notification has a strong impact on level of simplification and consequently ii) type of permit an applicant gets at the end of the process and the degree of client satisfaction of the service scenario are also affected by user time of the first appointment notification. The obtained results indicate that, from an alignment perspective, the probabilistic analysis together with the quality framework have provided useful information about critical factors at operational level for improving services related to residency permit, namely the relevance of *user time* with respect to the type of permit required. Yet actual government strategy focuses on the improvement of *service provision time* at the back-end level.

Limitations of the research are related to (i) the limited set of qualities considered, (ii) the relative small sample of interviews and questionnaires collected, and (iii) the lack of a formal model to map intentions at strategy level with modelling of workflow at operational level. In further works we will exploit a survey approach to extend the sample size of interviewees for analysis and extend the actual framework by adopting a formal model for strategy representation.

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Using Goals to Model Strategy Map for Business IT Alignment

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Abstract. Strategy Map (SM) is one of the widely used methods to create business aligned IT strategy map providing valuable insights to business executives. However, problem with strategy map method is that it is not easy to use which can lend itself to various interpretations. This is because linkages between the strategic objectives in the four strategy map perspectives are not explicit which makes SM ambiguous. Goal modelling approaches from Requirements Engineering (RE) have proven rigorous in elicitation and representation of information system requirements. In an attempt to make explicit the causal relationships of SM linkages meaningful this research proposes the use of goal modelling approach i*.

Keywords: Business IT alignment, strategy map, goal modelling, i*

1 Introduction

Business aligned IT strategy has been the top ranking concern of business executives in the last two decades [1]. Due to strategic misalignment, firms often fail to accrue the full business value from their IT investment [2]. To address the alignment issue, researchers and practitioners from Management Information Systems (MIS) have proposed many types of methods for business executives providing insights about different aspects of strategic alignment. Some methods focus on social aspect of strategic alignment [3] in which the resulting causal model of resources (such as *knowledge sharing, trust* and *successful IT history* as pre-requisite to *communication between business and IT executives* and *connection between business and IT planning*) to achieve alignment are presented. Others highlight the importance of informal organisational structure for strategic alignment [4]. Several other models describe alignment as planning process [5]. There are also methods that identify holistic view of alignment process such as Strategic Alignment Model (SAM) [6] and *strategy map* (SM) [7] in which several aspects of alignment process and relationships among them are identified.

Strategy map which evolved from *balanced scorecard* has been regarded as the most widely used alignment method and more than 300 organisations have used to create maps for their business aligned IT strategies [8]. Strategy map defines four perspective map (Financial, Customer, Internal and Learning & Growth (L&G)) of an

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organisation's value creating strategy. It provides textual concepts that executives can use to discuss the directions and priorities of their enterprise. Strategy map identifies the cause-and-effect relationships among the objectives in the four perspectives of an organisation's strategy in which the desired outcomes are defined in terms of objectives in financial and customer perspectives. Internal perspective identifies the critical internal processes that an organisation must excel in so as to deliver the strategic outcomes. L&G perspective identifies the human and organisational capitals along with technology assets necessary to support the value-creating internal processes. Visual representation of the causal relationships in the four perspectives provides greater insight to executives as to how the firm's tangible and intangible resources must be aligned to create value for the customers and the firm.

However, researchers found that the SM method is not *easy to use* and the created strategy map lends itself to *various interpretations* [9, 10]. The major reason for these problems is that the linkages created among objectives in four perspectives are not explicit as shown in Figure 1. The lack of an explicit model of relationships contributes to the difficulties in evaluating the relative importance of performance objectives in SM [11]. According to [12] an adequate causal model should help members of organisations to understand how objectives can be achieved. However, a recent study reported that the vagueness of SM guidelines results in three different types of interpretations of the SM created by a firm [9, 10]. The problem of implicit model of relationships exists in most of business IT alignment models.

Goal modelling approaches from RE have been considered rigorous and structured in elicitation and representation of requirements [13]. Many goal modelling approaches have been proposed and compared in terms of their requirements modelling capabilities [14]. Among them, i* appeared semantically richer and that it provides greater requirements analysis support than other modelling approaches [15]. Therefore, we consider exploiting the constructs of i* approach to overcome the above-mentioned weaknesses and make strategy map more structured.

Thus, we set a research question to address the problem of strategy map:

How can we use i to make strategy map more structured and unambiguous for business executives?*

In this regard we use Consumer Bank exemplar (a case study conducted by [7] and its created strategy map is shown in Figure 1). Application of i* to the textual description of Consumer Bank enables us to create an i* model of SM which we call SMi* model. Using the knowledge of Consumer Bank exemplar to develop SMi* model is advantageous in a way that we can effectively compare SMi* model with conventional strategy map in terms of explicitness in linkages. The rest of the paper is structured as follows. Section 2 compares and contrasts strategy map constructs with i* constructs in a tabular form. Development process of SMi* model has been presented in section 3. Section 4 presents lessons learned from the development process of SMi* model. Conclusion and future work direction are presented in section 5.

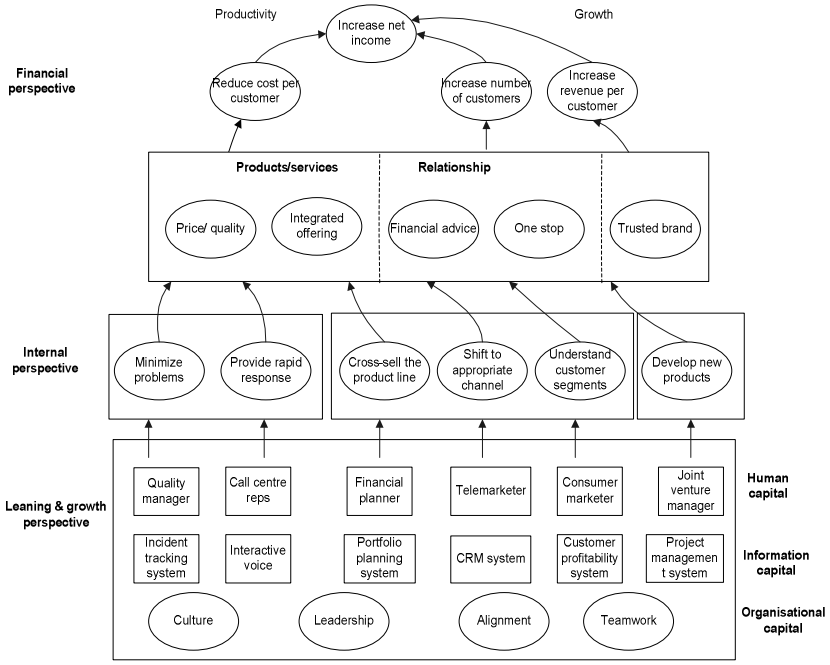


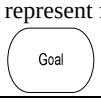
Fig. 1. Conventional strategy map model of Consumer Bank [7]

2 Suitability Analysis of i* Constructs for Strategy Map

Before we develop SMi* model we need to evaluate whether the constructs offered by i* are suitable and adequate to conceptualise and represent SM constructs. In this regard, we carefully analyse textual description of the exemplar and SM method used to create strategy map from [7] and identify constructs needed to be represented. Similarly, we also evaluate i* constructs in an attempt to match them against strategy map constructs. Evaluation of SM and i* constructs is described in Table 1.

Table 1. Analysis of strategy map constructs and suitable i* constructs

Modelling requirements (strategy map)	**i*constructs**
Perspective refers to a firm's strategic view in terms of conceptual elements (e.g. goals and resources) pertinent to a particular domain of concern. Strategy map consisting of four perspectives describes value creating strategy in terms of objectives which provides basis for executives to discuss the directions and priorities of their enterprise.	i* does not offer any suitable construct to represent the concept of perspective of SM.
Contents of financial perspective present	i* offers graphical notation *Goal* to

<table>
<tr>
<td>how an enterprise intends to create sustainable growth in shareholder value. Primarily in the financial perspective Firm's financial targets are established which are precise in nature.</td>
<td>represent objectives/targets which are precise in nature. According to a definition goal is a condition or a state of affairs to be achieved [15]. Given that the objectives in financial perspective are precise in nature we use goal construct (as shown below) to represent financial objectives.
 
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<tr>
<td>Contents of customer perspective is used to describe customer value proposition (CVP) which can be understood in terms of customer benefits being offered by the Firm's products and services. Customer satisfaction which is the mission and purpose of every business can be achieved through clear identification of value proposition offered by the firms to please customers.
These value propositions have qualitative and quantitative values as shown in the Table.
<table>
<tr><th>CVP</th><th>Measuring approach</th><th>Suitable construct</th></tr>
<tr><td>Price</td><td>Value for money</td><td>Goal</td></tr>
<tr><td>Quality</td><td>SLA</td><td>Goal</td></tr>
<tr><td>Integrated offerings</td><td>Number of services</td><td>Goal</td></tr>
<tr><td>Credibility of service</td><td>Satisfaction</td><td>Soft goal</td></tr>
<tr><td>Help in planning & implementing financial plans</td><td>Always be there</td><td>Soft goal</td></tr>
</table>
</td>
<td>CVPs can be classified into precise/hard and qualitative/soft objectives. Goal construct is suitable to represent precise CVPs however we use soft goal construct to represent qualitative targets. Soft goal means it does not have clear-cut satisfaction criteria [15]. Soft goal is used to represent qualitative target in terms of satisfied sufficiently. Thus, goal and soft goal constructs conceptually qualify to represent quantitative and qualitative types of requirements potentially across SM four perspectives.
 
</td>
</tr>
<tr>
<td>Contents of internal perspective comprise of three value creating core process types (operations, customer and innovation management core processes). A firm typically defines the critical few (clusters of) strategic processes known as strategic themes that have the greatest impact on delivering the espoused CVPs. A core process comprise of many sub-processes. These sub-processes are executed to achieve CVPs. A strategic theme has clear performance targets (aligned with the CVPs) which must be supported by learning & growth perspective.</td>
<td>i* need to represent three types of elements here for internal perspective – (1) three clusters of core processes, (2) core processes which are known as strategic themes and (3) sub-processes executed to achieve strategic themes. i* does not offers any suitable construct to represent three clusters of strategic themes. Strategic themes have been described in terms of precise value. Therefore goal construct qualifies to represent strategic themes. To represent sub-processes we use Task construct. According to a definition task is a course of action that is carried out in a particular way typically to achieve</td>
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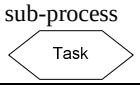
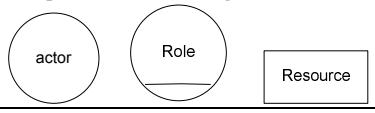
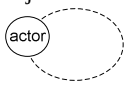
</table>

	some goal. For simplicity this concept Of *task* can be used as an approximation to equate the concept of sub-process 
Contents of learning & growth perspective comprise of three capitals: (1) human capital, (2) Information Capital (IC) and (3) organisational capital (known as intangible assets) each defined with precise objectives and performance targets to support the strategic themes. Human capital refers to specialist roles required to execute activities in internal perspective, organisational capital refers to interaction among stakeholders and IC refers to value creating computer technologies necessary to support activities in the strategic theme of internal perspective. Technology infrastructure used to support activities has been regarded as asset/resource in the MIS literature [16]. Therefore, we need to represent *technology* as asset/resource, *people* as stakeholders for all four perspectives and *organisational* issues as relationships among the stakeholders.	*Actor* is an entity that carries out actions to achieve goal by exercising its know-how. In addition an actor can be classified into specialised roles as shown below. The concept of actor is suitable and adequate to represent human capital potentially across all four perspectives. Fundamentally i* is an approach that is used to express complex social and organisational relationships through dependency relationships among actor [15]. i*'s inherent structure supports representation of human and organisational aspects. Thus for simplicity, in this study we present the human and organisational resources in conjunction with related concepts in the appropriate perspectives where they make sense. This means the L&G perspective only needs to represent IT resources which support the sub-processes of the strategic themes. According to [15] *Resource* is a provision of some entity either physical or informational to achieve some goals or to perform some tasks. This concept of resource is equivalent to the concept of IT resource which is used to execute sub-processes of strategic themes. 

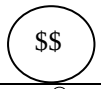
Classification of objectives. The exemplar describes objectives for all four perspectives. However these objectives are of different types of. For example Consumer Bank describes shareholder value as *mission/aspiration* and to achieve the mission the bank establishes many productivity and growth targets. In this case the firm's strategic aspiration is its *strategic intent* and productivity and growth targets are objectives defined to achieve the strategic intent. So, we classify targets provided for all four perspectives into intents and objectives categories. ***Cause-and-effect relationships*** are established among four perspectives by showing that IT supports internal processes which supports customer perspective and which supports financial perspective (for example, see Figure 1). Establishing relationships among perspectives mean to facilitate discussion among executives in terms of linkages between objectives.	In i* intentionality is described in terms of *desires* and *wants* of an actor from another actor in Strategic Dependency (SD) model [15]. To deliver a strategic intent an actor establishes some targets which are defined in Strategic Rationale (SR) model of i*. To make distinction between the variety of objectives and their strategic intents i* uses the concept of a boundary as shown below. This construct defines boundary of objectives in terms of goals, tasks and resources. i* describes it as workability analysis which fits well to represent that how well-integrated objectives support achieving strategic intents which are represented out side the boundary. Responsible actor to achieve strategic intent through targets inside the boundary appears an equivalent concept to SM concept on strategic intent and associated objectives.  Strategic Dependency (SD) relationship concept allows representing cause-and-effect relationships of SM through actor dependency relationship as the construct is shown below. With SR model SM will be able to represent explicit relationships among objectives as well as actors and dependency relationships among them for strategic intents for all four perspectives.
Relationship strengths, objectives in each perspective which drive to achieve strategic intent have various types of relationships and these relationships have various degrees of strengths. For example, the exemplar at many stages in [7] shows that the two sub-objectives/sub-processes support to achieve an objective that means sub-objectives/sub-processes have AND relationships, at some stage the exemplar describes one sub-objective is sufficient to achieve an objective then the relationship should be shown with Means-Ends link. At another stage one objective supports another objective but the relationship strength in unknown for which	The use of following relationship constructs can bring clarity to the relationships among the objectives of SM four perspectives. *AND/OR* construct is used to indicate that satisfying a goal can be accomplished by satisfying all its sub-goals. *Means -Ends* is used to show if a sole goal is contributor to another goal. + construct represents that one goal positively influences the other goal. It is

we use *Plus* contribution link.	used where strength is not sure. ——+——> *DECOMPOSITION* construct represents decomposition of a task into more than one sub-tasks. ——decomposition+

2.1 Extension to i*

i* approach appears to be suitable representing most of the SM constructs however, it lacks representing the concept of four different types of *perspectives* and three types of clusters of core processes for internal perspective. Therefore we propose new constructs presented in Table 2. We do not present theoretical background of these new constructs in this article due to the space constraint however in selecting appropriate visual constructs we take insights from [17].
Visual constructs are more effective in understanding and solving problems than their contents [17]. Visual representation in software engineering is pervasive but little attention is paid to perceptual aspect when a visual construct is selected. Two important principles should be addressed in selecting visual constructs: (1) symbols could be discriminated accurately from each other. Symbols are different from each other. The greater the visual distance between symbols the faster and more accurately they will be recognised and (2) appearance of constructs should suggest their meanings which means that the symbols are required to provide clues to their meanings. Such representation provides accurate and speed up recognition of constructs.

Table 2. New constructs to represent SM constructs

Perspective	
Financial perspective	
Customer perspective	
Internal perspective	
IT (Learning and growth perspective)	
Cluster of three core processes (operation, customer and innovation management processes)	We use three colours to represent three clusters of core processes. Red colour to represent *operations*, green colour to represent *customer* and yellow colour to represent *innovation* clusters.

Suitability analysis of i* constructs (Table 1) and extension to i* constructs (Table 2) for representing SM constructs led us to believe that we can faithfully capture all the "structural constructs" of SM in a fully integrated SMi* model which unambiguously shows the inter-relationships of "structural constructs".

3 Development Steps

In the development of SMi* model we use two-step approach of i*. *First* we develop Strategic Dependency (SD) model in the context of Consumer Bank exemplar. SD model helps us to capture dependency relationships among stakeholders for strategic intents in the four perspectives of SM. Strategic intents can be captured in the form of *goals* to be achieved, *tasks* to be performed and *resources* to be furnished. *Second* based on detailed level of knowledge provided in the exemplar we identify rationale behind those strategic intents in the form of goals, tasks and resources that each stakeholder facilitate to achieve strategic intents. This is called Strategic Rationale (SR) model which basically expands on SD model by showing internal arrangement of an actor to achieve strategic intents. So, we term it as SMi* model comprises of SD and SR models.

3.1 Strategic Rationale (SR) Model

This section presents detailed information about Consumer Bank exemplar for four SM perspectives and how this information is used to develop SMi* model. We ensure that the development of SMi* model is entirely based on the knowledge provided in the exemplar.

Financial perspective, Exemplar describes that the overarching *shareholder* objective for *Consumer Bank* was to *dramatically increase earning per share*. This statement presents two stakeholders[1] – shareholder and Consumer Bank and one strategic objective – increase earning per share. By using i* approach we can conceptualise stakeholders and the objective by saying that shareholder depends on Consumer Bank which we consider from now on as Financial Service Provider (FSP) to increase earning per share. We use i* construct *actor* to represent these stakeholders and the *goal* to represent the quantitative strategic objective of *earning per share be increased*. Exemplar also describes that the target be achievable for increase in earning per share which we consider a qualitative aspect of the target of *earning per share be increased*. So, we use soft goal construct to represent *target be achievable* for shareholder. The following information provided in the exemplar is used as rationale to achieve shareholder objective.

FSP sets a stretched target of *net income* - $100 million on which the strategic intent depends. *Net income* is a precise objective and is represented by using *goal* construct as shown in Figure 2. This stretched target can help to calculate earning per share for shareholders precisely that's why we represented strategic intent with *goal* construct.

[1] stakeholder: human, departments, organizations

FSP sets two sub-objectives – increase productivity and profitable revenue growth. FSP considers them as two high level and main objectives to achieve $100 million net income target (p.374) [7]. Therefore, we use *AND* decomposition link to show that the achievement of productivity and growth objectives means achievement of the stretched target of $100 million. We use *goal* construct to represent *productivity be increased* and *growth be achieved* as both objectives can be measured quantitatively based on the targets which are discussed in the next paragraph. In addition, FSP expects 11% annual revenue growth which also refers to a clear-cut growth objective.

According to the textual description of the exemplar FSP defines two growth related sub-objectives – increase revenue per customer *from $200 to $300* and increase the number of high value customers *from 200,000 to 600,000*. These are two quantitative sub-objectives to achieve a precise growth objective. Once again we use *goal* construct to represent these objectives and *AND* decomposition link to show that the achievement of both sub-objectives means achievement of growth objective.

FSP defines one productivity related sub-objective *reduce annual customer cost from $100 to $75* [7]. This is another clear-cut financial objective and we use *goal* construct to represent the objective. This objective can help to measure productivity objective therefore we use goal construct to represent the productivity objective. Since *cost per customer be reduced* is a sole objective to increase productivity we use *means-ends* link to show that it is strong enough to achieve the productivity objective. In this way we capture rationale behind the financial strategic intents as shown in Figure 2 which is entirely based on textual description of the Consumer Bank exemplar.

Customer perspective, FSP pursues relationship based customer strategy instead of old transaction based customers strategy (p.377) [7]. In relationship context, FSP wants four strategic intents to be achieved in order to realise financial objectives:

(1) *Products/services be provided*, FSP defines precise target in terms of products and service so we represent it with goal construct.
(2) *Relationships with customers be developed* is a qualitative objective which is not measureable so, we represent it as a soft goal.
(3) *One stop shopping* is a precise goal in which FSP provides all the financial related needs to its customer.
(4) *Trusted financial advice* is related to the provision of information which is represented with resource construct.

To deliver these strategic intents, FSP hires a *financial advisor*[2] who is specialist in this domain. So, FSP depends on financial advisor for these four strategic intents. Rationale behind these four strategic intents is described below.

With respect to the rationale, exemplar describes that strategic intent – trusted financial advice depends on the goal of *helping customers develop and implement financial plans*. Trusted financial advice is a resource and it is based on product knowledge which we represent with *resource* construct, however, helping customers

[2] We acknowledge that there can be other customer interfaces such as customer service agents, bank tellers however Consumer Bank created new strategic role to shift customers from transaction based to relationship based customers. Therefore we used financial advisor as responsible role to deliver four strategic intents for customer perspective.

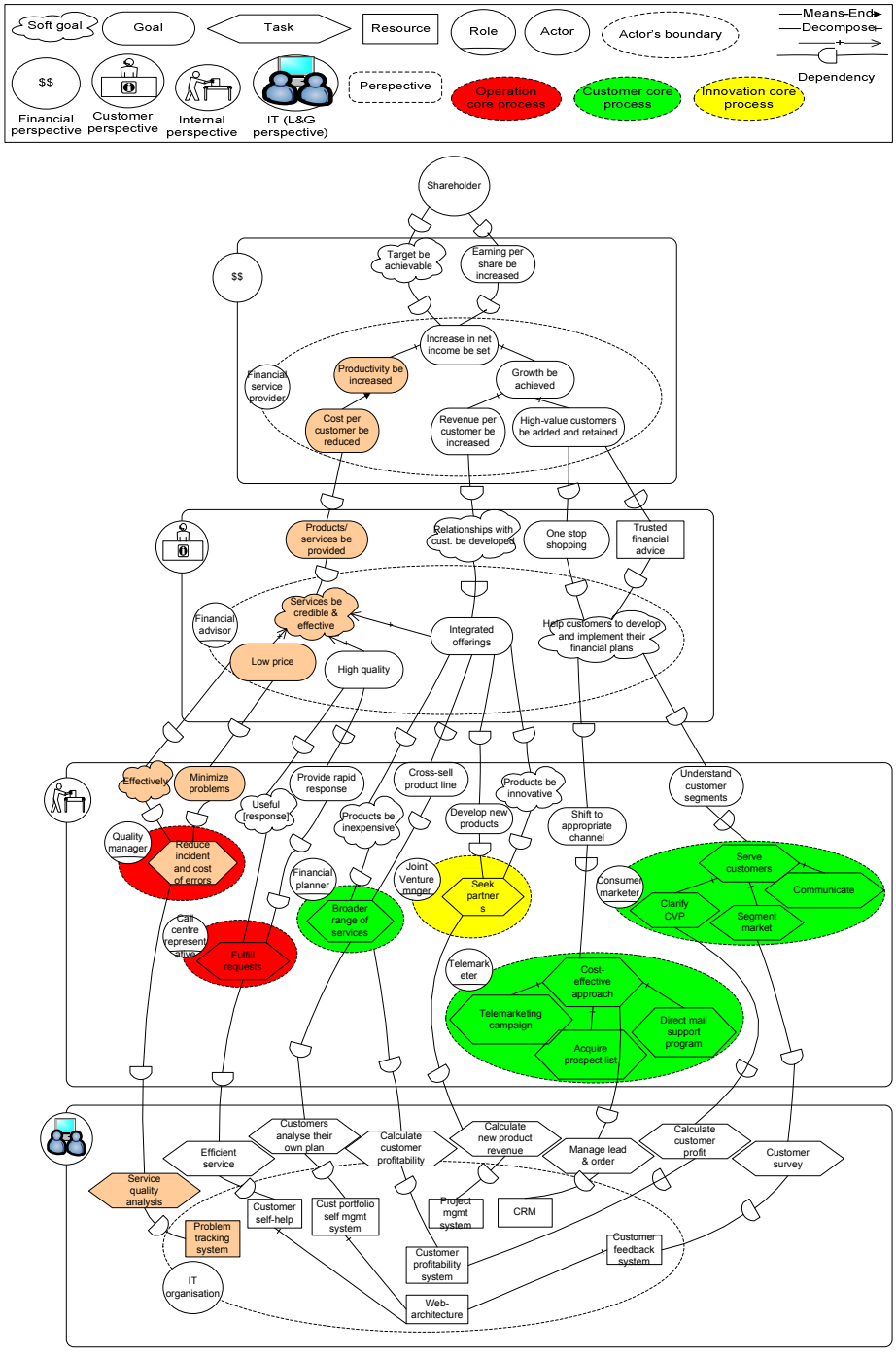


Fig 2. SMi* model of Consumer Bank

to develop and implement their financial plans is a qualitative goal as it can not be clearly measured. In addition, *One stop shopping* which means to provide all financial solutions under one roof depends on helping customer in developing their products.

Strategic intent *relationship based customer* supports financial target *revenue per customer be increased*, according to the exemplar it depends on *integrated offering*. *Integrated offering* is a quantitative goal as financial advisor can easily figure out how many products/services a customer has been using.

Strategic intent – *products and services* that helps to achieve *cost per customer be reduced* depends on CVP *Services be credible and effective*. Textual description presents *price* and *quality* of products and services as key CVPs to support *products/services to be credible and effective* and hence helps to reduce cost per customer for productivity objective, so we use positive contribution link showing that the CVPs *price* and *quality* positively support the soft goal of *products/services to be credible and effective* as shown in Figure 2.

As *price* (value for money) is a known value it is represented with *goal* construct. Firms use Service Level Agreement (SLA) to achieve quantitative goals in term of quality of their services, so quality level can be identified precisely and is represented with goal construct[3]. So, we can show through linkages that how strategic intents depend on CVPs to support financial targets. One of the advantages of using i* is that it helps to differentiate strategic intents from supporting objectives.

Internal perspective, Exemplar describes six critical processes in three clusters – operation, customer and innovation that must be executed to achieve four strategic intents of customer perspective. Six core processes – minimize problems, provide rapid response, cross-sell product line, develop new products, shift to appropriate channels and understand customer segment are described as *six themes*. Exemplar identifies six specialist roles to achieve targets set for six strategic themes. Therefore by using i*, we capture dependency relationships between financial advisor and six specialist roles for six strategic themes (along with some soft targets perceived from the textual description) as shown in Figure 2. We introduce six strategic themes in the context of three clusters below:

The exemplar describes two *operation management* related themes which are important to satisfy existing customers and delivering desired productivity objective.

(1) *Minimize problems* is a strategic theme in which *quality manager* is given the target of 0.1% reduction in incidents and cost of errors to achieve *low price* CVP. *Reducing the number of incidents and the cost of errors* is the task that quality manager performs to achieve 0.1% target and achieve it effectively. In i* terms financial advisor depends on quality manager to achieve this strategic theme and to achieve the strategic theme quality manager performs the task of reducing the number of incidents and cost of errors.

(2) *Provide rapid response,* means 24/7 service with fulfilment time. The exemplar describes *call centre representatives* as responsible people to achieve this service objective and task for them is to *fulfil request*. The response must be useful for

[3] In some cases quality could include the level of customer experience in using the services offered by Consumer Bank. In these cases, quality is not measureable entity and will be represented as a soft goal.

customers. Same i* principle is used here and onward to represent relationship between financial advisor and roles associated to rest of the four strategic themes.

The exemplar described four more strategic themes in customer management & innovation clusters which can help to achieve *revenue growth* and *increase in high value customers* objectives. Based on the textual description we find that two themes *cross-sell the product line* and *develop new products* are more supportive to achieve relationship based customers and hence increase in revenue per customer. However, two other core processes – shift to appropriate channel and understand customer segment are more supportive to achieve *increase in high value customers*.

(1) *Cross-sell the product*

For this strategic theme, financial planner is considered an ideal role who is given the target of *2.5 products per customer* to be achieved. To achieve this target financial planner is responsible to perform the task of *providing broader range of products and service*.

(2) *Develop new products*

In this theme, *joint venture manager* is given the target of increase in revenue per customer by 50%. To achieve this target joint venture manager performs the task of seeking more partners in order to create additional products and services.

(3) Shift to appropriate channel

This theme requires telemarketing program in which 40% shift in channel mix is the target for telemarketers. To achieve this target, three types of tasks are suggested in the exemplar – (1) telemarketing campaign, (2) the acquisition of prospect list and (3) direct mail support program which are associated with the task through decomposition link.

(4) Understand customer segment

Consumer marketer is the responsible person to achieve the target of 30% segment share for this theme. To achieve this target responsible person has the major task of serving customer which is divided into three sub-tasks - clarification of CVP, segmenting the market and communicating the message with potential customers. Achievement of the targets for these six themes through value creating tasks means achievement of overarching net income target of $100 million.

IT (L&G perspective). This perspective focuses on three aspects – human, organisational and IT. As we have described in Table 1 that i* inherently supports expressing *organisational* and human aspects of information systems through dependency relationships among actors for goals to be achieved, tasks to performed and resources to be furnished [18]. Therefore, we do not need to model human and organisational aspect separately in L&G perspective however, we must represent IT aspect for L&G perspective.

For information capital, exemplar presents that the *IT organisation* is responsible of installing and maintaining several of the applications and integrate these applications to the bank's overall web infrastructure. Sub-processes supporting six strategic themes encompass IT domain of L&G perspective. Six specialist roles depend on the IT organization (actor) for the support of sub-processes associated to their domains. Exemplar describes eight sub-processes that an IT organisation needs to support in order to realise six strategic themes. IT organisation as an actor for IC capital furnish applications and infrastructures which are considered as resources [16] IT organisation furnishes these resources to support six strategic themes.

To achieve strategic theme *minimize problems* IT organisation installs *problem tracking system* who's main purpose is to perform service quality analysis in which it helps to reduce operational errors. Thus according to i* quality manager responsible to achieve strategic theme *minimize problems* depends on IT organisation to perform the task of *service quality analysis* for which IT organisation furnish resource – problem tracking system. Similarly five other roles responsible of strategic themes depend on IT organisation to furnish resources for particular tasks which are described below.

To support the process of *provide rapid response*, IT organisation install *customer self help system.* This system provides efficient and 24/7 services through web-systems. For cross-sell theme IT organisation installs two applications – customer portfolio self management system and customer profitability system. Former system helps customers to develop their financial plans and this system is supported by web-architecture providing customers 24/7 services. Later system provides facility for financial planners to calculate profitability of customers. Strategic theme *develop new product* requires *project management system* which helps project manager to product based revenue.

Shift to appropriate channel is another vital theme for which a complete suite of Customer Relation Management system (CRM) including lead management system, order management system and sales forces automation is used. CRM supports tasks related to this strategic theme effectively. Customer profitability is partly useful for the *understand customer segments* theme. Customer feedback system is also needed to understand customer needs and it helps to segment customers. *Customer feedback system* is supported (to some degree) by web-architecture providing the bank a cost effective and efficient way of conducting surveys.

With i*, relationships among objectives across four perspectives are explicit and in one example (see Figure 2) we have shown traceability for a strategic theme – minimize problems upwards for CVPs and financial objectives and downward support from sub-processes and hence IT resources.

4 Lessons Learned from Using i* to Represent Strategy Map

1. Development of goal structure using AND alternatives. i* has effectively shown clarity in relationships among different types of objectives for four SM perspectives. Linkages present relationship types among objectives. Representation of different types of objectives with different types of i* constructs such as goals, tasks and resources can also be observed in SMi* model. It is also observed that the explicit representation of elements and their relationships has enhanced readability of SM and thus executives should be able to view SMi* model as an explicit model of relationships.
2. i* has facilitated more than just enhancing clarity in linkages. i* has captured roles/actors related to each perspective (contrary to conventional SM in which roles are identified only in L&G perspective for strategic themes) and provided a network of dependency relationships among actors. Through this dependency approach i* actually addresses issues related to organisational and human capitals

which are highlighted in L&G perspective for conventional SM. Therefore, only IT is captured for L&G perspective in SMi* model. SMi* is ideal to communicate with executives explicitly showing them strategic intent and their responsible roles and what measures these roles take to achieve their strategic intents.

3. We do not represent clusters of core processes into groups as shown in conventional SMs. The major reason is the representation of explicit relationships making difficult to group the core processes. So, in SMi* model we use three distinct colours (red for operations, green for customer and yellow for innovation processes) to represent three groups of core processes. In this way we maintain clarity in relationships among objectives.
4. *Regulatory and social processes* is the fourth cluster of core processes, required for regulatory and environmental sustainability compliance purposes, which is not being represented in this SMi* model for two reasons: (1) we do not find sufficient information on this cluster in consumer bank exemplar and (2) representation of this core process is debatable as the MIS literature mainly discusses three core processes to achieve customer and financial targets which we have represented in SMi* model.
5. SMi* model shows the complete linkages explicitly across the four perspectives of SM. SMi* model, in one example clearly shows that the core process *minimize problems* helps to achieve CVP *low price* and hence achieve productivity target while having support from *problem tracking system* from IT organisation.
6. SM identifies aspects of strategic alignment in term of four perspectives. In this regard new constructs are identified in Table 2. These constructs help to reduce complexity of alignment process and enhances readability of SM.
7. In i* context, SMi* model is dependency heavy. The basic reason is that the exemplar provides limited knowledge for four perspectives of SM process and it is particularly visible for internal perspective. However, we have provided a model – SMi* model which is further explore-able. Provision of such integrated model of explicit linkages was our study objective which we have achieved through this exercise.

5 Conclusion and Future Work

Application of i* has introduced structuredness and explicit traceability to SM that was weak in the conventional SM. i* approach has provided meaningful visual constructs to represent different types of targets and relationships among them for four SM perspectives. Integrated network of relationships provides excellent traceability across four perspectives. It is our conjecture that this kind of structuredness and traceability can make SM easy to use as we have not yet validated this in the field the SMi* model produced and the method used to develop it. Given that the researchers from MIS have identified ambiguity in relationships among SM objectives is the problem we believe that with the use of i* constructs relationships among SM objectives now become explicit. Development of SMi* model is the first step in this line of research. In the next step we intend to conduct interviews with IT

strategists to evaluate whether SMi* model has better structure and traceability than conventional strategy map. In the final step we will evaluate the method used to develop SMi* model through a field case study.

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The Business Behavior Model

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Abstract. For solving problems related to business/IT-alignment we propose a model called the Business Behavior Model. The main idea behind the model is to capture the motives that drive an agent to take decisions about what resources he should exchange in a business collaboration. The model draws from the rational agent theory, the resource-based view, the business model ontology, and causal graphs. The usefulness of the model is illustrated through a small case study. The result indicates that the business behavior model is interesting and useful as a complement to goal models and value models.

1 Introduction

A major problem in the area of business/IT-alignment is to ensure that the information technology available to an organization provides the support the organization needs. One demand on the support is that it should be adapted as the organization adapts to changing conditions [1, 13]. In [2] an argument was put forth that alignment of models could be used to meet this demand. Of special interest of that paper was the alignment of goal models [3, 5] and value models [6]. The argument was that by properly aligning goal models and value models (together with process models) sufficient information was available to be able to adapt IT resources to the organization's needs. Thus, alignment of models was considered a means to a Business/IT-alignment end.

In this paper we look further into the link between goal models and value models. We argue that the information contained in both those models can be complemented in order to give a more complete view of the link. Limiting our analysis to some well-known goal models (BMM [5] and i* [3,4]) and value models (e³value [6]), we note that, for example, the goal model is good at describing goals and dependencies between them, but less good at describing the decisions and motivations that lead to the formulation of those goals. We note that the value model is good for describing exchanges of resources, but less good for describing the structure of those resources.

To capture and present this complementary information we propose a model called Business Behavior Model (BBM). We chose to include "behavior" in the name as we aim at capturing the way the agent could interact with its own organization and environment based on its motivation. We have three goals in this paper; first,

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providing a clear and understandable definition of the BBM. The second is to define the context in which the BBM could be applied and used. The last one is to provide some clues on the usefulness of the model.

The rest of the paper is structured as follows; in section 2 we overview theories that the BBM draws from. In section 3 we define, develop, and explain the BBM. We also discuss how it can be used. Section 4 contains an illustrative example of its use in the form of a case study. An analysis of the case study is done in section 5. Section 6 ends the paper with a concluding discussion and directions for future research.

2 Foundations

The Rational Agent Theory. In this paper we assume that the agents being modeled are rational. The Rational Agent [8] theory is a widely used concept in the Decision theory [10] and Game theory [11]. The rational agent theory aims at describing how actors react in various contexts that involve decision making. An agent is being represented as having beliefs, desires and intentions (BDI, a set of mental attributes) [8]. Beliefs are information about the agent's view of its environment. Desires are information about the agent's motivation. Intentions are about deliberative states of the agent. A rational agent has clear preferences and aims at performing action that result in the optimal outcome from among all feasible actions. In other words, based on its beliefs, an agent takes decisions with the intention to fulfill its desires. In a resource-based view those desires are fulfilled by exchange of resources.

The Resource-Based View of the firm. The Resource-Based View (RBV) [9, 19, 20] is an economic tool used to determine the strategic resources available to a firm. All firms possess resources. A subset of those resources could provide a competitive advantage and a further subset (the strategic resources) could lead to the sustainable competitive advantage. Whether a resource is considered strategic depends on its properties and how well those meet a set of criteria. Commonly used criteria in RBV are proposed by Barney [20]. He suggests that a strategic resource must possess the following properties: value, rareness, inimitability and non-substitutability [14]. In other words, in the resource-based view of the firm an agent, in order to survive, must exchange resources considered valuable for its environment. We note, however, that some resources are not exchangeable but actor inherent. Those resources are valuable in the sense that they are used to produce exchangeable resources.

The Business Model Ontology The Business Model Ontology (BMO) [17, 7] describes the logic of a "business system" for creating valuable resources. In BMO a business model is understood as the conceptual and architectural implementation of a business strategy and as the foundation for the implementation of business processes that uses and produces resources. The BMO is useful for sorting out a resource's properties in an elegant and structured way. This framework is composed of four pillars representing four different aspects of the business organization:

- Offering: Value proposition, target customer segment and capabilities.

- Infrastructure management: Activity configuration, resources and assets and partner network.
- Customer relationship: Information strategy, channels and trust and loyalty.
- Financial: The financial aspect is modeling the firm's profit and therefore its ability to survive in competition.

We learn from BMO that the resources handled by an agent have properties (reflecting four different aspects of the organization) and depending on from which aspect the organization is analyzed those properties become more or less relevant.

The Causal graph. A Causal graph is a set of nodes and arcs. The Causal graph was chosen as the syntactical basis for the BBM as it is well-founded and contains the concepts we needed for BBM development structured in a coherent way. Table 1 overviews the basic concepts of the Causal Graph.

Table 1. Basic concepts of Causal Graph [14].

Nodes	**Arcs**
Chance: A variable that could conditionally be influenced by other nodes.	*Informational:* The out-node is considered before the in-node is analyzed.
Utility: The expected utility of the outcome from decision nodes.	*Causal:* The in-node has conditional probability to take a certain value considering a previous out-node.
Decision: The alternatives that are possible considering the studied domain.	*Definitional:* The in-node is composed of the all nodes linked to it.

Related models. For this research, some models from strategic and business layers are used as comparison basis. For the strategic layer: i* and BMM and for the business layer: e³value. i* is a goal and agent oriented framework developed to model the goals of an agent or organization. The main idea of i* is to model an agents intentions, i.e. its goals, beliefs, abilities, or commitments [16]. Business Motivation Model is a model for expressing means for an agent to achieve goals or objectives. The BMM answers the following questions [5]; what is needed to achieve what the enterprise wishes to achieve? Why does each element of the business plan exist? BMM is present in this paper because it offers a compact notation that makes it convenient for short case study. e³value model is a value model focused on the analysis of a value proposition [6]. The e³value provides concepts for showing which parties exchange resources of economic value with whom, expecting what in return.

3 The Business Behavior Model

3.1 Definition

The definition of the BBM is based on three concepts that come directly from the Rational Agent theory and the Resource Based View – decision, resource and motivation. Those concepts are not independent and are therefore linked through causal relation with a value that indicates the intensity of the link (table 2).

Definition: *"The Business Behavior Model is a model which describes the impact of the participation of agents in a business by integrating their resources in a causal graph. The participation is realized through decisions and driven by motivations."*

3.2 Syntax and semantics

Table 2. Syntax and semantics of BBM (see also figure 4)

BBM Name	Syntax	Semantic
Economic resource properties	Rounded box	Property of a resource evaluated on a qualitative or quantitative scale. Property concerns inner characteristics but also customer, financial and infrastructural aspects
Non-economic resource	Diamond box	Resources which are not transferable directly to another actor or to another resource. They are concerning inner value for the actor.
Economic resource	Dotted square box	Resources which are transferable and described by a set of properties. One economic resource is present in the actor model if the actor rents or owns the resource.
Decision	Square box	Decision nodes represent identification of (alternative chains of) goals and means in order to reach an objective
Informational link	Arrow	The information from the out-node decision is available at the time the in-node decision is taken. Similar to a temporal meaning.
Causal link	Arrow with value link	Out-node has an impact on the value assigned to the in-node depending on the value link.
Definitional link	Empty arrow	The connected nodes are decision nodes. The purpose is to improve the definition of a decision by using sub-decisions (which are more detailed).
Creation link	Dotted links	Creation link are used in order to trace the reason why a resources is analyzed. The reason is linked to a specific decision.

XOR-relation	Bounded connector	A connector between links of same type. Those connectors act as constraint on the nodes attached to the links; at least one out-node have to be considered to grant the consideration of the in-node but not all of them.
AND-relation	Double bounded connector	A connector between links of same type. Those connectors act as constraint on the nodes attached to the links; all out-nodes have to be considered to grant the consideration of the in-node.
Value indicator		
Strongly positive	++	Strong positive influence.
Positive	+	Positive influence.
Negative	-	Negative influence.
Strongly negative	--	Strong negative influence

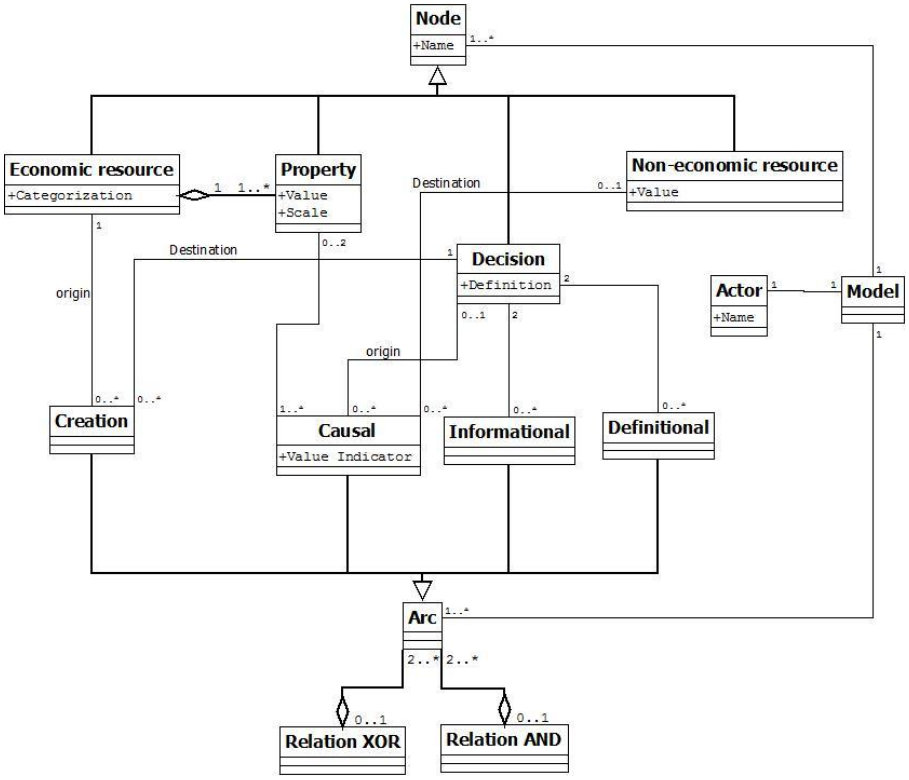

Figure 1. Meta-model of BBM

To complement the meta-model of figure 1 we use an additional methodological tool which we call a categorization. The main point of categorizing a resource is to

emphasize from what aspect a resource's property is important for a particular analysis. This tool is inspired by the Balanced Score Card (BSC) [18] approach. The categories we use, however, come from the four pillars of BMO as those pillars are more adapted to the RBV. Figure 4 shows this categorization of the MMOG resource (rectangle box). Note that we do not prescribe that all resources should be subject to categorization at all times; this is determined by the modeling purpose.

Motivation for syntax and semantics. A rational agent has beliefs, desires, and intentions. It chooses from a set of available actions and performs one in order to reach an optimal outcome. Therefore the model is structured according the following pattern (figure 2): actors have motivations (desires-outcome) that are fulfilled by actions and supported by decisions (Intention-actions) in the presence of environmental constraints (belief). In order to integrate RBV, actions are led on resources that are changed and exchanged through agent activities. Furthermore, to provide a deepest view of resource, the model analyzed them through their properties as proposed by Petit [12]. Figure 2 captures the idea of this pattern starting from decision in the bottom and ending at the motivation at the top. Figure 2 also positions the developed model between the goal layer and the business layer and shows the added value of the model (detailed in section 5).

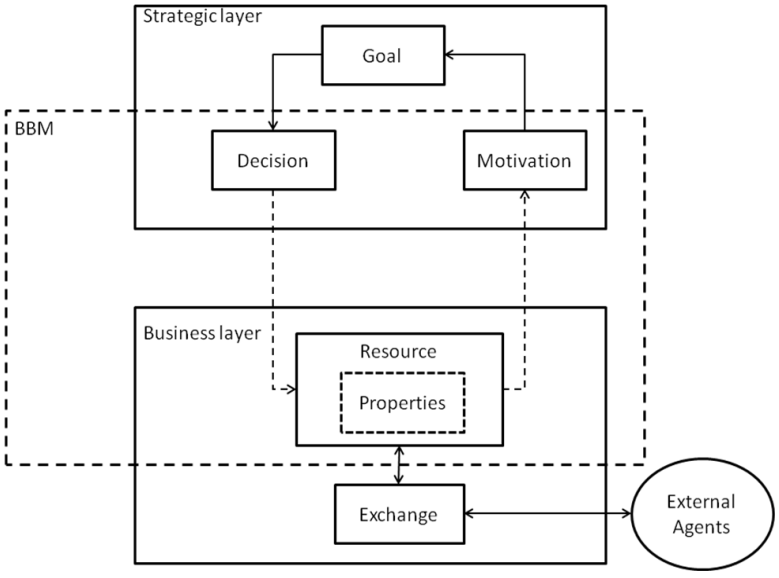

Figure 2. The position of BBM and the added value for alignment (dotted elements)

As action are completed on resource, motivation is the result from improvement on specific resources; non-economic resources. Those non-economic resources emphasize the selfish process of the outcome's optimization (the motivation). For instance, profit is often not an end in itself but a specific feeling is. The feeling of

high esteem or respect in the society is a resource as it can help in forging new alliances, but it is not an economic resource as it cannot be traded. It is strictly attached to a particular agent.

3.3 Usage

As we focus on the alignment of models on goal and business layers we use i* [3, 4] and the Business Motivation Model (BMM) [5] as goal models and e³value [6] as a value model for illustrative purpose in this paper. Finding correspondences between the notions of the different models is important for solving model alignment problems.

As shown in figure 1 the BBM model is based on three notions; decision, actor, and resource. Moreover, the model includes the notion of property and captures different kinds of relations. Motivation is, as said, a derived notion in the model.

Decisions. As Means-End links in i* are an envisaged solution for the accomplishment of a goal, they are translatable in term of valuable decision. Indeed, a solution to fulfill a goal has to lead to a decision in the business process or otherwise the goal will not be achieved. Decision that implies actions toward another actor also emphasizes the Dependency Link between actors in i*. From a different perspective, a decision is taken as it generates valuable improvement for the motivation and Value Activities are themselves generating value. Therefore, a Decision can be transformed in a Value activity, but not all the value activities are related to a decision. Start stimulus are also interesting as they emphasize the initial need of the participation, therefore they are providing information on feasible initial decision. Considering the Business Motivation Model, decisions that appeal to factual means can be translated in terms of 'Means'.

Non-economic resources. The End node with a Vision semantic [5] of BMM is similar to a motivation, therefore this node is transformable into a non-economic resources. For i*, top level nodes are sometimes parented with the motivation meaning.

Economic resources. The Resources from i* are economic resources for BBM and their exchanges between actors in i* are modeled by causal links that cross economic resources: an exchange implies modification on properties of the resource (decrease of a resource to the profit of another). Resources are also present in the Value Model e³value within the Value Object.

Properties. Properties are related to the tasks, goals and soft goals of i* considering the fact that those elements are directed in the growth of aspects of a resource for the agent and therefore can provide indices on strategic properties. Properties are related to 'Means', 'Ends' or 'Influencers' from BMM for the same reason. 'Means' are usually related to low level properties at the opposite of 'End' nodes. Influencers are external constraints that can be associated with properties from rented or purchased

resources. Indeed, those resources possess properties that are not directly controllable by the actor.

Table 3. Translation table of related notions. Translation for links is based on semantic comparison. This table should help the modeler to find relevant information in other models for the BBM or the opposite.

BBM	**e³value**	**i***	**BMM**
Actor	Actor	Actor	
Property		Goal, Task, Means Soft-goal	End, Means, Influencer
Decision	Value activity Start stimulus	Means-end link	Means
Motivation		Goal	End : Vision
Causal link	Value exchange	Decomposition link Contribution link Dependency link	Links among nodes
Informational and definitional	Value exchange between value activity of one actor	Contribution link	
Resource	Value object	Resource	
Value indicator		Contribution link	
Alternative decisions	UCM extension (trivial)	Means-end link	

Table 3 emphasizes that it is possible to construct the Business Behavior Model on the basis of the other models or to construct (derive) those models on the basis of BBM. Constructing BBM on the basis of other models or the other way around results in models which are aligned on the same ideas – this reinforces the consistency among models and increases the alignment. For example, in the illustrative case in section 4, a BBM is constructed from an e³value model and subsequently a goal model (using the BMM notation) is constructed from the obtained BBM; the BBM bridges e³value and BMM. Another way of using BBM is to use it for simulation; the final objective is to optimize the motivation, hence the necessity to improve the related non-economic resource (attached to the motivation). When looking at the model, the improvement comes from Causal Links emerging from properties influenced by decisions (figure 1). Therefore, to optimize the motivation, the user has to optimize the improvement on the path through the non-economic resource by selecting the most efficient alternative decisions. By optimizing the improvement is meant comparing the value indicators on the causal links and selecting the one that provide the best end-effect. A simulation is also illustrated in the case study.

4 Illustrative case study

The following example is based on the case of a massive multimedia on-line game (MMOG [16]) provisioning. This case implies exchange of product (the game) and exchange of service (hosting). The idea is to bridge e³value and BMM through an intermediate model – the BBM. The first step is to build the BBM from the e³value model and then to continue with deriving a BMM from it.

The e³value model

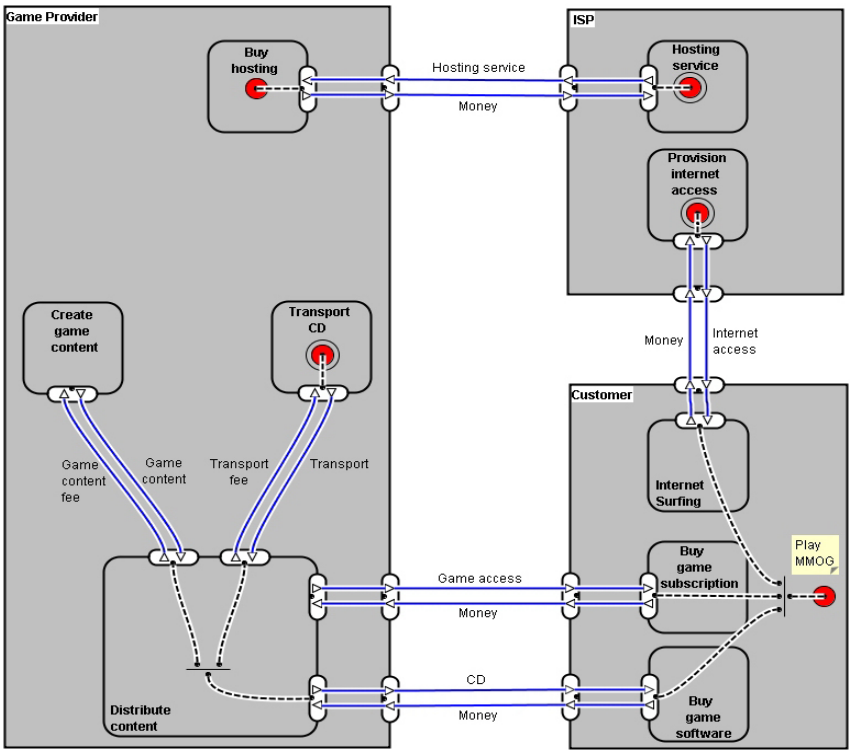

Figure 3. e³value model of the MMOG case (from [16])

By analyzing figure 3 we can sort out the decisions (value activity) and resources (value exchange). The final model considers one resource for both the CD and the Game Access – the MMOG. Motivation (a non-economic resource) is not present in figure 3, but is derived from reasoning about why an actor participates in the business collaboration.

Constructing a Business Behavior Model

As no more information is available in the e³value, the modeler should start to furnish the model with properties and link them together. This information is present in the problem description, and the BBM in figure 4 has been complemented based on this information. The final model is obtained by adding a categorization for the MMOG resource.

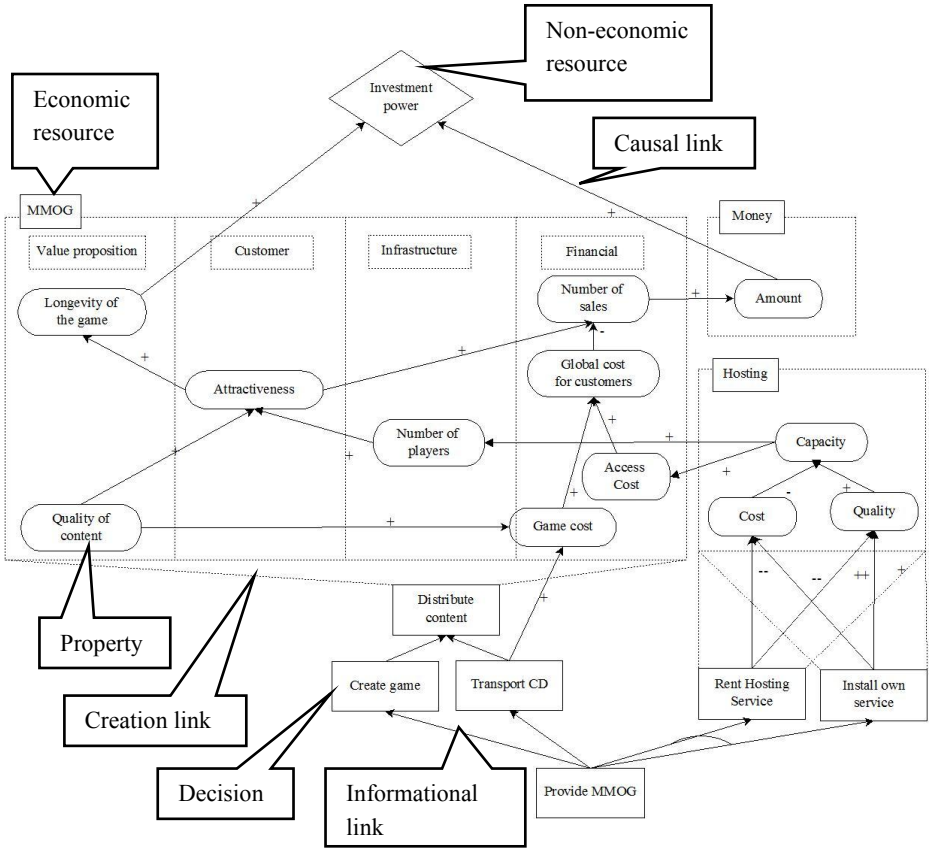

Figure 4. Business Behavior Model (Game provider's view)

Figure 4 shows the initial motivation of the business (improve the investment power), it could have been different but we do not possess the information in the source case. From there, the company decides to provide Massively Multiplayer Online Game. This requires creating the game, preparing a support (CD) and shipping them. On the other hand, the online aspect requires hosting capacity. The result is a MMOG resource with some properties separated in four categories (from BMO) and a Hosting. The company possesses some money as well (a third resource). Properties from the three resources are connected and act as constraints (resources that are not

variable by the considered agent) but also as variables whose values the decision makers can vary.

Figure 4 also illustrates simulation: the model proposes an alternative decision for the hosting resource which is to install a hosting service that would be owned by the game provider (shown in the lower right corner). When comparing Value Link on both out-relations from the two decisions:

- They cost the same (two double minus). For short term the renting is more advantageous, but in the long run owning is more advantageous.
- Quality varies (one is double minus and one is double plus). Renting provide the insurance of experience strengthen by contract. The installation requires experts that are maybe not present inside the companies; therefore, quality may be reduced.

In this case, the choice is quite easy; renting seems to be the better decision.
Similar models are constructible for the customer's and the ISP's point of view.

Business Motivation Model

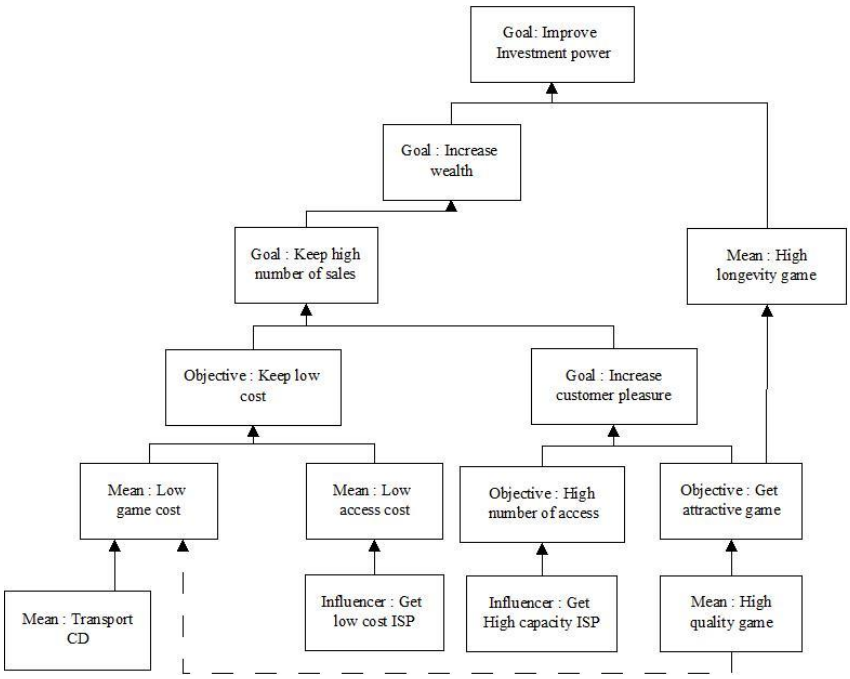

Figure 5. BMM of the MMOG case with conflicting relation

Figure 5 shows a BMM built on the basis of the BBM of figure 4. We opted in this paper to show a BMM instead of an i* model as it is more compact. The used process

did not consider the non-influencing decisions and focuses on the properties to sort them out in one of the following category of nodes: “End”, “Means” and “Influencer”. “End” nodes are top level properties in the graph of the BBM (figure 4). “Means” are low level properties (or leaves of the graph). “Influencer” nodes are external constraints. In our case the constraints come from the renting of the hosting service – the ISP is the one who fix the price and the capacity. The influencing decision (Transport CD) is also “means”. As it is visible in figure 5, the BMM conserves all the relation among nodes from figure 4. The negative causal relation between the “Game cost” and the “Quality of content” (in figure 4) is modeled through a dotted link in the figure below to avoid using Assessment elements from BMM.

5 Results

This section highlights the value of two approaches of using BBM. The first consists in comparing the model in both the strategic level and in the business level with the BBM by pointing out some valuable added notions. The second focuses on improving the analysis for both the strategic and the business level.

5.1 Added notions

Motivation oriented: Motivation is the engine that drives problem solving for a business. Therefore, modeling the engine of the participation is crucial to reach an optimal solution. Including motivation also brings the possibility of giving a non-profit oriented view of the business by focusing on this non-economic resource. The motivation can be present in goal model, but in our case, the motivation is linked with actions on resources (figure 2).

Decision oriented: Decisions are the first step towards the achievement of a solution. Plus, alternative decisions provide the possibility of reflecting on which solutions are the best for the business through simulation. In terms of alignment, it bridges the establishment of goals with their application in the value proposition. Once again, some decisions could be drawn in the strategic layers but here we connect them with motivation and action on the resource (figure 2).

High resource granularity: Modeling resources as a set of properties gives insights about the weakest and the strongest points of resource configurations. The categorization of resource properties improves the structured view of the resource. Modeling inter-resource relations gives a wider and a sharper view of the studied system and detailed descriptions of property dependencies emphasizes different aspects of a system.

RBV (resource based view): The Business Behavior Model is not a tool to determine the strategic resources. However, it is a view of the internal and external mechanisms that involve those strategic resources. Indeed, the analysis of the properties and their impact on the global system gives a wider understanding of the engaged resources. As

far as the BBM is connected to the RBV [19, 20] and gives interesting analysis of the resources management, it should be considered as a step towards obtaining a strategic advantage.

5.2 The usefulness of the BBM as an analysis tool for the business

The use of the developed model improves the analysis of the business on several aspects thanks to the introduction of new aspects for the studied layers. Indeed, the business and the goal layers are focused on goal and value proposition. The BBM brings a new approach by the way of the motivation, the resources view and the possible decisions. The introduction of the decision concept allows analyzing whether or not the motivation is fulfilled by decisions and how. Decisions are also the basis of simulation for optimization through their alternativity. The developed model also emphasizes the weakest and strongest point of resources by pointing out their negative and positive impacts. The analyst gets a view on the mechanisms that are linked to the resource and therefore, he owns clues for further improvement of the organization (considering the RBV). The model also improves on the possibility to analyze interdependencies between resources as it shows those interdependencies at a sublevel (as relations between properties).

6 Discussion

In this paper we have proposed a novel model, the Business Behavior Model, to be used when solving a part of the business/IT-alignment problem. The underlying idea of the model is to understand what are the motives that drive a collaborating agent to take decisions about resource exchanges.

The alignment problem is a complex issue that hits the organizations in their process of adaptation to the changing environment. In that context, this research aimed at achieving a support to improve the adaptation capacity. To do so, we had three goals; providing a clear and understandable definition of the developed model that we called the Business Behavior Model. The second was to define the context in which the BBM could be applied and used. The last one was to provide some clues on the usefulness of the model. This research has fulfilled the desired goals by the use of various theories, e.g. the causal graph, the resource-based view and BMO. The result of this research is a definition of the model and an indication of the usefulness of the model for solving the alignment problem. This is due to an analysis of the related model (BMM, i*, e³value) and the treatment of cases such as the MMOG. As shown, the BBM supports the bridging of two layers in an organization – the goal layer and the business layer. Through this research we also pointed out that the BBM could be used as an independent tool. It can emerge as a third kind of model next to the goal model and the value model with its own independent usage.

Future work: Improving the valuated causality relation among nodes by giving them real values is the most relevant further work. Doing so opens the possibility of using

calculation on large and complex models that are based on the Markov theory [15]. A non-economic resource could also be analyzed analogously to economic resources for the benefit of improved understanding of motivations. Additional modeling and evaluation of cases with different generic scenarios is also relevant for the study of the Business Behavior Model. This could widen the scope of usage and also establish the boundary of the model.

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Towards a Method Framework for Enterprise Architecture Management – A Literature Analysis from a Viable System Perspective

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Abstract. The discipline of enterprise architecture (EA) management is albeit a long history still developing. This is becomes obvious, when literature on the EA management function is analyzed. Multiple approaches describe different make-ups for the overall function, while a common sense does yet not exist. In this paper, we analyze EA management functions as proposed in literature from a systemic perspective and derive typical management activities such a function should encompass. Based on these activities, a method framework for EA management is derived, which is assessed in a case study from the financial industry.

1 Motivation and overview

Enterprise architecture (EA) management is a discipline, which has recently gained increased attention from academia and practitioners. Thereby, a few topics which are nowadays regarded to be part of EA management, have a long history in information systems research. This can be exemplified with the topic of business-IT-alignment, which has been discussed e.g. by Henderson and Venkatraman in the late nineties as strategic alignment [1]. While these discussions might have catalyzed the evolution of EA management, the overall discipline is still subject to ongoing development. This in particular applies as different research communities continue to argue on the perspective, from which EA management should be approached. Some researchers emphasize on business aspects, advocating for an understanding of EA management as an economic management discipline (cf. Frank in [2]). In contrast, other groups point to the engineering aspects (cf. Aier et al. in [3]) or take a systemic perspective on the topic (cf. Buckl et al. in [4] and Wegmann in [5]). The approaches nevertheless agree that EA management needs to provide a holistic view on an enterprise, accounting for aspects from all layers, ranging from business to IT aspects.

Regardless of the question of perspective, other indications for the ongoing development of the EA management discipline exist. A prominent example for this is the topic of EA modeling. Although most EA management approaches

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emphasize on the importance of modeling the EA, no common metamodel (called information model in accordance with Buckl et al. in [6]) has yet been established. In the last years, many information models were proposed but none of them has yet gained broad acceptance. Some researchers even challenge the hypothesis that such a model exists (cf. Buckl et al. in [7] and Kurpjuweit and Winter in [8]). They expect enterprises to have largely different expectations on the benefits of EA management, and therefore assume that an information model is an enterprise-specific artifact. Similar discussions apply to the overall make-up of the EA management function. Many different activities have been argued to be inseparable parts of EA management (see Section 3). In contrast, approaches presenting constituents of the EA management function or comprehensive processes descriptions are rare in academic literature (for one example cf. Hafner and Winter in [9]). Similarly, few practitioners (cf. Niemann in [10] and Schekkerman in [11]) and standardization bodies (cf. The Open Group in [12]) discuss processes but stay on a fairly abstract level. These processes are usually complemented with a remark that "they have to be adapted to the company's needs"[12], while the details of this adaptation are left to the reader.

We expect the EA management function, similar to the information model, to be enterprise-specific, although – on a more abstract level – every EA management function might be comprised of similar activities. Thereby, we must provide additional clarification in respect to the understanding of the term EA in different research communities. While some researchers refer to the term EA as the management function, aiming at managing the evolution of the EA, others regard the EA as the inevitable fact, which refers to the make-up of the enterprise summarized as "every system has an architecture"[13]. The terminology used in this paper adopts the later wording and clearly distinguishes between the artifact (EA) and the corresponding management function (EA management).

The article presents a first step towards establishing a consolidated method framework for EA management, which can be configured according to the enterprise-specific needs of a company. The framed method is grounded in a systemic perspective on EA management, which is exhibited in Section 2. From this perspective, Section 3 revisits prominent approaches to EA management from literature and collects typical work packages that these approaches propose. In addition, the representations of the EA, the so called EA descriptions, are analyzed. With the activities and the descriptions at hand, Section 4 proposes a method framework for EA management, consisting of four main activities of an EA management function and three different types of EA descriptions. The framework further describes how the activities relate to each other, and specifies which descriptive information about the EA is exchanged between them. In this respect, it can be regarded as abstract method framework for the EA management function, providing the answers to the article's research questions:

- *Which typical activities constitute an EA management function?*
- *Which information objects are created by, exchanged between, and used for these activities?*
- *How do the activities relate in a method framework for EA management?*

Section 5 sketches the results of a case study on the EA management function of a company in the financial industry. We thereby show to which extent the method framework can be validated. The article concludes with Section 6, which summarizes the findings, shows limitations of the research approach chosen, and gives indications of future areas for research.

2 EA management from a systemic perspective

Enterprises form highly complex systems consisting of various different elements interlinked by a large number of interdependencies. These systems are further embedded into a changing environment that they continuously have to adapt to. In particular, market changes and new legal requirements force enterprises to adjust their architectures, e.g. to rework their business processes or to evolve their IT artifacts. Additionally, newly emerging technologies may enable new business opportunities that an enterprise should proactively seek to gain competitive advantage (Ross et al. in [14] and Wagter et al. in [15]). Both the reactive and the proactive change of the enterprise fall into the responsibility of enterprise-level management functions, as application or project portfolio management, but also of the EA management function. In this respect, the different management functions on the one hand and the EA management function on the other hand form an interacting system. Understanding this system of systems is a necessary prerequisite for developing a method framework for EA management.

The viable system model (VSM) (Beer in [16, 17, 18]) provides a framework for describing complex management systems from a systemic perspective. In the following, we discuss the five subsystems of the VSM – operation, coordination, control, planning, and identity – and identify these subsystems with constituents from the EA management system.

- The *enterprise-level management functions* form system one (operation) directly changing the EA via projects. Especially the management functions surrounding the project lifecycle contribute to system one. Exemplary functions are: enterprise-wide demand management, where demands are captured and prioritized; strategies and goals management, where demands and projects are aligned with the enterprise's goals; synchronization management, where project dependencies are monitored (cf. Wittenburg et al. in [19]).
- The *communication function* of EA management forms system two (coordination) by which architecture descriptions are distributed via appropriate communication channels. Thereby, the different enterprise-level management functions (cf. Wittenburg et al. in [19]) are provided a shared understanding of the as-is (current) and the to-be (planned) state of the EA. Based on his shared understanding peer-level coordination between the enterprise-level management functions should be fostered.
- System three (control) forms the *reactive function* of EA management, that establishes higher level control over the coordination function. In particular, the

reactive EA management observes the behavior of the enterprise-level management functions in coordination and assures that no 'oscillatory' effects between these functions develop. This would for instance be the case, if projects would adapt to comply with current architectural standards for business applications, while simultaneously the standards were adapted to incorporate the realities of the new application portfolio.
- Where system three ensures *stability* in the interactions of the enterprise-level management processes, EA management also encompasses a *proactive function* in system four (planning). Latter system is responsible for anticipating changes in the environment of the enterprise and for addressing these changes by altering the status-quo that is maintained by the underlying *homeostatic* control in system three.
- Completing, system five (identity) is responsible for EA management governance, i.e. is concerned with questions of the overall scope and reach of EA management. It further shapes the design of the EA management function itself. Thereby, it ensures a balance between short-term and long-term efforts, and steers the EA management system as a whole.

3 State-of-the-art in EA management literature

This section provides an overview about selected EA management approaches from a viable system perspective as introduced above. Thereby, we focus on activities described as being part of the EA management function and detail on the EA descriptions they expect for input or provide as output. In the description of the approaches, the original terms employed by the authors are used.

One of the most prominent frameworks for EA management is proposed by The Open Group – *The Open Group Architecture Framework (TOGAF)* ([12]). The core contribution of TOGAF in respect to describing the EA management function is the *Architecture Development Method (ADM)*, which delineates how an EA can be developed and maintained. The ADM describes EA management as an iterative and stepwise process consisting of different phases. The initialization of one EA management cycle is performed in the *preliminary phase*, where decisions about the scope and reach of the management endeavor are made (system 5). Thereby, the topic how to link EA management to other enterprise-level management functions is decided upon. The following four phases *architecture vision, business [architecture], information systems [architecture]*, and *technology architecture* are concerned with the development of a target state, the investigation of the current state, and gap analyses comparing these states. From a viable system perspective these phases present the reactive and proactive EA management. The transition planning from the status quo to the desired target architecture is performed in phase *opportunities and solutions* and decided upon in phase *migration planning*. The execution of the transformation is monitored in the *implementation and governance* phase. Finally, the overall performance of the management process is measured and assessed in the phase *architecture*

change management, which therefore deals with aspects of EA management governance. The aforementioned phases are continually adapted to the needs and concerns of the stakeholders in an activity, called *requirements management*. TOGAF complements the description of the activities with elaborations on the input and output artifacts of each phase – namely visualization artifacts, e.g. a *solution concept diagram* or a *business interaction matrix*, as well as textual documentations, e.g. reports or catalogs. The aforementioned EA descriptions together with the stakeholder management, which a dedicated chapter of TOGAF emphasizes on, contribute to the communication task of EA management. A characteristic of the TOGAF framework is that each iteration of the ADM cycle is project-driven, which on the one hand guarantees the sponsorship for the EA management initiative, but on the other hand makes it hard to ensure the continuity of the outcomes. A consequence of this approach is the absence of an activity, which keeps the EA documentation up to date.

Similar to the TOGAF ADM, Schekkerman [11] describes EA management as an iterative and stepwise process. Each iteration starts with the development of the *EA vision* (phase 1), which defines the environment, business drivers, and guiding principles. In addition, the *scope and context* (phase 2) as well as the *goals, objectives, and requirements* (phase 3) of the EA management endeavor are defined. Subsequent phase 4 derives different *opportunities and solutions* from existing documentations of the current state and future architecture plans. Thereby, special attention is paid to support decision making during management via adequate visualizations, models, and reports, which are chosen in this phase. Based on the opportunities identified in the preceding phase, different *evolution scenarios* are developed and evaluated regarding their organizational impact (phase 5). The costs and benefits of the scenarios are analyzed via *business case calculations* (phase 6) to support funding of the EA management endeavor. The results of the preceding phases are used in phase 7 to set up a *scheduled transformation plan*, including capability planning for the EA. Finally, a *governance structure* is implemented (phase 8), which defines the responsibilities as well as roles, groups, and committees needed. The EA descriptions developed in and exchanged between the phases are only briefly alluded to. Further, viewpoints used in the different phases of the EA management process are only discussed with regards to content without providing graphical representation. Furthermore, EA management governance is not presented as being part of the EA management function, although the importance of EA management maturity is discussed and a model to assess the maturity is presented.

Niemann also emphasizes on the iterative and stepwise nature of EA management incorporated in the corresponding management "cycle", that consists of four phases – *document, analyze, plan,* and *act* – and a parallel *check phase* [10]. The document phase is concerned with gathering and maintaining information about the current state of the EA. The architects have to decide on the adequate level of detail of the documentation and define the appropriate EA descriptions to populate the model as part of the communication system of EA management. For the latter case Niemann further proposes different kinds of visualizations

in [10], which can be used to document parts of or provide an overview over the EA. Although the approach elaborates on questions regarding *what* should be documented, it does not detail on the question *how* this information should be gathered and maintained. Based on the documentation an analysis of the current state of the EA is performed in order to identify potentials for improvement and optimization (reactive EA management). Niemann presents different areas for analysis, e.g. dependencies, heterogeneity, complexity, or conformity and provides methods as well as appropriate visualizations to perform the analysis. During the plan phase integrated development plans leveraging identified potentials for improvement and optimization are established. They represent planned states of the EA that are further assessed regarding their impact on e.g. business and IT goals, costs, and risks. The assessment should result in the selection of the optimal development plan in respect to the criteria devised before. This plan is realized in the act phase. Therefore, on the one hand reference architectures and blueprints are developed and implemented. On the other hand the required governance structures and processes are set up, e.g. the role and responsibilities of the enterprise architect are refined. In respect to the viable systems perspective a focal point in the approach lies on the reactive system of EA management. The EA management governance system is presented in the check phase, in which the performance of the previously described phases is measured and controlled. Thereby, key performance indicators (KPIs) are defined to analyze the overall performance of the EA management endeavor.

Hafner and Winter present a *consolidated process model for enterprise application architecture management* in [9]. Although the paper restricts itself to enterprise application management, the approach is discussed here, as the presented process model is designed with the goal of effective and efficient business-IT-alignment, and therefore takes an EA perspective. The process model contains the phases *architecture planning, architecture development, architecture communication,* and *architecture lobbying*. The architecture planning phase is concerned with the documentation of current states of the EA. Thus, also EA principles are identified, derived, and updated, which guide the evolution of the EA. The proactive and reactive aspects of EA management are reflected in the architecture development phase, in which strategic and operational requirements regarding the EA are continuously recorded, consolidated, and prioritized. Subsequently, these requirements are incorporated in planned states of the EA. The phases architecture communication and architecture lobbying explicitly refer to the communication function of EA management. Nevertheless, aspects on how to relate the EA management endeavor to existing enterprise-level management processes are only briefly alluded to. More precisely, Winter and Hafner in [9] resort their approach to identifying target groups for training, information delivery, etc. While the task of analyzing the EA is made explicit as part of the consolidated process model, the assessment and improvement of the EA management approach itself (EA management governance) is not discussed.

Another prominent approach in the field of EA management is the *systemic enterprise architecture methodology (SEAM)* [5]. The methodology defines the

role of EA management as to *federate the efforts of the specialists [from the enterprise-level processes] to ensure successful projects.* This point-of-view interprets EA management as the glue between the different processes, i.e. bringing together information in this multi-disciplinary environment, thereby especially emphasizing on the communication function. The federation of efforts is achieved via enterprise models, which form means of analysis and communication of EA relevant information. These models account for the multi-disciplinarity of the environment, but go beyond specific models for each discipline, e.g. process chains or network topology models. They provide an integrated view on the enterprise. In [20], Le and Wegmann 2005 highlight two additional aspects of EA management: firstly, the reactive aspect, which deals with necessary business and technology changes ex post; secondly, the proactive aspect, which anticipates future changes of that kind and prepares the enterprise to them by increasing agility and flexibility. In contrast SEAM abstains from discussing questions of how to establish and govern the EA management process.

In addition to the aforementioned approaches, which claim to define their own EA management function, various approaches exist that focus on selected topics in the context of EA management. Lankhorst et al., for example, detail on the topics of EA communication, documentation, and analysis in [21]. Therefore, a specialized modeling language is introduced, which fosters the communication between business and IT stakeholders, and can also be used for documenting current, planned, and target states of the EA. As means for decision-support, different kind of analysis techniques, including analtytical and simulation techniques are discussed. Thus, the approach focuses on aspects of reactive and proactive EA management in the sense of a viable system perspective, while the aspect of the communication system is discussed as a side-effect of the proposed modeling. Similar considerations hold for the approach of *multi-perspective enterprise modelling (MEMO)* presented by Frank [2]. The approach focuses on the activity of EA modeling by providing special purpose languages for different parts of the EA, e.g. the *IT modelling language (ITML)* [22] – for modeling IT related aspects – or for different activities performed in the context of EA management, e.g. the *ScoreML* [23] – contributing to the field of analyzing EAs. Although, the EA management function is not in the focus of the approach of Frank, he contributes to the field of reactive and proactive EA management in the terms of our viable system perspective.

4 A method framework for EA management

Based on the above discussions of the EA management function and special purpose approaches for dedicated EA management activities, we devise a method framework for EA management. Central to our framework is the understanding of the three different architectural states – *current, planned,* and *target* – that can be found throughout the approaches discussed in Section 3. Table 1 revisits the state-of-the-art in EA management with a focus on EA descriptions.

	[2]	[5]	[9]	[21]	[10]	[11]	[12]
target state	○	●	◑	◑	○	●	●
planned state	●	●	●	◑	●	●	●
current state	●	●	●	◑	●	●	●

Table 1. EA description in literature

These architectural states are subject to different activities during EA management. Aggregating them to a high level view, we identified activities for

developing and describing an architecture state, which is concerned with describing the enterprise-level management functions (system one) as well as developing planned and target states of the EA in an proactive manner (system four),

communicating and enacting an architecture state, which considers communication function aspects (system two),

analyzing and evaluating and architectural state, which analyses architectural (system three), and

configuring and adapting the EA management function itself, which represents EA management governance (system five).

Table 2 revisits the state-of-the-art from Section 3 and summarizes the results.

	[2]	[5]	[9]	[21]	[10]	[11]	[12]
Develop & describe	◑	●	●	◑	◑	●	●
Communicate & enact	○	◑	●	○	●	○	○
Analyze & evaluate	●	●	●	●	●	○	●
Configure & adapt	◑	●	○	○	◑	◑	◑

Table 2. EA management activities in literature

The method framework for EA management provides the abstract frame consisting of the aforementioned activities and EA descriptions, any EA management endeavor encompasses. This framework is not concern[1]-specific, i.e., it is a generic method that can be used in combination with typical EA management concerns as e.g. discussed in [25]. As detailed below, the activity *configure and adapt* activity is concerned with determining the scope and reach of the EA management function. Thus, the goals of the EA management endeavor are mapped to corresponding concerns, which can be detailed utilizing concern-relationships (cf. [26]). Subsequently, we introduce the activities of the method framework briefly and provide additional details on the architectural descriptions that are created and consumed by activities. The activity *develop and describe* is further

[1] The term *concern* is used here in accordance with its definition in the ISO Std. 42010, which defines a concern as "those [areas of] areas of interest which pertain to the system's development, its operation or any other aspect that are critical or otherwise important to one or more stakeholders" [24].

subdivided to exemplify the development and description of current, planned, and target states of the EA. Similar subdivisions could be introduced for the other activities but are not detailed here for reasons of brevity.

Develop & describe target state – This activity is concerned with creating a target state of the EA based on the business and IT strategies that the enterprise seeks to implement. Different sub-activities are e.g. the creation of a target business architecture and the design of a target application portfolio. In the target business architecture the future product portfolio of the enterprise is reflected and complemented by corresponding business processes. The target application portfolio is designed towards the support for the intended business architecture. In addition, a target infrastructure architecture is set up, describing the basic services as well as the execution environment, which the business applications can rely on. The target state further goes beyond simple architectural descriptions on different EA levels. It establishes *architecture principles* that guide the evolution from the current to the target state. Such principles reflect specific parts of the business or IT strategy that do not directly shape the make-up of the future architectures. To exemplify this, one could think of an outsourcing strategy that would be converted to an architectural principle demanding that support for business processes of low criticality is not provided in-house, if a suitable outsourcing provider is available.

Develop & describe current state – This activity is concerned with creating a description of the current state of the EA, i.e., the as-is architecture. Thereby, all levels of architectures ranging from business and organization level, via the application and information level, to the infrastructure and data level are considered. Further, information on projects, which affect the EA, as well as on business and IT strategies is documented. The same is true for information on current architectural principles and standards. The develop & describe current state activity is thereby greatly influenced by the EA concerns that drive the EA management function. For implementing the activity, different ways can be used, ranging from documentation endeavors on regular basis, to continuous endeavors accompanying the EA relevant projects (cf. Moser et al. in [27]). Irrespective the chosen way, the activity *develop & describe current state* provides and maintains an appropriate description of the current state of the EA.

Develop & describe planned state – With the target and the current state at hand, the activity derives intermediary architectural plans that are realized by projects. These projects are thereby, not solely derived from the two architecture descriptions, but also based on the demands, from enterprise-wide demand management. In this respect, a planned state is not expected to strictly develop towards the target state, but can also pursue a different road of development in response to an urgent business need. The intermediary states are in this way tightly coupled to the planned projects that are necessary for their implementation. More precisely, each planned project of EA relevance contributes some changes to an intermediary state of the EA. By selecting sets of architecturally compatible projects, i.e., projects whose changes do not interfere, different scenarios for the intermediary states can be derived. The descriptions of these

scenario architectures, which also encompass references to the thereby addressed demands, form the output of the activity *develop & describe planned state*.

Communicate & enact – EA management is heavily concerned with making plans as well as defining architectural principles and propagating them to the enterprise-level management functions. This propagation aims at influencing the decision making in the related functions. Therefore, communicating and enacting architectural principles is always connected to contributing to the decision making in the enterprise-level management functions. Enacting takes the architecture plan and principles as input and effects the decision making in the other management functions. Again, as with the other activities, different ways to implement the activity *communicate & enact* exist. These range from the fairly non-interfering way of informing the decision makers to the most powerful method of having the right to stop projects, which are non-conformant to the EA. This activity hence always takes the description of the planned EA and the architectural principles as input, but can create multiple output artifacts that are handed over to the enterprise-level management functions. These artifacts thereby depend on the method of communication and enactment chosen.

Analyze & evaluate – At some points during the management of the EA, different states of the EA, i.e. current, planned, and target state, or architectural plans, i.e. different scenarios of the planned state, exist. The *analyze & evaluate* activity makes these architectures comparable in order to prepare a subsequent decision on the state to pursue. Different properties of the architecture may thereby be of interest, ranging from the compliance with architectural principles to economic properties. Functional properties of the architecture, as e.g. the provided business support, may also be important (cf. Niemann in [10]). Most commonly non-functional properties, e.g. the availability of certain business services (cf. Johnson et al. in [28]) or the flexibility of the overall architecture are used for analyzing different states. In literature, a broad variety of approaches to EA analysis have been proposed, differing widely in respect to the employed level of formalization, ranging from expert-based assessments (cf. Niemann in [10]) to indicator-based computations (cf. Frank et al. in [23] and Iacob and Jonkers in [29]). The approaches also vary concerning their time reference: some approaches are designed to analyze current architectures (cf. Niemann in [10]), while other approaches (cf. De Boer et al. in [30]) provide prediction capabilities that can be used to analyze architectures not yet realized.

Configure & adapt – Before starting an EA management endeavor the goals and objectives of the initiative should be clearly defined. Based on these goals, decisions must be taken during the activity *configure & adapt* regarding the management subject of the EA management function. Relevant stakeholders must be identified and the concerns, which should be addressed, need to be defined. Further, decisions on the scope and reach on the EA management function must be made, ranging from bottom-up approaches, in which only a certain division of the enterprise is considered regarding a certain aspect like standardization, to top down approaches, where the whole enterprise is examined regarding multiple aspects like risk management, compliance, etc. After the

initial establishment of an EA management function, the configure and adapt activity is concerned with measuring the overall performance of the EA management function. Adaptations can be necessary, e.g. if the enterprises mature or the scope and reach of EA management change.

The above described activities form an idealized framework. In reality, the different activities of the EA management function are executed parallel and with distinct frequency and duration. The method fragment does controversely not add prescriptions on the frequency and ordering of the activities and steps to be taken, but provides an abstract and general frame of the main constituents of an EA management function.

5 A case study from the financial industry

In order to validate the method framework for EA management, we conducted a case study in the financial industry. Subsequently, we give a short characterization of the enterprise at hand and then discuss to which extent the method framework can be used to classify the approach taken.

The case study was conducted at an internationally operating bank from Germany. The topic of EA management has a long history in this enterprise since a merger in the year 1996. Prior to the merger both companies independently conducted enterprise-wide data modeling endeavors. After the merger, the enterprise-wide data models were maintained, although a change in the focus as well as the reach took place. In certain parts of the enterprise the focus shifted towards a strongly business process centric approach, while other parts continued with data modeling. In the year 2002 the term EA management makes its first appearance, when a project was launched to increase the business-IT-alignment based on a holistic approach. In this holistic approach architectural information from different parts of the enterprise was consolidated and used to identify fields for action. In order to assess the advances made in this field, a similar project was launched in the year 2005, which refined the utilized EA management process. The take-over by an international banking company at the end of 2005 changed the overall make-up of the company significantly. In particular, the IT departments of the formerly independent enterprises, as well as the IT assets developed, operated, and managed by them, were to undergo extensive changes leading to an increased centralization of structures.

The EA management function currently operated at the banking company encompasses the evolution of the technical as well as the business architecture. Thereby, the technical architecture is organized in the following layers: operative, system, integration, and application layer. The business architecture covers the business process and the business model layer. The goals of the efforts are among others defined as follows: The EA management function

1. supports planning processes,
2. demonstrates benefit of architecture development,
3. identifies and aligns needs for action,

4. develops future scenarios of the EA as well as migration plans, and
5. ensures balance between short-term realization of business functions and long-term improvement of the EA.

These goals were selected as they can be used to illustrate the systemic approach to EA management, which was taken by the banking company. Thereby, the goals 1 to 5 directly map to the respective systems of the viable systems approach as presented in Section 2, while no counterpart of the EA management governance function or the activity *configure & adapt* is alluded to.

The management function established at the banking company consists of the following activities:

(1) **Creation and adjustment of IT strategy:** Based on the enterprise business strategy, the IT strategy is developed, which includes information on core competencies, products, business areas, etc, and is used to design a target state of the EA. Furthermore, an IT security strategy is formulated.
(2) **Development and update of architectural guidelines and standards:** Architecture principles are identified and guidelines as well as standards are developed and updated on this basis. To decide on new guidelines or standards, an architecture board was introduced.
(3) **Identification of needs for action originating from business and IT:** Business and IT demands are collected and analyzed in respect to their strategic or operative importance. The identified needs are further assessed and prioritized according to the architectural principles identified as architecture conformity, costs, risks, benefit, etc.
(4) **Development and update of architecture artifacts:** EA descriptions, like viewpoints, artifacts, guidelines, and standards are developed from three perspectives: the functional, technical, and security perspective. They are updated on a yearly basis either prior to or after the creation of the annual project plan. Therefore, defined EA descriptions like e.g. the technical building block maps are used.
(5) **Check architecture conformity:** The EA conformity in respect to the architectural principles is ensured via quality gates for projects. Thereby, the vertical escalation in the organizational structure depends on the scope of the project.

The EA management function as presented above was subject to various changes in the past, where the performance of the function itself was assessed. Such an assessment took place in the year 2005, where impediments, which hampered the successful management of the EA, were identified. As a consequence of this assessment, decisions on architectural guidelines (cf. Activity (2)) were not longer taken in a central board, if the activities have only local impact. Thereby, an overloading of the architecture board was prevented and the decision process was sped up. Although this assessment is not part of the documented process of EA management in the company, it refers to the EA management governance discussed in Section 2.

In summary, the EA management function established at the banking company can be mapped to the activities of the method framework presented in Section 4 as shown in Table 3.

	(1)	(2)	(3)	(4)	(5)
Develop & describe	●	●		●	
Communicate & enact					●
Analyze & evaluate			●		
Configure & adapt					

Table 3. Mapping the method framework to the banking company

6 Conclusion and outlook

This paper aims at establishing a method framework for EA management. Therefore, existing literature on EA management is analyzed from a viable system perspective. The objective of this analysis is the identification of typical management activities performed in this context. Furthermore, the architecture descriptions exchanged between these activities were of interest to analyze the relationships between the activities. As a result of the paper, it can be stated that a method framework for EA management should contain the following activities: *develop & describe* different states of the EA, *communicate & enact* architectural principles and plans, *analyze & evaluate* different states of the EA, and finally *configure & adapt* the EA management function. The identified activities could further be evaluated via observing a case study at a banking company, in which the EA management function of the company was analyzed. Nevertheless, the case study presented in this article only provides an ex post evaluation. In order to further investigate the applicability and suitability of the proposed activities, an ex ante setting, where the activities identified are used to establish an and enterprise-specific EA management function, is necessary. In addition, further case studies need to be conducted to prove the applicability in different industry sectors and for different company sizes.

The case study discussed in this paper hints to the need for configurability of the EA management function. Via configurable method building blocks for the different activities of the method framework, an effective EA management function can be designed and established. Making the configuration points explicit in the method framework, problems and exceptional situations during EA management can be linked back to these points, where adaptations have to take place as part of the activity *configure & adapt*.

This paper presents a method framework for EA management on a very abstract level. In order to foster the applicability of the approach in practice, more detailed information on the execution of the single activities would be beneficiary. Such best practice realizations could be documented as EA management

patterns (cf. [25]) for which the method framework would not only provide a classification but also would supply information on how to interrelate and integrate single patterns.

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Enhancement of Business IT Alignment by Including Responsibility Components in RBAC

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Abstract. Good corporate governance requires an improvement of the definition and the enforcement of the employees' responsibility throughout the companies' processes. In the field of information technology, one translation of this requirement targets a strict alignment of the access control policy with the permissions needed by the employees to achieve the obligations linked to their responsibilities. There has been much work related to access control over three decades and Role Based Access Control (RBAC) has emerged as a reference model in that discipline. Although its advantages have been largely recognized, when taking into account the new governance constraints, it appears that its mechanism of assignment of users' permissions is improvable. In this paper, we propose enhancements of RBAC by taking into account the concept of responsibility and explain it can be modeled using the OWL Web Ontology Language.

Keywords: Role, Access Control, Policy, Responsibility, Commitment, Capability, Accountability, Separation of Duty.

1 Introduction

IT governance frameworks [40,41] require companies to have employees' responsibility aligned with the IT constraints. This requirement concerns all layers, from the employees' responsibilities identified in the business processes up to their translation onto technical policies applied to IT applications and infrastructures. In previous work [1], we address that requirement with a responsibility model (figure 2) built around three sets of concepts: (i) *accountability* of the employee regarding an *obligation* derived from a responsibility; (ii) the *rights* required to fulfill the obligation; (iii) the *commitment* pledged by the employee to fulfill the obligation. Whereas the first two sets are common in the field of IT, the last one comes from social aspects that underline the importance of dealing with the engagement of the employee in the responsibility assignment process.

The review of the literature performed in [39] highlights that the specification of technical policies does not include the notion of responsibility as advised by

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governance requirements. In this paper, we propose an integration of our responsibility model with RBAC [2] to minimize the three weaknesses identified in section 4. RBAC is an access control model that simplifies structuring the access right for a domain. Policies are elaborated using a policy language such as XACML (Extensible Access Control Markup Language) [36]. The basic RBAC model can be extended by modeling using OWL (Web Ontology Language) [35] that enables going beyond the basic semantics of RDF schema to perform reasoning tasks necessary to enforce specific constraints such as the separation of duty (SoD) or role hierarchies. We also use OWL for the representation of our responsibility-RBAC model.

This paper is organized as follows. Section 2 introduces the RBAC model and its user to role and permission to role assignment process. Section 3 presents our responsibility model, section 4 integrates both models into a single one, section 5 compares the representation of our model with two representative existing works and the last section concludes.

2 Background: RBAC

2.1 The RBAC Model

The concept of role has been introduced in software engineering about 35 years ago and has followed the development of traditional access control techniques such as the Mandatory Access Control or Discretionary Access Control. Role Based Access Control (RBAC-Fig 1.) has been introduced in the NIST standard for role-based access control [2] and embodies the entire previously developed notions in a single model which is now the reference access control mechanism for most software applications. The publication of this standard has been followed by many related papers which adapt the model for specific fields (e.g. eCommerce, [3]), to propose alternative solutions according to other constraints (Context Aware RBAC, [4]), or for proposing solutions for managing some of its aspects (e.g. ARBAC [5], URA97 [6] or PRA97 [7].

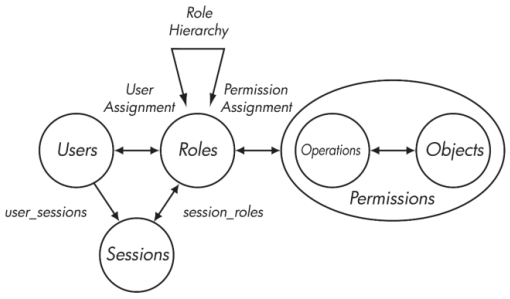

Fig. 1. RBAC model

RBAC is a high level model with the objective to simplify the management of granting permissions to users. This is especially necessary in multinational companies where the amount of employees often count in thousands. It provides access decisions

based on two associations – the association of users to roles based on the function that users assume and based on their responsibilities, and the association of permissions to roles describing that a role has the permission to perform specific operations on objects. This means that it is easy to change the assignment of people to roles without changing permissions.

2.2 User-Role and Permission-Role Assignment

The process of assigns users to roles and permissions to roles is normally a managerial function performed by the business manager or the process owner to decide which employee needs to access what application to achieve her job. The actual implementation of this may be delegated by the application business owner to a security administrator. URA97 [6] and PRA97 [7] are both part of the ARBAC97 [5] model (Administrative RBAC) that permits the assignment of the users to roles and permission to role by means of administrative roles and permissions. Both URA97 and PRA97 are defined in the context of RBAC96 model family but are applicable for most of the RBAC model. Their philosophy is the creation of administrative roles managed by security officers. These administrative roles are granted administrative permissions to assign or remove user to/from roles. In the same way that RBAC96 defines role hierarchies, ARBAC97 defines administrative role hierarchy so that a senior security officer inherits permissions from a junior security officer below him in the role hierarchy. For example, if the junior has assigned an employee to a inappropriate business roles, the senior security officer can remove that employee from the role or change the permissions associated with it. URA97 gives a detailed explanation of the administration of the assignment process.

The simplest way for a manager to assign permission to a user is to assign that user in to a role that encompasses specific tasks to perform and has the required permissions to perform the tasks. By doing so, the manager implicitly obliges the user to accept the responsibility to perform the tasks but does not actually know whether the employee has agreed to this. Not taking into account the employee's commitment is an authoritarian way of managing staff and may result in company goals not being achieved due to unwillingness of employees to perform assigned tasks (see section 3.3). Although this may seems unavoidable, especially in large companies, it could easily be improved by incorporating acceptance of responsibility by a user within the role assignment process, as shown in this paper.

3 Responsibility model

In this section, we present our generic responsibility model as a proposed enhancement to RBAC. The complete responsibility model (figure 2) is presented in detail in [1]. The analysis of the concept of responsibility [1,10] highlights that there is a plethora of definitions for it. A commonly accepted definition of responsibility encompasses the idea of *having the obligation to ensure that something happens*. The responsibility model is built around three sets of concepts. The first set concerns

accountability of the employee regarding the *obligation* targeted by the responsibility, the second set concerns the *rights* required to fulfilled the obligations and the third set concerns the *commitment* to be pledged by that employee.

3.1 Concept of obligation/accountability

We define an obligation as *a duty to perform an action*. Dobson et al. [11] classifies it following two perspectives: functional obligation as what a role must do with respect to a state of affairs (e.g. execute an activity) and a structural (managerial) obligation as what a role must do in order to fulfill a responsibility such as directing, supervising and monitoring.

Accountability and answerability are similar concepts that are composed of one or more obligation(s) to report the achievement, maintenance or avoidance of some given state [12] to an authority. For our model, we prefer the definition of answerability provided by Cholvy as *an obligation or a moral duty to report or explain the action or someone else's action to a given authority* [10] and the definition of accountability from Laudon and Laudon [15] as *a feature of systems and social institutions: It means that mechanisms are in place to determine who took responsibility of actions*. Accountability thus includes answerability as well as the possibility of sanctions for non-fulfillment of obligations [13]. Stahl [14] argues that accountability describes the structures, required to facilitate responsibility and that responsibility is the ascription of an object to a subject rendering the subject answerable for the object. Stahl also focuses on the sanction as being of central importance for responsibility. He nuances the sanction as positive or negative.

3.2 Concept of right

We define the right as *what is due to a employee*. This concept is common but is not systematically embedded in the IT frameworks [16, 34]. It encompasses facilities required by an employee to fulfill his accountabilities. These facilities could include, amongst others, capabilities, authorities or the right to delegate.

Capability describes the possession of requisite qualities, skills or resources to perform an action [12,16,17] and relate to a user. This may be implied through access rights, authorizations or permissions [18,19].

Authority describes the power or right to give orders or makes decisions. This concept is introduced in CIMOSA [16] as *the "power" to command and control other employees and to assign responsibilities*.

Delegation is a right to transfer some part of the responsibility to another employee that pledges commitment for it (see section 3.3). This transfer may concern the transfer of right or of accountability or both. The delegation of an obligation may or may not be accompanied by the delegation of right for the delegatee to further delegate the same obligation [12].

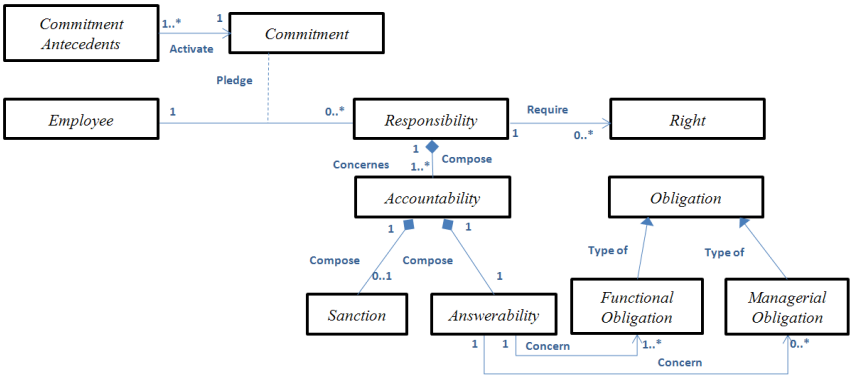

Fig. 2. UML responsibility model

3.3 Assignment/delegation process

We define assignment as *the action of linking an employee to a responsibility* and delegation is the transfer of an employee's responsibility assignment to another employee.

The commitment by an employee related to that assignment or delegation represents his moral obligation to fulfill the action and the assurance that he performs it with respect of an ethical code. The commitment remains a virtual concept, difficult to define as well as to integrate in a strictly formalized framework. In [20], Meyer and Allen acknowledge that *commitment should be conceptualized as a psychological state concerned with how people feel about their organizational engagements*. To bypass the integration difficulty, we propose to extend the model with the components that can be used to enforce the commitment.

Commitment's antecedent in the literature relate to pragmatic variables [21] that may influence a person's commitment e.g. the age of the employee and the time he spent in the organization [23,24,25], the perception of job security [26], management culture and style [27], the employee's investments in time, money and effort [28] or how his experience is valued by the company [22]. A scientific survey of commitment also highlights that *Commitment outcomes* may really influence the quality and efficiency of the action achieved. Pfeffer in [29] explains that *Employee commitment is argued to be critical to contemporary organizational success*. The following list summarizes commitment outcomes:

- Employee performance [30] – committed employees performed better when committed to both their organization and their profession.
- Retention of the employee – many studies demonstrate the link between the commitment and the employee's turnover [28,30,31].
- Citizen behavior[1] – research over these outcomes remain however inconclusive [32].

[1] According to [7] definition, it represents the *individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and in the aggregate promotes the efficient and effective functioning of the organization*

Based upon the commitment outcomes and antecedent definition, we may assume that commitment for responsibility of an action means will increase trust in the achievement of an obligation or in the accountability attached to the responsibility, as well as increase efficiency (and consequently capabilities) for this employee to perform the action.

4 Mapping RBAC with the responsibility model

In this section we propose a novel model called r*esponsibility-RBAC* (figure 3). As seen in section 2, the three main elements of RBAC are User, Role and Permission (dashed boxes in figure 3) and the two main functions are User-role assignment (URA) and Permission-role assignment (PRA) indicated by dashed arrows in figure 3. Although RBAC presents many advantages such as facilities to grant or to remove permissions to a large number of employees, it also presents weaknesses regarding the following business IT alignment constraints:

1. Number of roles: the inflexibility of the model may result in more roles than users *if all permission assignments are very distinct* [33] or *in order to accommodate a user specific constraint* [38]. Moreover, in small organisation, the concept of role does not always map onto access rights.
2. Employee's commitment: RBAC does not offer cater for management of the employee's commitment regarding the tasks they are responsible for.
3. The representation of RBAC in OWL results in the following problems: inconsistencies in ontology [8], difficulty of detection of constraint violations using DL-reasoner [8], as well as the need to deploy complex architectures [9]

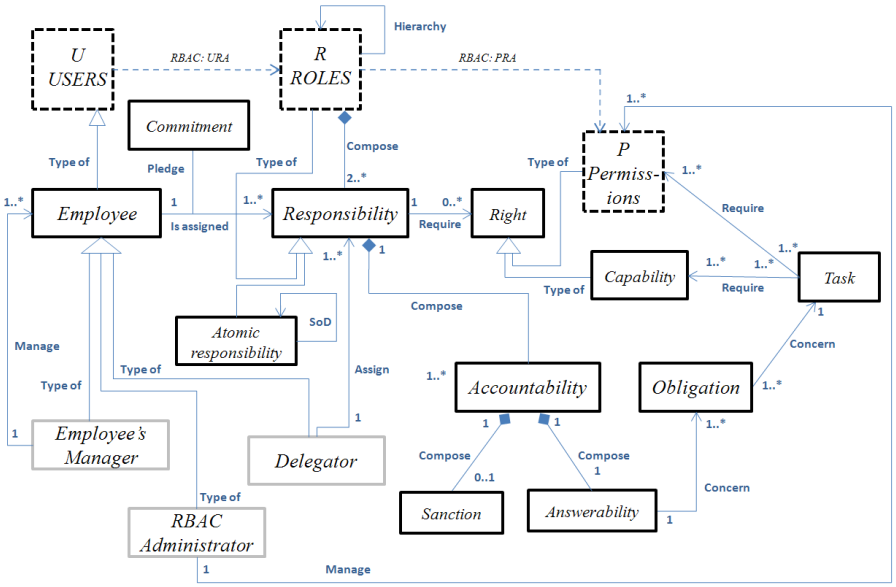

Fig. 3. UML responsibility-RBAC model

The three next sub-sections analyze the contribution of the responsibility-RBAC model to improve RBAC above listed weaknesses

4.1 Number of roles optimization

RBAC requires an employee (type of business USER) who needs a permission to achieve a task to be assigned to a role. Thus, if an employee needs to have permissions to perform a task which is independent of existing roles, then a specific role must be created or the task must be associated with an existing role, even if the latter is not directly related to the task. This is mainly due to the lack of granularity of RBAC that may lead to situations where the number of roles is larger than the number of users, or where roles do not reflect real job functions because they are assigned permissions for a too heterogeneous set of tasks.

Our proposal to solve those problems is to introduce the concept of responsibility as an intermediary concept between the user and the role in RBAC (figure 3). We consider that the role is a predefined set of responsibilities, that employees can be assigned specific responsibilities, independent of roles and that permissions are associated with the responsibilities for which they are required. This model allows us to refine the URA concept of RBAC: users are assigned to responsibilities as far as they commit to them. The responsibility is an abstract concept that could be either a concrete atomic responsibility or a concrete role (group of responsibilities). The PRA concept of RBAC is refined through associating permissions both to atomic responsibilities and to roles.

The tuple of concepts [user-role-responsibility] facilitates defining two types of user-role assignments and one type of responsibility-role assignment:

1. Direct role assignment: an employee is assigned to a role and gets the corresponding responsibilities and permissions. In that case, the role is often the main function of the employee and corresponds to his main function in the company.
2. Direct atomic responsibility assignment: An employee is assigned an atomic responsibility without any associated role and the employee then gets the corresponding permissions.
3. Indirect role assignment: an employee is assigned, by direct atomic responsibility assignment all the responsibilities that compose a predefined role, so he is implicitly assigned to the role and he gets the permissions corresponding to those responsibilities. This case reflects the situation where an employee is assigned to more and more responsibilities which happen to the responsibilities predefined in a role. Whereas from an IT point of view, the set of these responsibilities correspond to a role, the employee does not have the title corresponding to the role, from an organizational viewpoint.

The direct role assignment corresponds to the user-role assignment mechanism proposed in RBAC. The advantage of this solution a large number of permissions for users are granted or managed. For example, suppose that the role of project manager is composed of three responsibilities:

- management of the team,
- management of the project outcomes,

- management of the budget.

The employee who is assigned to that role receives all the permissions necessary for the management of the budget, the management of the team, and the management of the outcomes. If a new responsibility is added to the role, the employee is automatically assigned to it.

The direct atomic responsibility assignment: the user is assigned to an atomic responsibility and receives the permissions necessary to perform the tasks linked to that responsibility. E.g. an employee who is not project manager but who however performs the management of the outcomes is assigned responsibility for that task and receives the permissions necessary to perform it. This situation could occur for example in the case where the project manager assigns the management of the outcomes to a subaltern. In RBAC, representing this situation requires the definition of an explicit role for the management of outcomes. If the equivalent situation occurs for the budget management and for the team manager, the number of roles could considerably increase and the advantage of using roles for granting or removing permission to a user will diminish.

The indirect role assignment corresponds to a user-role assignment that exists when an employee is assigned to all responsibilities that compose the role. Whereas RBAC only offers the possibility to assign users to roles, the responsibility-RBAC model permits additionally to refine the granting of permissions to atomic responsibilities and to automatically assign an employee to a role when that employee performs all the atomic responsibilities that compose that role. E.g. an employee who is separately assigned responsibility for the budget management, then for the outcomes management, and afterward for the team management is, as result, implicitly assigned to the project manager role. In that perspective, the employee is assigned to a role from an IT point of view but that employee to role assignment is not recognized by the company. Detecting and officially acknowledging that employee to role association (and consequently make it a direct role assignment) is an improvement of the business IT alignment. If a new responsibility is added to the role, then it will be automatically assigned to the employee in the case of direct role assignment but not in the case of indirect role assignment.

There are three types of responsibility/role de-assignment: direct removal of role, direct removal of responsibility and indirect removal of role. In that last case, when all the responsibilities of a role are removed from an employee, this role is from an IT point of view no longer assigned to the employee whereas from an organizational point of view, this employee is still assigned to the role.

The delegation of responsibility is not the same as the removal of responsibility. In the case of delegation, the employee keeps the obligation of supervision [12].

4.2 Employees' commitment to the responsibility

In order to explain how the commitment may be included the user to role/responsibility assignment process, a conceptual assignment process is proposed as illustrated in figure 4. When being assigned to a role or to an atomic responsibility, the employee needs to explicitly commit to the achievement of the task(s) related to the role or to those related to the atomic responsibility. This concept of commitment

does not exist in RBAC as it considers the assignment of an employee to a role as an action performed solely by the employee's manager. Based on our review of the significance of the commitment in section 3.3 and according to the responsibility model, we propose to integrate the commitment in the employee to responsibility assignment process. The stakeholders involved in that process are indicated in figure 3 as grey boxes. The *employee* is assigned responsibility to achieve a task by the *delegator* who remains responsible and accountable for the management of the task, as in CobiT [34]. The *employee's manager* is responsible for the management of the employee. Sometimes the task manager and the employee's manager is the same person. The *RBAC administrator* is the security officer who manages the access rights.

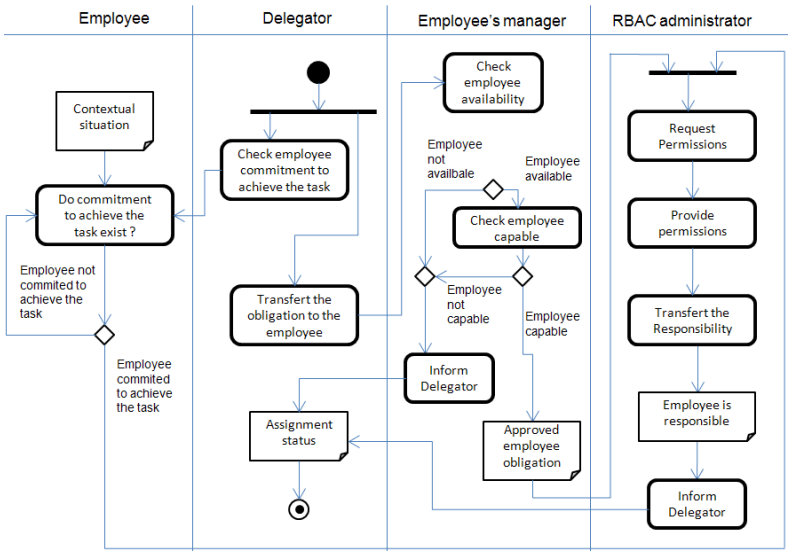

Fig. 4. Responsibility assignment process represented as a UML Activity diagram

An employee to responsibility assignment process may start with a request from a delegator to transfer the obligation related to a task to an employee (figure 4). This transfer is possible if the employee's manager accepts the assignment of the responsibility to the employee and if that employee explicitly commits to fulfill the task. The first condition corresponds to a double control which is: the employee availability and the employee capability. In some cases, the employee is also the manager and consequently, decides whether to accept or reject new responsibilities according to availabilities. The second condition corresponds to the commitment pledged by the employee according to his perception of the environment, guarantees received, interest in the task, etc. (see commitment antecedent in section 3.3).

Once the delegator receives the agreement from the employee's manager and the commitment from the employee, the delegator requests the RBAC administrator to provide the permissions needed to achieve the task. As soon as the permissions are granted, the employee is assigned the responsibility (figure 4).

4.3 Responsibility-RBAC representation with OWL

The Web Ontology Language OWL is a semantic markup language for publishing and sharing ontologies on the Web. OWL defines *classes*, *properties* (binary relation that specifies class characteristics), *instances* (individuals that belong to the classes) and *operations*. Recent research efforts [8,9] concern the translation of RBAC model onto policy languages using OWL. [8] argues that *Policy languages grounded in Semantic Web technologies allow policies to be described over heterogeneous domain data and promote common understanding among participants who not use the same information*, and using OWL *will help in developing security frameworks with well understood and verifiable security properties for open, dynamic environments, which require coordination across multiple organization […]*.
To represent the responsibility-RBAC model and remain aligned with the current research, we retain some elements of the R*OWL*BAC representation and extend it with the definition of a new domain for the responsibility-RBAC model, called `rrbac` (figure 5). R*OWL*BAC provides following classes: *Action*, *Subject*, *Object* (lines 1 to 3) and two subclasses of action: *permission* and *prohibition* (lines 5 to 8). We also prefer the representation of the role as a class (1st approach of [9], line 4) and the representation of the separation of duty (SoD) by the property disjointWith. The SoD is the concept of having at least two people required to complete a task to prevent too much power for a single person. In order to bypass the addition of new rules and to avoid the problem of detection of constraint violation by the DL-reasoner (see section 5), the SoD is represented at the responsibility layer. SoD can be static (SSoD) or dynamic (DDoD) if it is function of the run time environment. We do not consider the representation of the dynamic SoD in this paper. To represent the responsibility in the new rrbac domain a new owl class is needed (line 12). The user to responsibility and the responsibility to role assignments are represented by lines 13 to 18.

```
1  Action a rdfs:Class
2  Subject a rdfs:Class
3  Object a rdfs:Class
4  rbac:Role a owl:Class
5  PermittedAction rdfs:subClassOf Action
6     owL:disjonctionWith ProhibitiedAction
7  ProhibitiedAction rdfs:subClassOf Action
8     owL:disjonctionWith PermittedAction
9  Subject rdfs:property, owl:FunctionalProperty
10    rdfs:domain Action
11    rdfs:range Subjects
12 rbac:responsibility a OWL:Class
13 rbac:role owl:ObjectPropety rdf:ID=”isComposedOf”
14    rdfs:domain rbac:role
15    rdfs:range rrbac:responsibility
16 rrbac:responsibility owl:ObjectPropety rdf:ID=”isAssignedTo”
17    rdfs:domain rrbac:responsibility
18    rdfs:range rrbac:employee
```

Fig. 5. Responsibility-RBAC representation in OWL

Figure 6 illustrates the permission to responsibility association that is represented by the creation of a subclass of PermittedAction. E.g. Buy material for a project is created and only allowed to employees that are assigned to the role BudgetManager is represented with an OWL class expression to create classes of permitted actions (lines 14 to 25) for a specific action and whose subjects are employees assigned to the concerned responsibility. The role is represented as an exact set of responsibilities (lines 5 to 11) and to illustrate the SoD, suppose that BudgetManager is a sub-role of ProjectManager and that an employee may not have access to both roles BudgetManager and BuyerOfficer together (line 13). Finally, the hierarchical is represented using the rdfs constraint subClassOf at the roles layer. Line 26 represents the role project manager which is the superior hierarchical role of the buyer officer.

```
1  ProjectManager rdfs:subClassOf rbac:Role
2  BudgetManager rdfs:subClassOf rbac:Responsibility
3  TeamManager rdfs:subClassOf rbac:Responsibility
4  OutcomesManager rdfs:subClassOf rbac:Responsibility
5  owl:Class rdf:ID="ProjectManager"
6     owl:oneOf rdf:parseType=”Collection”
7        owl:Thing rdf:about=”BudgetManager”
8        owl:Thing rdf:about=”TeamManager”
9        owl:Thing rdf:about=”OutcomesManager”
10    /owl:one of
11 /owl:Class
12 BuyerOfficer rdfs:subClassOf rbac:Role
13 BudgetManager owl:disjointWith BuyerOfficer
14 PermittedBuyAction a rdfs:Class
15    rdfs subClassOf rbac:PermittedAction,
16    owl:equivalentClass [
17       a owl:Class
18       owl:intersectionOf
19         ( Buy
20            [ a owl:Restriction
21                owl:allValuesFrom ex:BudgetManager
22                owl:onProprty rbac:subject
23            ]
24         )
25      ]
26 BuyerOfficer rdfs:subClassOf ProjectManager
```

Fig. 6. Illustration of responsibility-RBAC representation in OWL

5 Related work regarding the translation of RBAC into policy

This section explains how our approach handles the weakness of other ones related to the translation of RBAC into policy. From the existing work, we focus our review on what we consider are the two most significant ones: R*OWL*BAC and XACML+OWL. In R*OWL*BAC [9], Finin et al. propose two approaches to define an OWL domain to represents RBAC. In the first approach, the role is considered as a class. The hierarchy between roles is represented using subClassOf and the SoD is represented

using the property disjointWith. The association of permission or prohibition to role is achieved with an OWL class expression equivalent to our representation of the permission to responsibility assignment. The second approach (figure 7) models a role as an instance of the generic role and uses the ObjectProperty role to link a subject to her possible role (lines 2 to 4). The hierarchy between roles, SoD and the permission to role association is represented by the creation of a new property, respectively: subRole (lines 5 to 7), ssod (for static SoD, lines 8 to 10), dsod (for dynamic SoD) and permitted (lines 11 to 13). Figure 8 illustrates that second approach.

```
1   rbac:Role a owl:Class
2   rbac:Role owl:ObjectProperty
3      rdfs:domain rbac:Subject
4      rdfs:range rbac:Role
5   rbac:subRole owl:TransitivePropety
6      rdfs:domain rbac:Role
7      rdfs:range rbac:Role
8   rbac:ssod owl:symmetricProperty, owl:TransitiveProperty
9      rdfs:domain rbac:Role
10     rdfs:range rbac:Role
11  rbac:permitted rdfs:propety
12     rdfs:domain rbac:Role
13     rdfs:range Action
```

Fig. 7. R*OWL*BAC second approach representation in OWL

```
1   BudgetManager rbac:subRole ProjectManager
2   BudgetManager rbac:ssod BuyerOfficer
3   BudgetManager rbac:permitted Buy
```

Fig. 8. Illustration of R*OWL*BAC second approach representation in OWL

For Ferrini et al. [8], the analysis of both R*OWL*BAC representations [9] shows that the first approach has the disadvantage of being inconsistent when 2 classes (D_i and D_j) are at the same time included (according to the role-hierarchy) and subject to SoD. Ferrini et al. also uses the ROWLBAC second approach to model RBAC in OWL (namely, the association between a subject and a role is represented by the ObjectProperty hasRole(subject,Role)). However, this has the disadvantage that constraints applying to properties to bind roles together (such as for DSoD or SSoD) is not handled by the standard DL-reasoner [8]. Ferrini et al. defines a framework to integrate XACML and OWL ontologies for supporting RBAC. It proposes to decouple the management of constraints such as the SoD from the specification and enforcement of XACML policies. The framework includes a critical module to support the DSoD that is based on an obligation to update the ontology with the information related to permissions granted to a subject. The principle is that when a DSoD exists and when a permission has already been granted to a subject, the obligation to update the ontology for another permission (that may not be assigned to the subject during the same session) will fail because it results in an inconsistency in the ontology. The failure of that obligation results in the denial of the second permission.

In XACML+OWL, a role is represented as a class and the hierarchy by the ObjectProperty subRoleOf (Role, Role). The SoD is represented with the property disjointWith. The disadvantage is that it solves the translation of the SoD constraint with the manipulation of an obligation generator module that supports the automatic creation of policy. This solution is not simple and could be complex to deploy in practice.

The responsibility-RBAC model proposes an innovative approach to represent both of those constraints:

- In RBAC, the SoD is positioned at the role level and specifies that two roles may not be activated together. We position the SoD at the responsibility level (figure 3) and state that two responsibilities may not be activated together. This improvement limits the SoD strictly to the concerned responsibilities and allows an employee to remain assigned to many roles under the condition that all responsibilities that compose that roles respect the SoD constraint. If this is not the case, conflicting responsibilities must be assigned to another employee.
- RBAC positions the concept of role-hierarchy at the role level (figure 3). We keep it as it is, since we agree that the hierarchy reflects the structure between job functions.

6 Conclusions and future works

In this paper we have proposed improvements to some aspect of business IT alignment by refining the assignment of permissions to users based on their business responsibilities. To achieve that, we have proposed an extension to RBAC with responsibility aspect to form the responsibility-RBAC model.

The main contributions are: the optimization of the number of roles by enhancing RBAC with the concept of responsibility and the association of permissions to responsibility, requiring an employee's explicit commitment regarding the tasks they are responsible for, and the representation of the responsibility-RBAC in OWL, including a new perspective to represent the constraint of SoD and hierarchy.

Future work will complete the innovative responsibility-RBAC model, deal with some of the above listed issues such as the translation of the model onto policies and evaluate our proposals with real case studies.

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Return on Experience of the Implementation of a Business-IT Alignment Approach: Theory and Practice

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Abstract. Approaches for business-IT alignment assessment developed in the research community represent an increasing interest for practitioners as they offer an in-depth analysis of the business and IT systems in the organisations. In order to be used by practitioners as a regular tool, these approaches have to be validated. Our experience shows that the perception of validity in academia - "in vitro" - and in the industrial environment - "in vivo" – may differ substantially. In this paper, we discuss the theoretical and empirical (or practical) validity of alignment assessment approaches based on metrics. We propose an empirical validation of a fitness measurement approach for business-IT alignment. First we identify a set of practical validity criteria for this approach and then we generalise our example proposing a set of practical guidelines for operationalisation of approaches based on alignment measurements. Our study reveals a significant gap between our understanding of validity and the perception of our industrial partners about this validity. The contribution of this work is a set of empirical criteria of validity and a set of practical guidelines that can significantly improve the usability – by organisations – of research approaches for business-IT alignment assessment.

Keywords: business-IT alignment, criteria of validity, measurements, theoretical validation, empirical validation.

1. Introduction

Assessment of business-IT alignment is a subject of continuous interest in research and industrial communities. For practitioners, validation of business-IT alignment is an important part of the organisation government; for researchers, approachs toccurate alignment measurement pave the way to new theories in the field [1]. Many

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approaches to business-IT alignment assessment are addressed in the literature. These approaches can be divided into three groups: questionnaire-based approaches [2], [3], [4], framework-based approaches [5], [6] and approaches based on alignment measurements [7], [8]. For many organisations the metrics-based alignment assessment is beneficial: it provides quantitative results that allow managers to measure the business value of the existing IT, and to increase this value. Our work is concentrated on the last type of business-IT alignment assessment approaches– the metrics -based ones. Validation of business-IT alignment approaches based on metrics is addressed in the research literature [9], [10], [11]. We agree with the author in [12] that in order to be valid these approaches should be grounded on a solid theory: *"it is questionable whether it is worth showing that a measure is measuring a particular attribute if that attribute is not part of a theory"*.

Briand [12] argues that most of the proposed metrics and the way to measure them have not undergone an empirical validation. Schneidewind [10] advocates an empirical validation process in which a metric is associated with a measure of interest. This process is specified for the software metrics but remains valid for metrics in any other discipline - particularly in Enterprise Architecture. Our experience shows that practical validation criteria of a metrics-based approach can be quite different from the theoretical ones. We follow the author of [16] who argues that *"a measure can be correct from a measurement theory perspective but be of no practical relevance to the problem at hand. On the other hand, a measure can be not entirely satisfactory from a theoretical perspective but can be a good enough approximation and work fine in practice"*.

In this paper, we discuss the theoretical and empirical (or practical) validity of metrics-based approaches to alignment assessment. We propose an empirical validation of the fitness[1] measurement approach for business-IT alignment developed in [17]. First, we identify a set of practical validity criteria for this approach and illustrate these criteria on the example. Then we generalise our criteria and propose the guidelines for operationalisation of approaches based on alignment measurements.

Research protocol: In the literature, five classes of empirical research are identified [18]: controlled experiments, case studies, survey research, ethnographies and action research. In our work, we have selected "case studies" as a research method type. This method offers a deep understanding of a given phenomenon and explains how and why this phenomenon occurs.

In this work, we use the ABC-Supermarket case for our study.We justify this case as a critical case to test the fitness measurement approach [17]. We proceed with the case study as follows: first, we identify the criteria of theoretical validity for the fitness measurement approach [17]. To justify our criteria, we make an analysis of related works and show that these criteria are considered important in many approaches [7], [9], [10], [12], [13], [16]. Then we implement this approach in the industrial project of Information Systems (IS) evolution in ABC-Supermarket. While implementing, we (i) observe whether the theoretical criteria of validity are met; (ii) check that the theoretical criteriaare recognised as "important" by practitioners (iii) identify other validity criteria, which are important for practitioners but are omitted in the identified theoretical criteria list (we call these criteria "empirical vriteria of validity").

[1] [1] The fitness relationship definition used in [17] is ''the degree to which the needs, demands, goals, objectives and/or structure of one component are consistent with the needs, demands, goals, objectives and/or structure of another component''.

Our study shows that some of the theoretical criteria are refuted and other factors related to fitness metrics validity are elicited.

This paper is organised as follows. In Section 2 we introduce the Fitness Measurement Approach and define the theoretical and the empirical criteria of validity for this approach. In section 3, we present the case study, by introducing the industrial project and the scope of our research; we describe how the fitness measurement approach was implemented, and we report the measurements' results. In section 4, we summarise the lessons learned and discuss the gap between our understanding of the measurements validity and the perception of our industrial partners about it. In Section 5, we present the conclusions and future work.

2. Validation of Fitness Measurement Approach

In this section we present the Fitness Measurement Approach developed in [17]. We define a list of theoretical criteria that should be respected by the ***valid*** fitness metrics These criteria correspond to the perception of the Fitness Metrics Approach validity from the researchers' point of view.

2.1. Introduction of Fitness Measurement Approach

In [17], authors propose an approach to evaluate the fitness relationship between the business and the system supporting it. The fitness relationship is established between components of business and system models. The approach proposes a fitness measurement according to four points of view (called "factors"): *intentional, informational, functional and dynamic*. This approach also identifies the ten fitness *criteria* associated with these factors and defines a specific metric for each of them. For example, the g*oal satisfaction* criterion characterises the intentional alignment factor. It describes how the business goals specified within an organisation are supported by the IT systems existing in this organisation. The metric defined for this criterion is a *goal count*. Goal count can be *measured* by calculating the ratio between the business goals explicitly represented by the corresponding *states* of the IT systems and the total amount of business goals (see [17] for more details). The measurement result $0 <$ goal count ≤ 1 can be then analysed: if goal count = 1, then all goals are taken into account. Please note that the approach does not address the cost, human and social factors. It is rather concentrated on evaluating the information which is supposed to be included in the IS.

Table 1. Fitness measurement framework

Alignment factor	Fitness criterion	Fitness Metric
Intentional alignment	1. Support ratio	Activity count
	2. Goal satisfaction	Goal count
	3. Actor presence	Actor count
	4. Resource presence	Resource count
Informa-tional alignment	5. Information completeness	Business object/System class mapping count
	6. Informational accuracy	Business /System state mapping count
Functional alignment	7. Activity completeness	Business object/System class mapping count
	8. Activity accuracy	Business/System state mapping count
Dynamic alignment	9. System reliability	Law-mapping count
	10. Dynamic realism	Path mapping count

The Fitness Measurement Approach is based on a set of concepts important for the alignment assessment. *Business goal* [19] is a set of stable states of business objects we seek to achieve. *Business object* (BO) is an object that represents the entities in the business domain. *Business state* (or BO state) is a state of a BO at a time t, defined by the values of all attributes of this BO. *Business actor* is defined as someone or something that interacts with the business or IT system using an interface; it participates in a business process and triggers external events that result in a state transition of a BO. *Business resource* [19] is a BO, which neither initiates actions nor causes a state change. In our case, a product specification is an example of a business resource. *System class* (or system object) is an object that represents the entities in the IT system (by analogy with a business object). *System event* [19] is associated with a system state change. By analogy with business activities that are changing business objects' states, we consider system events changing states of system objects. *System goals* describe purposes of the system [17]**.** We say that a system goal maps a business goal if the states of business objects associated with this business goal are represented by the states of the corresponding system objects. *System state* (or system object state) is a state of a system object (class instance) at a time t. It is defined by the values of all attributes of this object. *Paths* are sequences of business (or system) states. *Business laws* represent legal rules and principles adopted by business organisations.

The Fitness Measurement Approach addresses the problem of business-IT alignment in the organisations and strongly relies on the detailed information about the organisation processes, data models, etc. In case this information is not available, one can build it up as it was discussed in [20].

2.2. The evaluation hypothesis

In this section we define evaluation hypotheses of the Fitness Measurement Approach. The hypotheses consist of a set of theoretical criteria of validity for the fitness measurements. Based on our research experience and on the related literature analysis we retain the following validity criteria:

1. The ***measurements should be based on verifiable observations*** (models, specifications, interviews, etc).
2. The ***measurements' results should be non-ambiguous*** – they should have only one interpretation.
3. The ***measurements should be effective***: they should correspond to the problem complexity and help practitioners to decide on the course of improvement actions.
4. The ***measurements' results should be accurate***: they should precisely localise the misalignment in the organisation.

Many works on metrics-based approaches validity confirm our validity criteria.

Verifiable observations: research works [12], [22] argue that a metric is valid if it measures what it purports to measure. To do so, we need to clarify what attribute we are measuring and how we proceed to measure it. The precision of the underlined data to be measured is thus important to have a valid measurement.

Non-ambiguity: in [9], authors discuss the validity of a metric structure. In order to be valid, the metric requires the validity of the attributes it measures, the unit it uses, the instrument it underlies and the measurement protocol it defines. They argue that the *non-ambiguity* of these elements guarantees the metric validity.

Effectiveness: Fenton [11] discusses the metric validity view based on the identification of the usefulness of a metric for a stakeholder's purpose. In [21], [16], [7] the authors argue that metrics constitute a crucial source of information for decision-making. Indeed, they (metrics) should localise where malfunctions hold and where resources are needed and give accurate information to managers in order to

help them make decisions.

Accuracy: Bodhuin [7] emphasises that the purpose of metrics is to check the alignment and to detect misalignment between business processes and the information system supporting them. He defines two metrics: “technological coverage” indicating the percentage of activities supported by the system. If an activity *i* is supported by the system, the second metric: “technological adequacy” brings more precise information and measures how adequately is the support of a set of system components for the activity *i*.

3. The Practical Test of the Evaluation Hypotheses

In order to be widely accepted, each research method or approach, , should prove its usefulness in practice [12]. In the previous section we defined the theoretical criteria of validity for the fitness measurement approach. In the following, we test if these criteria remain valid in practice. We argue that proving the empirical validity of a research approach guarantees its entire validity.

Practical validity addresses the ability of the research approach to meet the practitioners’ needs: it tells the practitioners how they can benefit from this approach and what will be the added value. To validate the Fitness Measurement Approach, we should answer the question: « when do the results of this approach can be considered by the users as satisfactory? ».

To do so, we apply the Fitness Measurement Approach [17] in a real project. The appreciation of the results by practitioners informs us about the “practical validity” of this approach.

3.1 The Case study: alignment validation in ABC-Supermarket

ABC-Supermarket is a mass retail company - one of the leaders on the French market. ABC-Supermarket groups approximately 3000 independent operators, and thousands outlets in France and internationally. This company specialises in different sectors of retail business and is well known in both food and non-food retail markets.

The initial specialisation of the ABC-Supermarket is food and household products. Seven years ago ABC-Supermarket integrated a new product category – textile – in its portfolio and defined a new trade name - ABC-Fashion. To provide the IT support for purchase (upstream) and retail (downstream) activities for textile products, the company decided to use the existing information system – the one which is used to support the business activities for food products.

Initially, the reuse of the existing IS for ABC-Fashion seemed justified as retail business defines similar *processes* for food and textile products. *Master data* for both food and textile products also have a lot in common: all these products are characterised by their type, price, etc. However, over the years, the textile trade name turnover decreases and the survival of the trade name was threatened. The existing IS showed its limits in managing the textile business. As a solution, numerous manual fixes and workarounds have been developed over years. As a result, the existing IS got overloaded with patches and became not efficient.

The company decided to make evolve its information systems. The challenge becomes the trade name survival. The main objective of this evolution is to precisely define where the existing IS fails in supporting the textile business requirements, and what improvement can be made to correct the misalignment.

To answer these questions we apply the Fitness Measurement Approach. While the fitness measurements results in a set of values, the process of acquiring these values leads to a deep understanding of the gap between the existing IS and the textile business requirements.

3.2 Scope of the fitness approach application

The *upstream activities* of ABC-Fashion include marketing, products referencing, providers referencing, outlets billing, etc. These activities are supported by the existing upstream information system (or UIS) of the company. The *downstream activities* of ABC-Fashion address the product management in the outlet stores, e.g. stock replenishment. These activities are supported by the existing downstream information system (or DIS).

The cited UIS and DIS were affected by the evolution requirements. Among listed above, product referencing is one of the most critical tasks as it maintains the link between the upstream and the downstream information systems: the outlets use DIS to order products available in UIS (see fig.1). If a product is not referenced in UIS, it is not available for ordering. That is why the IT support for the product referencing represents the main concern for the ABC-Fashion management. Mismanaging the product referencing activity affects the whole business process: the stock management (in the upstream and at the outlet level), the ordering process, marketing campaigns... For this reason, we concentrate in this study on the textile product referencing activity and how the existing IS (the food one) supports it.

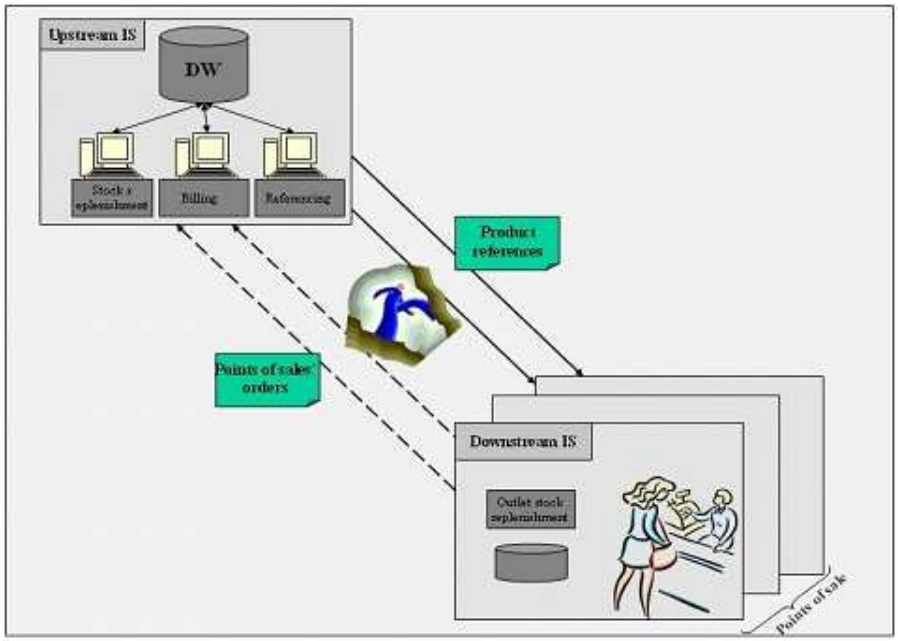


Fig.1. Product referencing application: the link between UIS and DIS

3.3 Constraints of the research work

Researcher: One researcher, working partial time, during 9 months in the ABC-Supermarket, applied the fitness measurement approach.

Experimental objects availability: Less than 20% of business and system models are available in the organisation. Indeed, over ten metrics, two were applied without building the corresponding "input" models.

The unavailable artefacts have to be built. Otherwise, fitness measurements cannot be applied.

3.4 Implementation of the Fitness Measurement Approach

As cited above, Fitness Measurement Approach relies on business and IS models. As the most of these models do not exist in the organisation, we built them up based on the available information sources. As a result, we were able to implement nine fitness metrics out of ten.

a) Data collection

To construct the missing business models, we collected data that describe the business view of ABC-Fashion on the textile product referencing. We interviewed the following business actors: (i) the head of department of the textile trade name: in order to understand the textile business requirements, (ii) the responsible of the product referencing department: in order to apprehend the product referencing problem, (iii) IS users: in order to understand the IS functioning and how it is used. The available business process landscape and process specifications were also analysed.

To construct the required IT artefacts, we collected data that describe the IT support of textile product referencing provided by the existing information systems (UIS and DIS). In order to apprehend the detail of the system architecture and functioning, interviews have been conducted with the following IT actors: (i) the referencing system administrator, (ii) the referencing system designers, (iii) the referencing system developers.

The following documentations were also analysed: (i) the user manuals of the product referencing system, (ii) short descriptions of application functionalities available on the Intranet, (iii) software applications' data dictionaries, containing the information about product master data, and (iv) screenshots.

We also studied the product referencing system testing it on some "toy" examples. After conducting interviews with the mentioned specialists and the examination of the existing documentation, two problems have been highlighted: (i) compared to food products, who's assortment can be either permanent (always on the shelf) or non-permanent (a subject of a commercial operation), textile products are subdivided into three planning categories: permanent products, collection products (e.g. summer/ winter), and short-cycle products (e.g. fashionable articles, brand promotions, etc); (ii) apart from the master data, operations on textile products also require textile-specific data (e.g. *colour range* and *size range*).

Business and system artefacts reflecting these two problems should be built in order to localise precisely the problem sources and identify accordingly potential solutions.

b) Consolidation of collected data

We are interesting in highlighting how the existing IS has been adapted to support the business requirements and to what extent it fits them. To conduct our study, we use:

- the MAP formalism [23] to build the business and IS goal models describing respectively the referencing process as it is seen by ABC-Fashion and as it is supported by the referencing application.
- UML modelling to build the business and the system class diagrams specifying respectively the data model for the product referencing as it is seen (or required) by ABC-Fashion and its implementation by the existing information system.

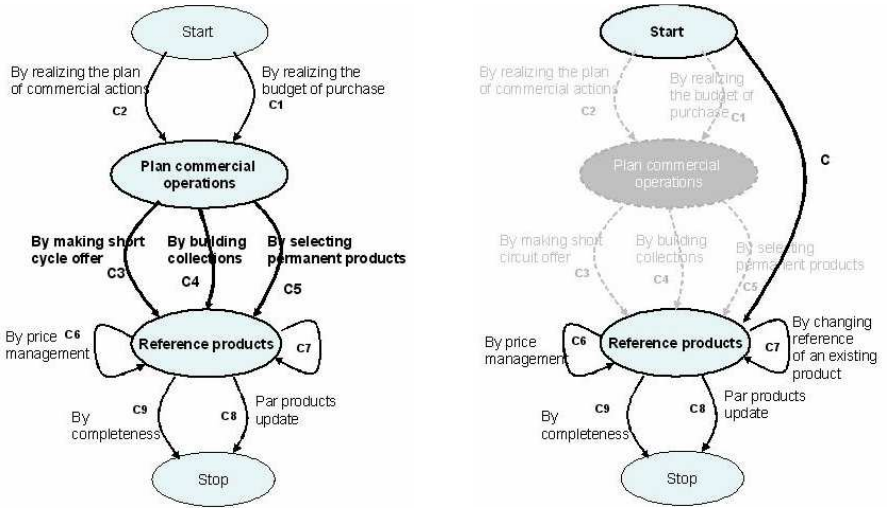
These artefacts (business goal models and business and IS data models) can highlight enough the problems cited above. For lack of space, these models are not

presented in the paper.

Problem detected by MAP modelling:

A *map* is a process model in which a non-deterministic ordering of *intentions* and *strategies* is defined. *Intentions* are the goals to achieve. S*trategies* represent the ways to achieve these goals. A *map* diagram is a labelled directed graph with *intentions* as nodes and *strategies* as edges between intentions. A *section* in a *map* is the triplet $<I_i, I_j, S_{ij}>$ where I_i is the *source intention*, I_j is the *target intention* and S_{ij} is the *strategy* connecting the source and target intentions. A *section* can be, in turn, refined by a *map*.

The comparison between business and IS maps shows that there are some business goals (at different level of abstraction) which do not correspond any IS goal. Some business strategies are also not supported by the product referencing application. In fact, as shown in Fig. 2, the business goal "*Plan commercial operations*" is not supported by the Product Referencing application (shown by dashed and grey arrows in Fig. 2(b)). The system implements only one strategy for achieving the goal Reference products. It does it from scratch by entering data from the product sheet directly. This means that the system does not distinguish Collection, Permanent, and Short cycle products and thus processes all product types in the same way. This explains a partial satisfaction of the business goal "*Reference products*".



(a) (b)

Fig. 2. (a) Business map for product referencing process (b) UIS map for product referencing application

Sections C3, C4 and C5 are refined in sub maps with sub goals and strategies (11 business goals in total). An important part of these sub goals are not supported by the product referencing application. For lack of space, the sub maps are not presented in the paper.

***Problem detected by the UML modeling*:**

To reference food products, only the business object Logistic Unit is required. A logistic unit for the product of a type T specifies *a container, a pack, or a box* with X items of the given product inside. It represents a minimal amount of the product of type T that can be ordered, delivered, or stored at the warehouse (e.g. a box of six

bottles of soda). As (speaking about food products) the products in the logistic unit are identical – i.e. the same soda bottles - there is no need to reference each product item within the logistic unit separately, it is the entire logistic unit with *X* items inside that is referenced. At the IS level, the logistic unit is represented by the "Product file" (or "Package" concept) which contains the package description, logistic and tariff data. The same IS (conceived for food products) is used for textile product. But applying the same simplified referencing method for textile product, the following has to be considered: textile products have much more variations within the same type as they can exist in multiple sizes and colours. Making (by analogy with soda bottles) a logistic unit contain the same product variation (e.g. a box of 100 jeans {size = S, colour = 'Navy'}) is not practical. Therefore logistic units for textile products can contain multiple variations of the same product type: a box of jeans: {{S, 'Navy'}->10; {S, 'Black'}->10; {M, 'Navy'}->20; {M, 'Black'}->10; {L, 'Navy'}->30; {L,'Black'}->20}.

Textile business requires the sizes and colors referencing. As the existing system does not support this need, several workarounds and manual fixes were added, for instance, a "package content File" describing the content of the logistic unit was added to inform points of sale about the quantity of products in terms of sizes and colors contained in each logistic unit. This indicative information provided by the referencing system can not be exploited by the points of sale to order a specifc product with specific size and color. The business was constrained by the system limitations causing then the emergence of gaps with the business requirements. These gaps explain several problems mainly:

- Points of sales cannot order only one variation of the product to replenish their stock – they have to order at least one complete logistic unit. This leads to unsold stock, discounting, and regular company loss as a result.
- The marketing department cannot make forecasting based on the logistic units, as it is not known which product was most demanded and brought to the company the maximum profit and which was not sold and caused loss.

3.5 Application of fitness measurements on the constructed data and result analysis

In this section, we present fitness measurements' results and propose guidelines that can help ABC-Fashion to improve the fit between their business and the existing IS. We note that some problems are detected during the business and IS models building. Indeed this activity is knowledge intentsive and allowed us to have a first qualitative aligment evaluation. The fitness measurements confirm and detail the qualitative evaluation by capturing the malfunctions in more detail and in terms of models' concepts and allow us to detect how we can act (add such concept if it is absent or extend its states if it is present but mismanaged in the system...) to improve the alignment.

Table 2. Fitness measurement results

Criteria:	Description	Measures:
1. Support ratio	{Number of activities represented by system events/Number of activities}.	7/32 (21%)
2. Goal satisfaction	{Number of business goals represented by the system goals/Number of business goals}	1/11 (9%)
3. Actor presence	{Number of business actors represented by the system user interfaces/Number of business actors}	2/5 (40%)
4. Resource presence	{Number of business resources represented by system classes interfaces/Number of business resources}	0
5. Information completeness	{Number of business objects represented by system classes/Number of business objects}	7/21 (33%)

6. Information accuracy	{Number of business states represented by system states/Number of business states}	21/42 (50%)
7. Activity completeness	{Number of business objects for a given activity represented by system classes /Number of business objects for a given activity}	values for different activities in [0,1]
8. Activity accuracy	{Number of business states for a given activity represented by system states/Number of business states for a given activity}	values for different activities in [0,4;0,72]
9. System reliability	{Number of business laws (where each business state is represented by a system state and the transitions between business states are represented by the transitions	11/31 (35%)

Our study revealed the significant differences between the referencing activity defined for the food and the textile products. This is the reason why referencing of textile products using the existing information system was so problematic in the past. The "misfit" between business and IT is confirmed by the measurements' results shown in Table 2.

1&2. *Support ratio and Goal satisfaction:* Only 20% of business activities are supported by the system and less than 10% of business goals are satisfied by the system. In fact, the significant part of upstream activities related to the planning of commercial operations on textile products (collection and short cycle operations) is not supported by the Product Referencing application.

3. *Actor presence:* the product referencing activity involves five actors. Only two actors interact with the system. The others (marketing, buyers and the head of the point of sale) are involved during the planning phase, which is not supported by the system.

4. *Resource presence:* All business resources required for the product referencing (e.g., specifications, product sheet containing information the product…) are created using Microsoft Excel software and are not integrated in the referencing system.

5. *Information completeness:* only the third of information is managed by the system. Our analysis revealed the following reasons that justify the low value of information completeness: (i) the need for referencing different textile product categories: the referencing of each product category has its own referencing process. These processes are manual or semi-automatic. Indeed, they are part of the planning activity which is not supported by the system. (ii) The specific requirement for referencing related to the textile products, taking into account their colour/size: on one hand, the concept of "Product" is absent in the system. Indeed, what is present in the system is the concept of "package" containing n products and not the product itself (see section 3.4). On the other hand, the size/colour business concept is missing in the system. It is for this reason that the product can not be referenced with the corresponding size and color. This generated the problems cited above and explain why the business goals are not satisfied by the system.

6. *Information accuracy:* Although only third of business objects are represented by system classes, 50% of business states are mapped by system states. This is explained by the fact that system objects are not consistent with business objects (the case of "Product" and "Package" concepts), they are forced to be treated in the same manner.

7. *Activity completeness:* More than half of business transitions are not implemented in the system.

8. *Activity accuracy:* for some activities, even if a business object (BO) is represented by a certain system object, the states of the latter might not represent the states of the BO. In practice, this means that the system counterpart of the BO is not processed by the IS as expected by business – it is not accurate. This explains why the completeness of an activity is higher than its accuracy. For other activities, the accuracy is higher than the completeness. In fact, some BOs are implicitly supported by the system: i.e. there is no object in the system that represents a given BO, nevertheless the system supports the behaviour of this BO. For example, the system object "*Package"*

does not map the *Product* BO in textile business (as explained in "information completeness"); however, it substitutes this BO in certain operations – we can say that the "*Package*" mimics the behaviour of the *Product* in the system.

9. *System reliability:* More than half of business transitions are not implemented in the system. This is explained by the fact that only a few activities are supported by the system.

We note that the fitness metrics organised around the four alignment factors are inter-reliated and complement each others. Indeed, the source of a mismatch detected at the goal level (intentional alignment) is explained in detail by metrics at more operational levels (functional and informational alignment).

As we can observe, there are huge differences in the gaps detected by the fitness metrics. A part of them was covered by workaounds and manual fixes (several treatments are done manually and several add-ons were made). These workarounds were not detected by fitness metrics. Indeed, they (workarounds) correspond to managing the information differently in the system and at the business levels. Whereas, as presented in table 2, the metrics are based on a correspondance between business and system concepts. This concern is beyond the scope of this paper. Metrics are used to detect the gaps, to help us localising the main differences between the business and the system domains and to propose a set of corrective actions which would improve the business/IT alignment. Indeed, it was shown that (i) the existing IS support demonstrates the serious lacks of flexibility: the stock replenishment for POS is supported only on the logistic unit level. We recommended that the IS of the ABC-Supermarket should support the textile product referencing on the product level, rather than on the logistic unit level. (ii) The colour/size management functionality is essential for textile products; we advised that it should be added to the existing IS. (iii) Many business activities are not supported by the system. Consequently, the corresponding actors do not interact with the system and the handled objects and the required business resources are not present in the system. We advocated that the organization should prioritize its business activities and revise the existing IS in order to extend its functionalities to support the critical business activities. The organisation should also verify whether the interaction of some actors with the Product Referencing application would be beneficial for product-referencing processes. If this is the case, new user interfaces should be developed and the business process may be redesigned taking into account the new actors. Organisation should also consider the IS support of identified business resources. Indeed, integration of business resources can increase the interoperability and facilitate the information exchanges between the business and the IS partners.

4 Lessons learned

In section 2.2, four theoretical criteria of validity have been defined. We will now evaluate the results presented in section 3 against these criteria according to two points of view: the researchers' point of view and the practitioners' point of view. The first one allows us to establish if the measure values obtained for the fitness metrics are hundred percent accurate, effective, verifiable and non ambiguous. The other point of view allows us to evaluate if for the practitioners these set of criteria are relevant or not.

4.1 Measurements validity: point of view of the researchers

- *The measurements are based on verifiable observations:* the models required for the measurements application were built up and validated by specialists within the organisation.

- *The measurements' results are non-ambiguous:* the project stakeholders understood the results in the same way.
- *The measurements are effective:* the results have been compared with the study made by the project team, requested by the CEO of the textile trade name. These results were confirmed during discussions with the project stakeholders.
- *The measurements' results are accurate:* the results helped us to localise the misalignments and confirmed the causes of non-fits.

From our point of view, the fitness measurements are valid; they fulfilled all theoretical criteria of validity.

4.2 Measurements validity: point of view of the practitioners

Fitness Measurement Approach was applied by one researcher on a restricted perimeter of the project as we showed in section 3. Practitioners confirm the usefulness of the approach and the effectiveness of its corresponding results. Nevertheless, concerning the reusability of the approach for other projects, the following criteria related issues bring up:

- *The measurements are based on verifiable observations:* Building models requires much time, new skills and further resources. Managers are aware of their data weaknesses and argue that this is not the priority of the company to build and to maintain such data.
- *The measurement results are non-ambiguous:* Managers are aware of their input data weakness and argue that even with ambiguous results, they would be satisfied.
- *The measurements are effective:* Concerning the effectiveness of the measurements, managers are satisfied. They confirmed that we found problems that indeed exist, and localised misalignments. Nevertheless, they deprecate the fact that the results did not indicate the severity of the identified gaps. They asserted that the prioritisation of gaps severity is very important for the decision-making.
- *The measurements' results are accurate:* The accuracy of the results is not important for practitioners. They are interested in getting more results precision only if it is done within a short period of time. Otherwise, it does not have much value. For managers, detailed reports take more time to be done and to be understood. Simpler results are preferred, at least in a first step. Sometimes, intuition is enough.

From the practical standpoint, fitness measurements are useful only if models required for their application are available in the organisation. For the majority of organisations, this is not the priority.

The measurement validity perception of our industrial partners revealed that (i) some of our criteria are not such important for them, and (ii) some criteria appeared to be very important but we did not consider them in our work. Overall, practitioners do not aim a perfect alignment, especially when it requires too much time and resources. Most of the time, they are interested in some aspects of the problem, not all. What is important for practitioners is to do things –approximately– right and fast. Besides the effectiveness, for them, the *efficiency* criterion is crucial. Table 3 summarises the importance of measurement validity criteria viewed from the theory and the practice standpoints.

Table 3. Measurement validity perceptions

	Theory	Practice

Measurement based on verifiable observations	++	--
Non-ambiguity	++	+
Effectiveness	++	++
Accuracy	++	--
Efficiency	--	+++

4.3 Discussion of the obtained results

Several factors may limit the generalisation of our results:

- The applicability of the Fitness Measurement Approach depends on the enterprise models availability in the organisation: if models required for metrics application exist in the organisation, the approach application is just a technical task. Otherwise, required models need to be built [20] and the application of the approach may become a complex and resource demanding task.
- The interpretation of the validity criteria by practitioners depends on the organisation data maturity level. Indeed, the more the data maturity level is high the more practitioners adhere to our validity criteria and confirm our evaluation hypothesis.
- Fitness metrics results depend on the quality (and validity) of the built models. In the big companies, knowledge is spread among many individuals and the understanding of the same part of business by different individuals may vary and may even be contradictory. Extensive cross-checking is thus mandatory.

5 Conclusions and future work

Our study revealed that researchers and practitioners do not have the same understanding of the validity of metrics-based approaches. In fact, some of our hypotheses have been refuted during the case study and new validity criteria emerged. The main requirement of practitioners is that alignment measurements give effective results – even approximately – with regard to the time and the budget constraints of the project. Our experience allowed us to identify practical guidelines to help the successful application of the metrics-based approaches and, more precisely, the enhancement of their applicability in industrial projects. The definitions of these guidelines are based on (i) the observation of the industrial context and (ii) the practitioners' requirements introduced during fitness measurements. We organise them as practical guidelines in three directions:

***Guidance in building models*:** The maturity of organisations (SEI Capability Maturity Model [24]) - has an impact on the metrics applicability. Indeed, metrics rely on models and verified data, which constitute the inputs of the metrics-driven approaches. The availability of such data depends on the maturity level of the organisation. For many organisations required models are often not available, and to build them is necessary to assess the business-IT alignment. Building such models is not a trivial task; the project scope should be well defined to allow the collection of the relevant data. Guidance is thus needed to assist engineers in building the business and IT models required for performing measurements. In [20], we proposed a "build-up process" consisting in four phases: (i) identification of the input data required by the fitness measurement approach and which should be constructed; (ii) initial data collection; (iii) data consolidation; (iv) validation of the consolidated data (which will be used as the input data of the fitness measurement approach).

***Customisation of the approach - Time To Market requirement*:** Business-IT alignment assessment is a sort of internal audit performed by an organisation in order to undertake the corrective actions and to enhance its performance. In an evolving environment, it is very important to react rapidly to the change. If it takes long time to produce and to communicate results, the measurements results become meaningless. Constructing the required artefacts for applying metrics-based approaches takes a long time (data collection and consolidation, and models validation). In order to address this issue, we observed that it is important to find a way to get, interpret and present results in a shorter time. For this reason, we argue that the measurement approaches require more agility, i.e. the results should not be delivered at once and intermediate results to lead the ways to measure are needed. Intermediate results are discussed and a deeper analysis can be undertaken if needed. The measurement cycle can thus be shortened.

Customisation of the approach - Time Boxing/Design To Cost: The main constraints of a project are the time, the cost and the quality of the resulting product. The time boxing (or design to cost) is a strategy used in practice to indicate the quantity of information, which can be delivered, under the constraint of a limited time (x months) and a fixed budget (y K euros). We argue that the approach can gain in usability if it is composed of fine-grained method chunks which can be applied according to the convenience of the *resources* involved in the project, i.e. time, budget and actors.

In our future work, we will explore the three first directions in order to improve the "usefulness" of our approach.

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Generating Value Models using Skeletal Design Techniques

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Abstract. This paper presents a novel approach to automatically generate e^3*value instance models*, based on skeletal design techniques. The approach has three phases. While the first two phases are related to the generation of a *value activity network* based on a given *value skeleton*, the third phase matches the elements of the value network with the capabilities of service providers. The main objective of our approach is to re-use a set of *value skeletons* for covering an industry sector from which more business cases may be generated. Finally, we validated our approach in a realistic case study.

1 Introduction

Enterprises increasingly participate in *networked value constellations* [1]. By doing so, enterprises can jointly satisfy a more complex consumer need than they could ever do on their own. Consider for instance the music industry, our case study domain. If a person listens to music on the radio, apart from the radio station, Intellectual Property Rights (IPR) societies will be needed to collect money for the artists, song writers, producers and other IPR owners. All these actors are part of a value constellation that is needed to listen to a music track on the radio.

In earlier work [2], we proposed the e^3*value* methodology to design value constellations. In brief, e^3*value* is a conceptual modelling approach, which is used to describe a network of enterprises who exchange objects of value with each other.

The contribution of this paper is to lift e^3*value* to the *industry* level, e.g. to describe the music industry, rather than just a single business case, as e^3*value* normally is used for. To do so we present e^3*value skeletons*. One of the most important differences between an e^3*value skeleton* and a normal e^3*value* business case model is that a business case contains named, specific, enterprises who participate in the business case at hand, whereas a skeleton contains only the set of activities to be performed for a business case.

One of the purposes of an e^3*value skeleton* is to easily generate many variations of business cases, which can be presented to stakeholders for selection.

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Moreover, since mass configuration of products is playing an important role nowadays [3], our long term ultimate goal is to automatically compose networked value constellations, including the required business processes and IT support in the form of web services. Such IT is then aligned with the business, since both are designed in an integrated way.

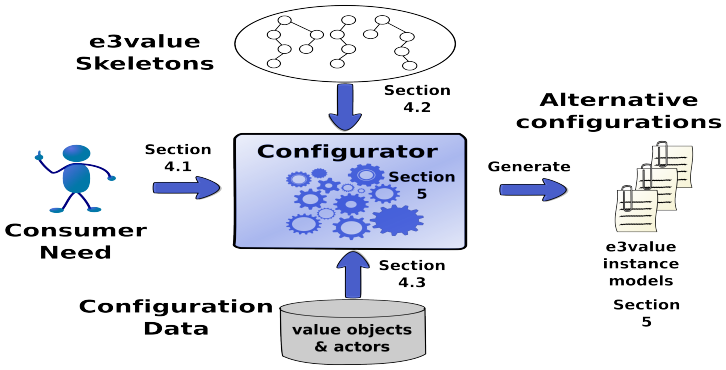


Fig. 1: Generation of value models using skeletal design techniques.

We refer to industry models as *skeletons* and to business case models as *instances*. By using skeletal design techniques (Sect. 2.2), we derive e^3*value instance models* from a *skeleton*. For the music industry (case study description in Sect. 3), we have developed various e^3*value* instance models to study variations of these models. Abstracted versions of these variations are captured in *skeleton* models (Sect. 4.2). By using user input (Sect. 4.1) and configuration data (Sect. 4.3), we generate e^3*value* instance models (Sect. 5). Fig. 1 depicts this general idea. Finally, Sect. 6 presents conclusions and future work.

2 Value models and skeletal design

2.1 Value models

An e^3*value* model depicts a network of enterprises creating, distributing, and consuming objects of economic value [4]. The focus of the model is on **what** kind of objects enterprises must exchange to each other in order to cover consumer needs [1]. Fig. 2 shows (at the bottom) the modelling constructs of e^3*value* and (on top) an educational example.

The most important e^3*value* constructs are as follows: *Actors*, such as a buyer and seller, are economically independent entities (Fig. 2). Actors transfer *value objects* (money, goods) by means of *value transfers*, which in turn connect *value ports*. For value objects, some actor should be willing to pay, which is shown by

[1] and not in HOW, this is the focus of a business process

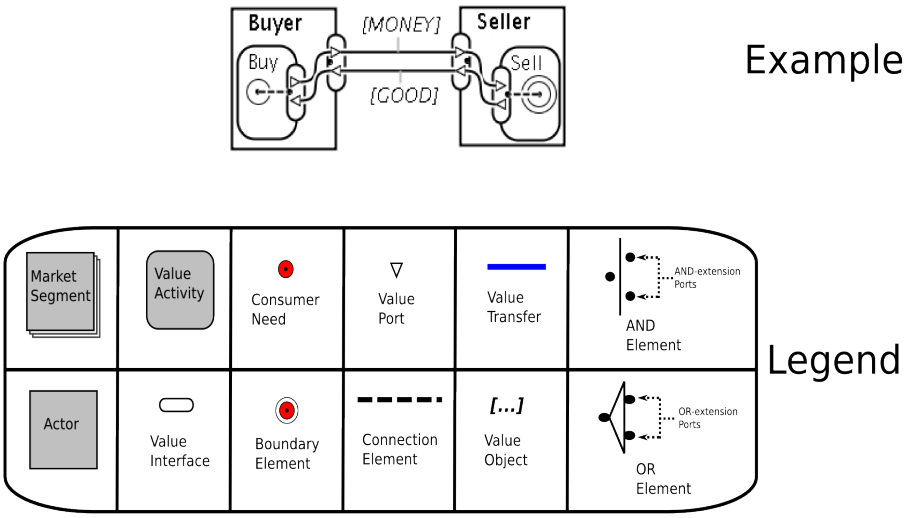


Fig. 2: e^3*value* constructs for value modelling.

a *value interface*. A value interface models the *principle of economic reciprocity*: Only if you pay, you can obtain the goods and vice versa. Besides, actors perform *value activities*, which create something of economic value. Finally, an e^3*value* model contains a dependency path, starting with a consumer need and ending with a boundary element. Along the path are value transfers, value interfaces and connection elements. The dependency path shows how many value transfers are executed as a result of a consumer need. An elaborated formalisation of e^3*value* can be found in [4].

2.2 Skeletal design

Since we want to generate value models by means of value skeletons, it is useful to take into account configuration design theory. According to Motta, a configuration design problem does not exhibit complex spatial requirements and all possible solutions adhere to *a common solution template* [5]. For this reason we think the configuration of services, by using value models, adheres to a generic template. Wielinga and Schreiber describe four main categories of configuration design: *assignment*, *scheduling*, *skeletal design* and *parametric design* [6]. The last two categories are related to our research.

Parametric design is described as the process of assigning values to *design parameters* not only satisfying needs and constraints but also following an opti-

mization criterion [5] [2]. Skeletal design refers to a model-based mapping between components and the assembly [6]. Because our solution is not considering assigning values to a fixed template but a model-based generation of new components, our approach is more related to skeletal design.

To sum up, our approach considers that the target artifact is modeled as a set of *elements* and the solution implies *generating elements* based on *a common solution template* matching the given design requirements and constraints (Sect. 5).

3 Case study: Clearing Intellectual Property Rights

In the music industry, Intellectual Property Rights (IPR) are an important concept. Neighboring rights are a kind of IPR, which have to be paid by users if they earn money by playing music, or in other words, if they make music public. Clearing such neighboring rights involves two steps: collecting fees from IPR users, *i.e.* radio stations, bars, discotheques and others, and distributing these fees to Right Owners, *i.e.* artists, song writers, producers. This process is usually performed by IPR societies and is called *clearing tracks*. One of the IPR societies designed to perform this activity in The Netherlands is SENA [3], our case study partner which is also one of our stakeholders.

Some results for modeling this case study have been already provided [2], however these results only address one of the multiple scenarios that can emerge in the music industry, such as new actors performing less or more activities because of *market liberalization* and new trends in the way of *delivering music* [7, 8]. One such a trend is that SENA, instead of clearing tracks based on play lists of the top 30 radio statios (estimation), clears tracks based on the actual usage (*pay-per-play*).

The e^3*value* model depicted in Fig. 3 presents a pay-per-play solution for background music. In this e^3*value* model, IPR users are the starting point, as they require to broadcast background music which is provided by background music providers (BMP). A BMP can provide background music in different ways, one of those is streaming (Value Transfer A). When providing streams, the BMP must pay to IPR Societies which collect fees related with making a stream available to the public (Value Transfer D-E). Here, the public refers to IPR users.

IPR users have to also pay IPR Societies, as they make public the music also to their customers. Although the BMP and IPR users pay to two IPR Societies, it does not mean they pay twice for the same thing. Paying BUMA/Stemra [4] is because of the right that the composers, publishers and lyricists hold (Value Transfer C), whereas paying SENA is related to the rights of the performing

[2] Motta also mentions preferences, however at this stage they are not essential to find an optimal solution.

[3] (Dutch: Stichting ter Exploitatie van Naburige Rechten, English: Foundation for Exploitation of Neighboring Rights)

[4] BUMA is other IPR society, also working in The Netherlands

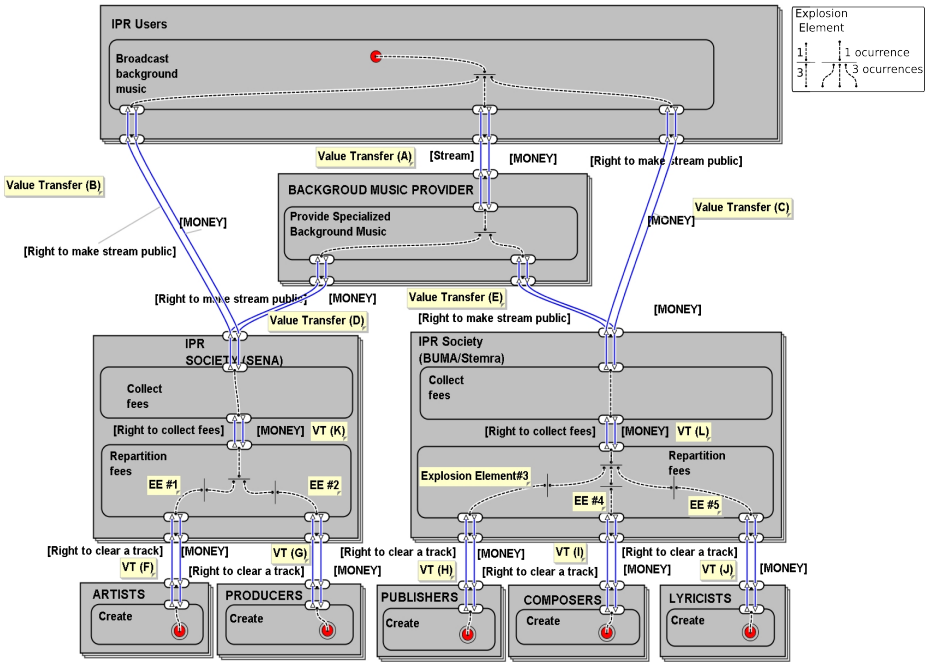


Fig. 3: e^3value model for the stream-based solution.

artists and producers (Value Transfer B). Indeed, Value Transfers A-E are constraints imposed by law, since IPR societies are the responsable entitites for collecting fees on behalf of IPR owners.

Once IPR societies got IPR-user fees, they retain a small percentage of these fees and the next step is to repartition the rest of the fees among Right Owners (Value Transfer K-L). This set of Right Owners is mainly composed by Artists, Producers, Music Publishers, Composers and Lyricists. Whereas SENA only repartitions fees to Artists and Producers (Value Transfer F-G), BUMA/Stemra does the same for Publishers, Composers and Lyricists (Value Transfer H-J).

Explosion Elements Due to the fact that tracks are usually performed by more than one artist, SENA must transfer the collected fees to each artist involved, consequently the value transfer F will occur more than one time per consumer need. In order to allow that SENA contacts more artists, an *explosion element* (EE #1) is added. Since the same holds for all the right owners, there are more explosion elements for each of them (EE #2 - EE #5). An explosion element models that the connected value transfers happen multiple times, rather than just once per dependency path execution.

In this scenario there are only two enterprises clearing tracks (SENA and BUMA). As we described before, market liberalization will require a more flexible scheme to assign value activities to different enterprises, *e.g.* the activi-

ties "Collect Fees" and "Repartition Fees" can be performed by different actors rather than one actor. In order to address this problem we have generated and analyzed variations in which several enterprises can cover different value activities. We have used these variations to build a few e^3*value skeletons*, however because of space restrictions just one of these *skeletons* is described in the next section.

4 Input elements for the configuration process

4.1 Consumer needs

For the configuration process, we assume that our consumer need is *playing background music* and that we can cover such a need by *providing a stream*. In addition, since the pay-per-play scenario must be analyzed, we also assume that our stream contains only one music track. So, the need boils down to a streamed track.

4.2 Value skeletons

The purpose of a skeleton is to abstract the set of relationships that are involved in an e^3*value* model. Later on, the instances of a skeleton will reflect a specific business case. In our approach, an e^3*value skeleton* implies three important features, which are described and explained by presenting our e^3*value skeleton*(Fig. 5).

No actors, No market segments e^3*value skeletons* focus on the definition of value activities and not on actors or market segments. In fact, assigning performing actors to value activities is an important part of configuring an e^3*value* instance model (see Sect. 5.4).

No Selection The main idea behind skeletons is that there should be an automatic process to instantiate specific business models by filling the elements in such skeleton. Therefore, this process must skip selection procedures like choosing among different dependency paths or different actors, as is normally the case in e^3*value* models. In e^3*value* words it means that we do not use OR-forks in dependency paths nor market segments.

On the use of Explosion Elements Consider the value transfers F-J in Fig. 3, these value transfers involve the repartition of fees among right owners and look very similar. By using explosion elements, we can abstract these transfers as shown in Fig. 4.a. While generating an instance model, this abstraction can be expanded to cover as many value activities as needed. In this example, we assume that fees must be repartitioned among three right owners, hence three

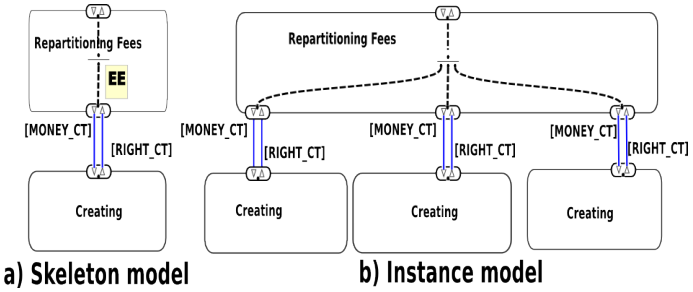


Fig. 4: Using an *explosion element*.

AND-extension ports are needed, which later allow connection with three other value activities (Fig. 4.b).

In the same way, our e^3*value skeleton* (Fig. 5) depicts abstracted versions of the value transfers B-E, K and L (Fig. 3), which are later instantiated into new transfers. How the instantiation process of the skeleton works is explained in Sect. 5.2. Finally, to facilitate reading, our skeleton also depicts short names for some value objects. In this way, RIGHT_MP refer to the Right for **M**aking **P**ublic a track, RIGHT_CL is the Right to **C**o**L**lect fees, and RIGHT_CT is the Right to **C**lear a **T**rack. The same holds for MONEY_MP, MONEY_CL and MONEY_CL.

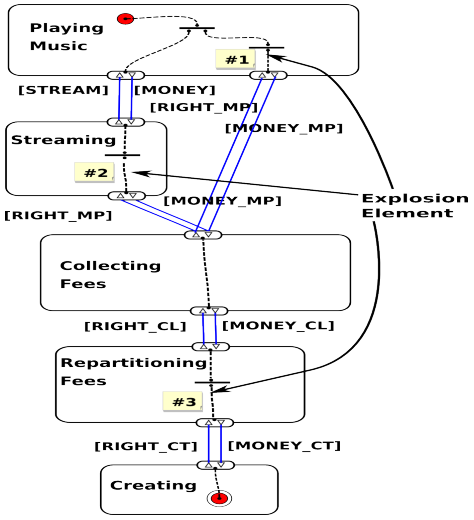


Fig. 5: e^3*value skeleton.*

4.3 Configuration data

The information about the environment in which the configuration process takes place is the last element to be specified before starting the configuration process. This environment, called *configuration data*, is composed of eight elements. The main relationships among these elements are depicted in Fig. 6.

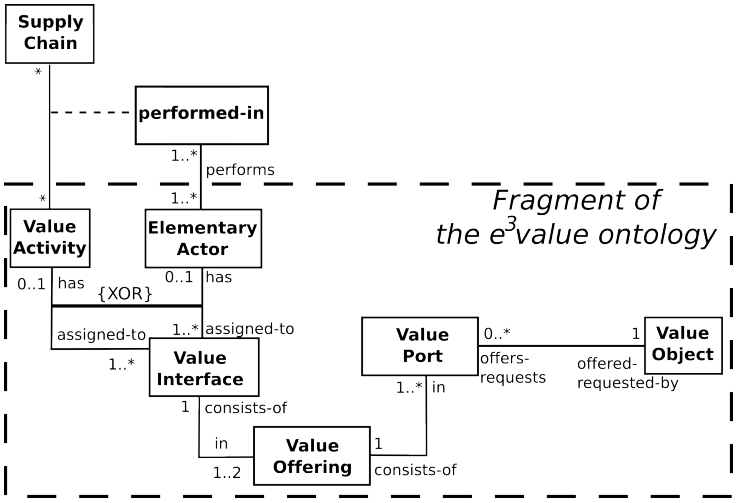


Fig. 6: Configuration data - class diagram.

Supply Chains The clearing process deals with five types of suppliers: *artists*, *producers*, *composers*, *lyricists* and *publishers*. Most of the time suppliers bring about different dependency paths in which different value activities and value objects are involved. We refer to these paths as *supply chains*. As can be observed in Fig. 6, a supply chain **consists of** several activities, *e.g.* in our case study, activities like Streaming, Collecting Fees, Repartitioning Fees and Creating are needed to provide a track, *i.e.* supply a service. Actually, these are the same activities that appear in the skeleton.

Elementary Actors The elementary actors represent the set of service providers willing to participate in a business case. In this sense, an elementary actor **has** value interfaces to interact with other elementary actors.

Value Activities In the same way, value activities represent the set of activities that must be performed to cover a consumer need. Therefore value activities **has** value interfaces for transfering value objects. As defined in Fig. 6 a value activity has a special relationship in which supply chains and elementary actors are involved. In fact, this relationship yields an aggregation class, the same is explained as follows.

Performed-in By using this class we want to express that elementary actors can only **perform** value activities related to specific supply chains. As an

example, SENA only take care of activities like Collecting and Repartitioning when they deal with artists and producers. BUMA does the same for the rest or right owners.

Value Interfaces A value interface is **assigned-to** either an elementary actor or a value activity but not both at the same time, which is depicted by using the XOR constraint. A value interface **consists-of** one or two value offerings, what the actor wants and expects.

Value Offerings A value offering represents what an actor offers through value interfaces. Therefore a value offering is **in** a value interface and **consists-of** values ports.

Value Ports By using value ports an actor either **offers** or **requests** value objects. In addition a value port is only **in** one value offering.

Value Objects Value objects represent the services or products that actors exchange to each other. For instance, according to our case study (Fig. 3), actors exchange value objects like RIGHT_MP, RIGHT_CL and RIGHT_CT.

5 Configuration process

This process involves three phases. While the first two phases are related to the generation of a value activity network based on a given value skeleton, the third phase matches the elements of the value network with a set of service providers.

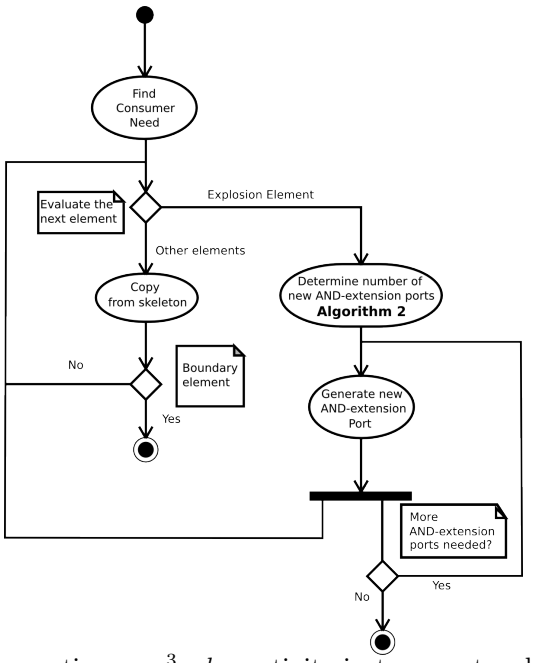
5.1 Selecting an *e³value skeleton*

The first step to build an *e³value* instance model is related to selecting an *e³value skeleton* from which the generation process can start. In this way, the *e³value skeletons* must be chosen according to a consumer need, *playing background music* (see Sect. 4.1). At this point we manually select an *e³value skeleton*. For a guideline how to perform a semi-automatic process see [9].

5.2 Generating an *e³value* activity instance network

Once a consumer need is defined and an *e³value skeleton* is chosen (in this case Fig. 5) , the generation process traverses this skeleton and produces an *e³value* activity instance network. Algorithm 1 performs this process generating this *e³value* activity instance network while traversing the skeleton based on a depth-first traversal method, where the consumer need and the boundary element are respectively the root and the leaf of the tree.

Algorithm 1 considers each element in the skeleton. If the considered element is not an explosion element, the element is simply copied into the value activity instance network. If however the element is an explosion element, Algorithm 2 is executed, which evaluates the explosion elements and determines the number of new AND-extension ports to be generated.



Algorithm 1 Generating an e^3value activity instance network.

Explosion Parameters Each explosion element has a set of parameters. These parameters are *e3_explosion*, *ce_related_actor* and *ce_refers_to_vo*. How these parameters work is explained in the Algorithm 2, and their effect is illustrated in Fig. 7.

The parameter called *e3_explosion* controls whether the explosion element will be evaluated. As can be observed in Fig. 7, there exist two ways to evaluate the explosion element:

1. the explosion element will result in a number of parallel supply chains (See Fig. 7a/b, *i.e.* $ce\_related\_actor == FALSE$),
2. the explosion element will result in a number of actors (Fig. 7c/d, *i.e.* $ce\_related\_actor == TRUE$).

5.3 Running example

We illustrate the case when a track, DE_WAARHEID, is cleared on behalf of three artists and two producers, i.e. two supply chains: one for artists and the other one for producers. For readability we omit the composers, lyricists and publishers. Therefore, Algorithm 1 travers the skeleton (Fig. 5). Once Algorithm 1 finds an explosion element, Algorithm 2 is applied to determine the number of new AND-extension ports to be generated.

For instance, assume that our algorithm walks down following the value transfer related to STREAM/MONEY and finds the explosion element #2 (See

Algorithm 2 Determine the number of new AND-extension ports

if $e3\_explosion == TRUE$ **then**
  if $ce\_related\_actor == FALSE$ **then**
    $value\_object = ce\_refers\_to\_vo$
    $New\_AND\_E\_ports$ = Number of supply chains in which $value\_object$ is involved
  else
    $value\_object = current\_track$
    GET current $supply\_chain$
    GET $next\_value\_activity$ according to the skeleton
    EA = set of actors performing $next\_value\_activity$ in $supply\_chain$ and offering $value\_object$
    $New\_AND\_E\_ports$ = Number of actors in EA.
  end if
else
  $New\_AND\_E\_ports = 1$
end if

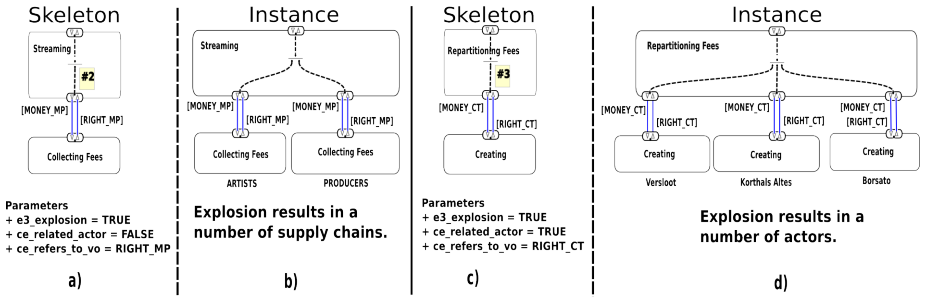


Fig. 7: Explosion parameters. a) Two activities and one explosion element. b) Instantiation of new elements based on *supply chains*. (Generation of supply chains) c) Two activities and one explosion element. d) Instantiation of new elements based on the number of elementary *actors offering a specific value object* (Splitting a supply chain).

Fig. 5). The evaluation of this explosion element takes place *i.e.* Fig. 7 .a and 7.b. This means that we have to count the number of supply chains, and we have to generate the appropriate number of AND-extension ports for that. Since our supply chains are artists and producers, and the RIGHT_MP is involved in the artists and producers supply chains, two new AND-extension ports must be generated, as can be seen in Fig. 8, element #2.

We continue to traverse the skeleton (for the artists supply chain) and find explosion element #3. This time, the evaluation is performed as in Fig. 7.c and 7.d. The number of new AND-extension ports depends on the number of elementary actors performing the Creating value activity in the artists supply chain and for the specific track, i.e. three artists. The process of copying elements from the skeleton continues till reaching a boundary element. Fig. 8 depicts

the final e^3value activity network, the numbering indicates the order in which element are instantiated.

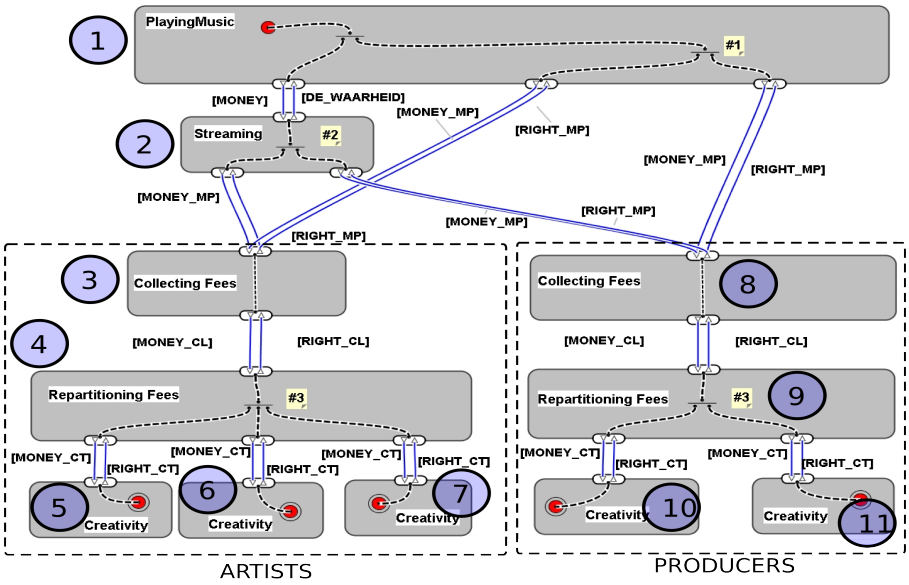


Fig. 8: e^3value activity network.

5.4 Assigning value activities to actors

After generating the e^3value activity network the next phase assigns activities to service providers. In a naive-sequential way, Algorithm 3 describes this process.

Algorithm 3 Assign activities to actors

```
for each value activity to be assigned do
  assigned = FALSE /* Boolean Flag */
  for each elementary actor && assigned == FALSE do
    if the elementary actor can perform this value activity in the specific supply
    chain and provide the needed value object then
      assign activity to elementary actor
      assigned = TRUE
    end if
  end for
end for
```

As can be observed in Algorithm 3, there is a search to determine whether an elementary actor can perform a value activity in a specific supply chain (by evaluating the performed-in association in Fig. 6). For instance, when assigning the value activity Collecting Fees (Fig. 8, number 8), the algorithm will search for an elementary actor that can perform this activity in the supply chain related to producers. As we already know, SENA is able to perform such as activity in that specific supply chain, therefore the algorithm assigns this activity to SENA, as shown in Fig. 9.

5.5 Running example

The model in Fig. 9 represents the way in which a set of enterprises work together to cover a consumer need which is composed of two things: DE WAARHEID and the needed rights to make this track public.

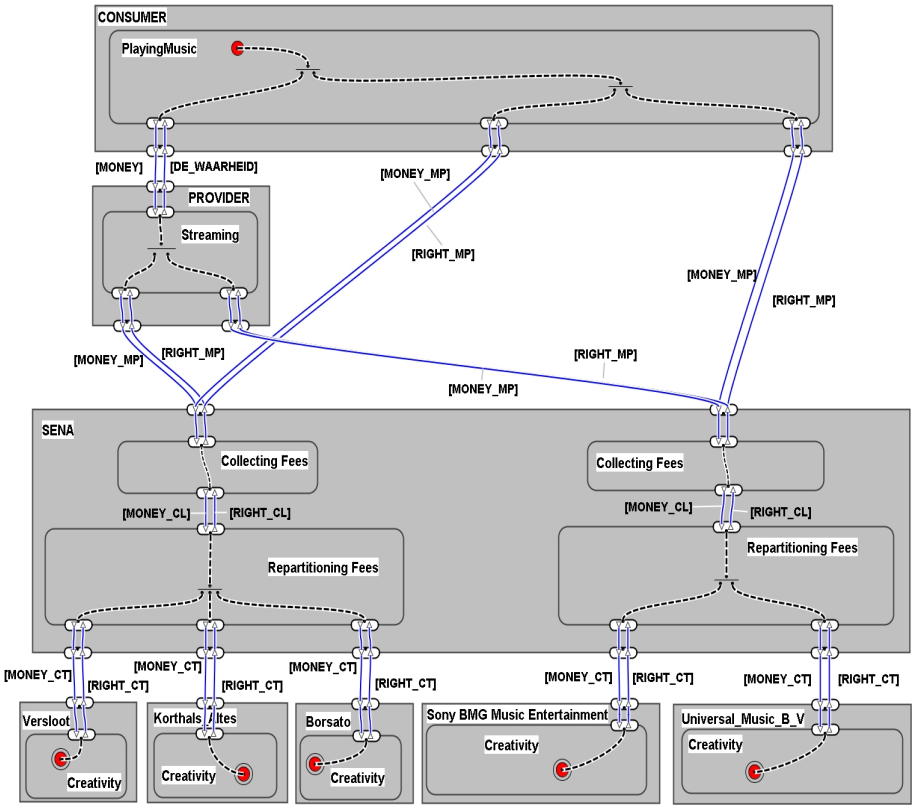


Fig. 9: Instance value model based on skeleton in Fig. 5.

As can be observed, the set of needed rights contains the rights from artists and producers. Consequently, the consumer must contact to enterprise(s) taking care of those rights, *i.e.* SENA. In the same way, since the stream provider is making public DE WAARHEID, it also needs to get the same rights. In order to get the rights from the set of right owners, SENA should also perform an activity related to repartitioning fees.

Furthermore, the activities related to repartitioning the fees contact the right owners associated to DE WAARHEID. The supply chain related to artists ends with three artists, whereas the supply chain of producers involves two right owners.

Finally, by applying the previous configuration approach, Sections 4 and 5, we have generated different e^3value instance models for other tracks. In this way, we test that by just changing our configuration data *i.e.* actors, their value objects and the activities they perform, we can generate instance models re-using the same skeleton and applying our configuration process. Nevertheless, due to lack of space these instance models are not presented [5].

6 Conclusions and future work

This paper has presented an approach to automatically generate e^3value models, based on skeletal design techniques. One of the objectives of our approach is to re-use a set of value skeletons for covering an industry sector from which more business cases may be generated. Consequently, in order to explain the intended use of this approach we have also presented a case study.

By following the idea of skeletal design we have exemplified how re-use of knowledge can help to solve the problem of massive service configuration. Our e^3value *skeletons* are useful to span (part of) an industry sector, helping to either automate current tasks or forecast/explore new scenarios.

Future work

Our next steps will address the problems related to elicitation of consumer needs, selection of skeletons and assignment of value activities to service providers, i.e. to add more flexibility to Algorithm 3. Consequently, while the work of Sybren de Kinderen [9] represents a good base-line to deal with the first issue, more research must be done to evaluate whether hierarchical configuration or skeletal planning could be implemented to cover our second issue.

Finally, even though our approach solve our configuration problem, we are aware of the limitations of this tool, mainly because some reasoning steps seems to be case specific. Therefore, more validation must be done and another case study will be explored, related to the energy industry where more dynamic behavior can be found.

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[5] The reader can consult some instances at: http://www.few.vu.nl/∼izapata/Generating-VM-SDT.php

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Exploring REA and Open-edi Business Frameworks for Service Modeling

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Abstract. Contemporary business collaborations foster enterprises to make their offerings available to partners and consumers as e-services. In this setting, high-level enterprise models, such as business models, provide an economically aware perspective for elicitation of business services, and thereby, e-services. Recently, REA and Open-edi business frameworks have been jointly considered to provide the Open-edi Business Transaction Ontology (OeBTO) for exploring concepts, relationships and actors involved in business collaborations. In this study, we use these frameworks and supporting architectures to propose a service-centric business model. From a model-based development perspective, the model that we propose is intended to be transformed to a system-centric service model, and further to Web service specifications and coordinations. The purpose of this study is primarily aimed toward an explorative and business-founded identification of services. An example from the insurance business sector is used to argument the way we ground and apply our proposed method.

Keywords: business model, REA, Open-edi, OeBTO, business collaboration, business services, service engineering.

1 Introduction

Over the last few years, it has been extensively argued by the industry community that model-based development is a best practice in software service engineering [1]. So far, SOA and the following Web services technology have succeeded in aligning with process models, enabling thereby loosely-integrated and reusable task automations. In such service solutions, the business perspective is captured on a tactical, that is, procedural level.

Business models offer some important advantages compared to process models, because they can capture a high-level description of a whole business in a single and easy-understandable view. Using a business ontology, such as for instance REA [2], e^3 value [3], or BMO [4], the business modeler can elicit the actors involved in a

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CAiSE 2010 Workshop BUSITAL'10, Hammamet, Tunisia, pp. 106-119, 2010.

business scenario and explain their relations formulated in terms of *economic resources* exchanged between those actors.

In the service-oriented business sector, capturing the consumer needs for economic resources plays an essential role in the elicitation of the services that will deliver these values, seizing thereby a desired competitive distinction. Another important aspect concerns the identification of an explorative service portfolio by spanning all the phases of a business transaction lifecycle, which, according to the International Organization for Standardization (ISO) Open-edi initiative [5] involves planning, identification, negotiation, actualization and post-actualization.

Recently, the ISO has set an effort on integrating REA and the Open-edi concepts to create Open-edi Business Transaction Ontology (OeBTO), for specifying the concepts and relationships involved in collaborative business transactions. In its essence, the framework captures the economic commitments realized by economic and business events issued by the partners, along the collaboration lifecycle in the Open-edi sense.

Following the previously outlined needs of the service engineering, in this study, we consider the use of the REA business framework and OeBTO to define a service-centric business model and a method for its creation. Being rooted in the two well-defined and stable ontologies, we believe that the proposed model forms a solid basis to be, from a model-based development perspective, transformed to a SOA model and further to Web services.

The rest of the paper is organized as follows. Section 2 gives the overviews on the used ontological frameworks, and related research. In Section 3 we present our proposal for identification and modeling of business services. Its main points are illustrated further in the section using an insurance business example. Section 4 concludes the paper and gives suggestions for further research.

2 Related Work

In this section, we describe REA, Open-edi and OeBTO models; in addition to that, we give a brief overview of the research related to the design of e-services from a business perspective.

2.1 The REA Business Framework

The Resource-Event-Agent (REA) framework was originally formulated by McCarthy [2] as a knowledge basis for accounting information systems and focused on representing increases and decreases of value in an organization. Over the time, the framework has been semantically enriched to form a value-based foundation for defining business models of enterprises.

The core concepts in the REA ontology are *resource*, *event*, and *agent*. It is assumed that every business activity can be described as an event where two agents exchange economic values, i.e. resources. To acquire a resource, an agent (i.e. actor) has to give up some other resource. For example, in a goods purchase, the buyer has

to give up money in order to receive some goods. Conceptually, two events are taking place: one where the amount of money is given away and another where an amount of goods is obtained. This combination of events is called *duality* and is an expression of an economic reciprocity - an event receiving some resource is always accompanied by an event provisioning another resource. Lately, Hruby has argued that application models developed based on the REA ontology can capture duality containing more than two economic events [6]. For instance, in banking, a loan receipt may be compensated with both an interest payment and a loan return.

In the study [7], the REA framework has been further extended to capture additional granularity levels of the business activities of enterprises. The resulting framework has integrated three vertical layers (Figure 1):

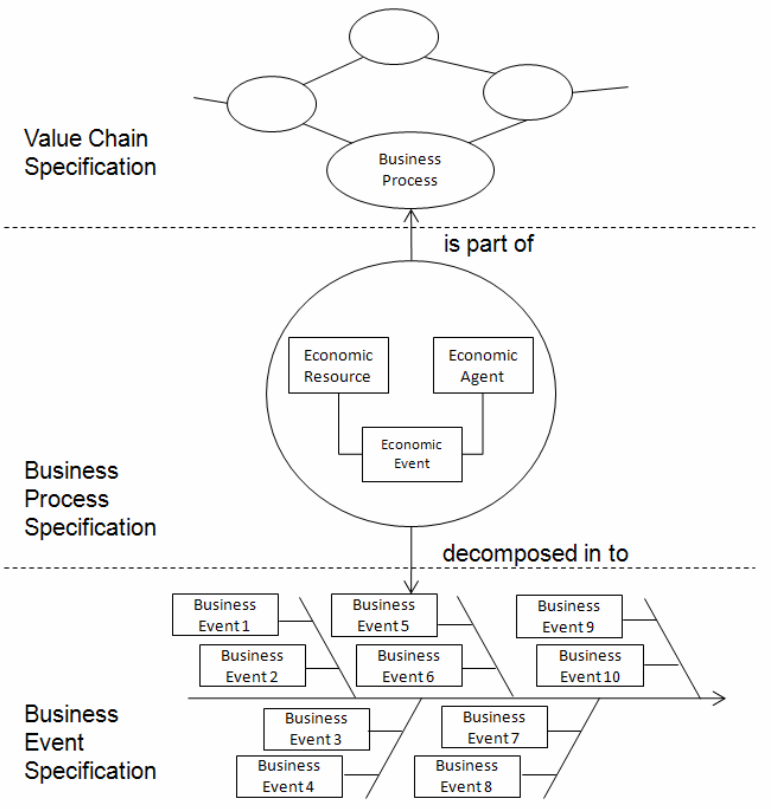

Fig. 1. The three-layered REA business framework.

- *Value chain* – this layer describes the configuration of the top-level, that is, value-added business processes of an enterprise. Each business process identified here has a set of inputs (economic resources given or consumed) and a set of outputs (economic resources taken or acquired).

- *Business Process (decomposition)* – this layer explores every top-level process as an aggregate of the reciprocal economic events issuing exchanges of resources, owned or acquired by the involved agents.
- *Business events* (workflow) – the layer specifies an ordered sequence of the activities (i.e. business events) needed to accomplish the business processes and the transfers of economic resources represented on the above two levels.

One of the vital aspects of the described three-layered REA framework concerns the capability for tracing low-level events to top-level business process in the value chain, and opposite, i.e. mapping the realizations of the processes and economic components down to business events.

2.2 Open-edi Business Transaction Ontology (OeBTO)

From the life-cycle perspective, business collaborations typically span a number of phases. ISO Open-edi initiative [5] considers a collaboration as consisting of five phases (activities): *planning, identification, negotiation, actualization* and *post-actualization*. In *the planning phase*, the customer and the provider are engaged in activities to identify the actions needed for selling or purchasing goods and services. *The identification phase* involves the activities needed to exchange information among providers and potential customers regarding selling or purchasing goods and services. During *the negotiation phase*, contracts are proposed and completed. Detailed specifications of goods and services, quantity, price, terms, and conditions are determined in this phase. If required, the parties involved may make bids and put forward counter offers. *The actualization phase* includes all the activities necessary for exchanging goods and services between involved actors as agreed during negotiations. The *post-actualization phase* encompasses the activities and associated exchanges between involved actors after the major resources are provided.

Recently, the core elements of the REA ontology and the Open-edi proposal have been jointly considered to create a more comprehensive ontological framework, OeBTO, for specifying the concepts and relationships involved in collaborative business scenarios [8].

Figure 2 shows the Open-edi Business Transaction Ontology (OeBTO). It extends the basic REA ontology with a number of concepts aimed to facilitate the modeling of business collaborations. *Economic Event* in the model represents an activity that transfer an *Economic Resource* between *Partner* agents. An *Economic Commitment* stipulates Economic Events that are planned or scheduled to occur. The *Economic Contract* represents a legally enforceable agreement between collaborating parties; it bundles reciprocating commitments where a buyer and a seller agree to fulfill by performing reciprocal economic events. The *Agreement* element represents a concept similar to Economic Contract. However, unlike Economic Contract, Agreement is not legally enforceable. *Business Transaction* element in OeBTO represents a predefined set of business activities. These activities are aimed to accomplish an explicitly shared business goal of collaborating parties and are terminated based on the economic contract between involved business agents. *Business Transaction Phases* defines the

set of fundamental collaboration stages - planning, identification, negotiation, actualization and post-actualization, associated with a Business Transaction. These phases are further decomposed down to *Business Events*, which represent activities that collaborating agents use to communicate the progress through their Business Transaction. *Location* in the ontology designates the site where an Economic Event occurs. *Economic Claim* element in the model facilitates the information regarding situations where an economic event occurs without its requited correspondence to another economic event. In addition to these concepts, the ontology also contains concepts such as *Resource Type*, *Role*, *Location Type*, and *Economic Event Type*, which model abstract specifications for the concepts modeling actual occurrences.

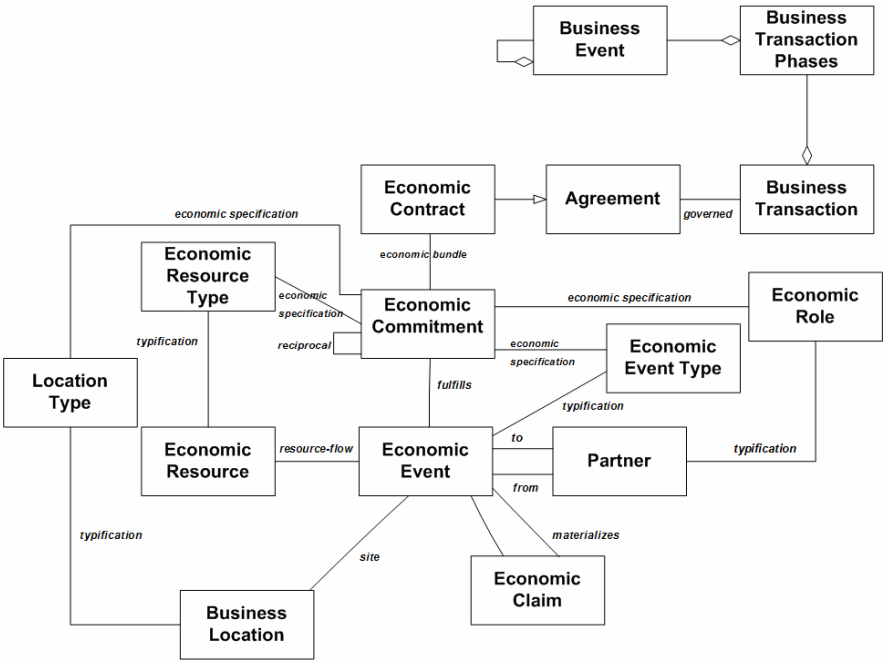

Fig. 2. Open-edi Business Transaction Ontology

Following [8], economic resources may be classified as *goods*, *rights* or *services*. Goods are tangible resources including, for, instance materials or funds; services are the provisioning of value-adding activities by a provider to a consumer, such as transportation or warranty; rights are intangible resources related, for instance, to the ownership of intellectual products.

2.3 Related work on Business Services

Following the paradigm of model-based system development, a number of research studies have reported proposals for e-service design. Many of them had set the major

focus on a system-centric abstraction level, to define enterprise-wide models of technology-independent e-services, such as in [9] and [10]. Some other studies have augmented the starting abstraction level by considering the business process perspective as a basis for creating a business-oriented service model, which is further mapped to SOA-aligned, or SOA-like e-services at the system level [1]. Being focused solely on the process (i.e. operational) perspective on the business level, the aforementioned studies have not considered the business viability of e-services.

Lately, research in both academic and industrial communities have implied that when designing service-oriented software solutions, the starting point should be the business models of enterprises [11], [12], [13] and [14]. This fact, according to the referred studies, is shifting the focus of large scale e-service design to the context of economic resource transfers. In [14], using the e^3 business ontology, the authors explore consumer needs and resource exchanges to evaluate the profitability of the identified resource offerings. Our approach differs from those studies in the way that we set our focus on a structured analysis of business transactions, relying on the OeBTO standardization effort, to identify the activities occurring between the actors in a hierarchical manner, and finally expand them along a number of collaboration phases to get a reach business service portfolio. We also believe that our approach facilitates a needed refinement in elicitation of business activities and thereby services, followed by a clear traceability between different abstraction layers.

3 Three-layered Framework for Service Elicitation

In this section, we first explain our method for the identification of business services of an enterprise that relies on the use of the three-level REA enterprise model and the Open-edi Business Transaction Ontology (OeBTO). After, we illustrate the method with an example from the insurance business sector.

3.1 Method

Following the presentation of the extended REA framework given in Section 2.1, the specification of an enterprise comprises the decomposition of business activities along three granularity levels: value chain, business processes and business events.

Value Chain Specification In service industries, the traditional Porter's value chain [15] has been found as non-fitting, as the resulting chain analysis based on the five, production-rooted, primary activities often blurs the focus off service-centric value creations. In [16], it is argued that present enterprise value configurations conform to three generic types: the traditional *value chain*, *value shops* and *value networks*. The later two configurations suit to service environments – value shops model the activities and resources to resolve a particular customer problem, while value networks create values by organizing and facilitating exchanges between a set of customers. Each of the three configurations promotes a different set of primary

activities. The insurance business taken as the illustration example in this study conforms to the value network configuration assuming that the essence of its value creation lies in an indirect linkage and an organization of insurance customers through a common pool of assets and funds. Following [16], the primary activities of the value network are:

- *Network promotion and contract management* consisting of activities associated with inviting potential customers to join the network, the initialization, management, and termination of contracts governing service provisioning and charging.
- *Service provisioning* consists of activities associated with establishing, maintaining, and terminating links between customers and billing for value received.
- *Network infrastructure operation* consists of activities associated with maintaining and running a physical and information infrastructure. The activities keep the network in an active status, ready to service customer requests.

Thereby, when creating a business model, and considering any of the three value configurations, we outline the first design guideline:

Guideline 1: To fulfill the top, value-chain layer of the REA framework for an enterprise of interest, identify a suitable value configuration, and using its classification for the generic primary activities, elicit the value-adding processes for the enterprise.

The OeBTO model, as described in Section 2.2 and illustrated in Figure 2, captures the notion of business transaction; it has been argued in [17] that in a collaborative setting, the business transaction being defined as a predefined set of activates, can be equalized with the concept of the business process as defined in the REA three-layered framework. Following this, for a business collaboration, once the value-adding business processes are outlined using *Guideline 1*, they will be captured by the Business Transaction element in the OeBTO model as given in Figure 2.

Business Process Specification At this layer, every process specified on the top is explored to elicit the agents involved in the process and the economic events resulting in the exchange of economic resources. The events itself are stipulated from the commitments agreed between the collaborating agents as we have explained in Section 2.2. (see also Figure 2). We have explained that in a REA business model, when offering a resource, an agent expects in return some other resource, which can be, as we have explained in Section 2.2, goods, services or rights. Thereby, each duality of economic events in the process is considered as an economic symmetry and as such, gives rise to a candidate service - we name it *aggregated service*, because it needs to be further expanded on the next layer of the framework, to discover actual business services belonging to- and realizing that service. Thus, every service elicited at this layer is considered as an economic aggregator of the business services that will be actually created to realize and/or support the delivery of economic resources

between the agent offering a resource (i.e. the provider) and the other agent giving away another resource as a compensation (i.e. the consumer).

Guideline 2: To specify the middle, process level of the REA framework for an enterprise of interest, explore every top business process identified by *Guideline 1*, to elicit the economic events, resources and the agents offering or receiving the resources. Define an aggregated service for each duality of economic events.

Starting from this point, the OeBTO model shown in Figure 2 is extended with a new element, aggregated service (see Figure 3). The element is, as explained above, associated with a duality of economic events, the resources being exchanged by these events and the involved agents (considered as playing the roles of the service provider and the service consumer).

Business Event Specification At this layer, a workflow for the resource exchanges defined in the middle architecture level is expanded along all the Open-edi business transaction phases, i.e. planning, identification and negotiation, actualization and post-actualization to elicit candidate *business services* and business events. Every aggregated service specified on the business process level is decomposed to a number of the business services, following the rules:

1. For every business phase of interest, a single business service is defined. Commonly, negotiation, actualization and post-actualization phases are recognized in any business collaboration, while planning and identification are considered as optional.
2. Depending on the economic resource type being offered to the consumer, business services in the actualization phase differ. When the resource is a service, then it will directly identify the business service; when the resource is a good, then a business service provisioning the custody of that good and/or evidence document for the good ownership will be added; finally, in case the resource is a right, the business service will be created to provision the evidence document for that right.

According to the OeBTO model (Section 2.2), the notion of the business event is used to represent the atomic business activities occurring at the third framework layer. Thereby, in our view, a business service is an aggregation of business events, that is, once a business service is defined, it can be further decomposed to smaller workflow tasks, i.e. the business events, which business partners need to accomplish in every phase of the collaboration. A business service may, as common, require for certain *input* objects and provide in return some *outputs*; the object can be information, or physical items. Following this argumentation and the rules to the above, we propose the instruction for the elicitation of the last framework layer:

Guideline 3: Decompose every aggregated service defined at the middle REA layer to a number of business services on the lowest architecture layer, along the five business collaboration phases, by following the two decomposition rules outlined to the above. For every business service, define input and output objects, if such exist. Finally, refine the business service to a number of business events.

In this step, the OeBTO model shown in Figure 2 is extended with the business service element (see Figure 3). The service may bring an input and an output object, and encloses a number of business events.

In service-oriented business interactions, it is the provider who offers certain functionality and the consumer who utilizes it. Before the provisioning of a service, the two parties need to come to an agreement that specify the obligations related to service provisioning. In the OeBTO model (see Section 2.2), the decision what capabilities and constraints the economic resources will be offered, how they will be compensated and under what conditions, are modeled with the notions of economic contract and economic agreement. Thereby, in the service modeling context, we consider contracts and agreements to include, in addition to legal aspects, requirements for provisioning of services. In our extension to the original OeBTO model, we define the element *business policy* that is specified from an agreement and includes directives related to the execution of services, that is, business services and containing business events. A business policy can be further refined to either *business rule* or *service policy*. A business rule restricts the workflow, that is, the control flow of the business events, while a service policy includes sets of constraints and capabilities of a business service to describe how the service and the client will interact.

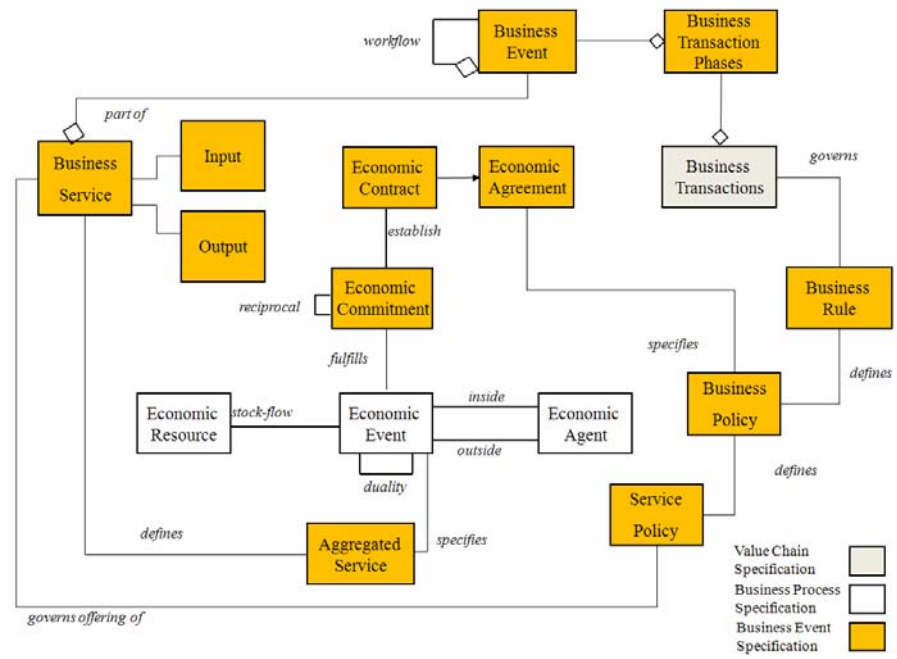

Fig. 3. OeBTO, extended with service-related notions.

To summarize, the method proposed in this section extends the original OeBTO model to capture the business service perspective and its core aspects, such as functionality, composition and policies. From a model-based system development perspective, by defining a set of transformations, the service-aware OeBTO model as shown in Figure 3 can be considered as the input for creating a system-, i.e. UML-based service model (or simply, an e-service model). At this stage, there is a number of service-oriented UML profiles, which in the MDA context provides a common way to focus toward a specific architectural style [9].

3.2 Application

In this section, we illustrate the method presented in Section 3.1, using an example from the insurance business. We consider three agents: insurance provider, insurance broker and a customer. To obtain information about insurance policies, customers can either approach the insurance broker, or the insurance provider. The insurance provider is responsible for providing information about the available insurance policies to insurance brokers and to customers. Once the customer identifies the insurance policy that fits him, he obtains an insurance contract from the insurance provider. Additionally, the insurance provider is responsible for collecting monthly payments from customers and for managing customer insurance claims.

Following *Guideline 1* and the classification of the primary activities of the value network configuration defined in the previous section, we identify the following business processes belonging to the Value Chain REA layer.

- *Insurance Sales* process for managing insurance contract with customers (Network promotion and contract management)
- *Payment Handling* process for collecting payments from customers for the insurance services they receive and handling payments regarding customer claims (Service provisioning).
- *Claim Handling* process for receiving and approving customer insurance claims (Service provisioning).
- *Marketing Management* process for managing the provisioning of insurance policy information to insurance brokers and for managing insurance information updates to existing and new customers (Network infrastructure operation).

By following further *Guideline 2*, the *Insurance Sales* process elicited above is explored to identify economic events and associated resource exchanges belonging to the Process Specification. Here we identify, two economic events; *Provide Insurance Contract – Obtain Right to Invoice* defined from the Insurance Provider perspective (see Figure 4). The former economic event is responsible for provisioning the economic resource *Insurance Contract* to Customers whereas the latter is responsible for receiving the resource *Right to Invoice* from the Customers. The obtained duality gives a rise to an aggregated service *Provisioning of Insurance Contract.*

The elicited aggregated service is, by following *Guideline 3*, further expanded to identify business services and aggregated events. As it was mentioned in the method

section, here we consider planning, identification, negotiation, actualization and post-actualization phases to identify business services and events.

- (Planning) Considering the case where a customer directly approaches the Insurance Provider to get information about insurance policies, we identify the business service *Insurance Information Provisioning*. This business service composed of two business events; *Accept Customer Contact* and *Provide Insurance Policy Information* (see Figure 4).
- (Identification) In this phase, we identify the business service *Customer Information Acquisition* for establishing a literal relationship with the customers who wish to obtain an insurance contract. This business service is further expanded to identify two business events: *Obtain Customer Decision* and *Obtain Customer Information* (see Figure x).
- (Negotiation) The business service *Contract Formation* is identified to support the formation of an insurance contract realizing the aggregated service in the Business Process Specification layer. We identify two business events *Offer Insurance Contract* and *Obtain Contract Acceptance* (see Figure 4) for the identified business service.
- (Actualization) For supporting this collaboration phase, we identify the business service *Invoicing Right Acquisition* corresponding to receiving the right to invoice to customers for the insurance contract they obtained from the Insurance Provider. This business service aggregates the business events *Send Customer Copy of the Contract*, *Obtain Invoicing Information* and *Update Customer Insurance Information* (see Figure 4).
- (Post-Actualization) In the last phase, we identify business service *Customer Information Sharing* which is responsible for passing customer information further to Payment Handling, Claim Handling and Marketing Management processes. This business service constitutes the business events *Provide Customer Invoicing Information (Right to Invoice)* and *Provide Customer Details* (see Figure 4).

Following what has been stated in Section 3.1, we finalize the model by identifying the business rules that will govern the execution of the workflow specification, and the service policies constraining the offering of the business services elicited above. For instance, a service policy for the business service *Insurance Information Provisioning* can be defined as "*A customer request for insurance information should be fulfilled within five working days*". Additionally, "*Customer information should be validated before issuing an insurance contract*" is an example of a business rule that governs the ordering of the workflow events.

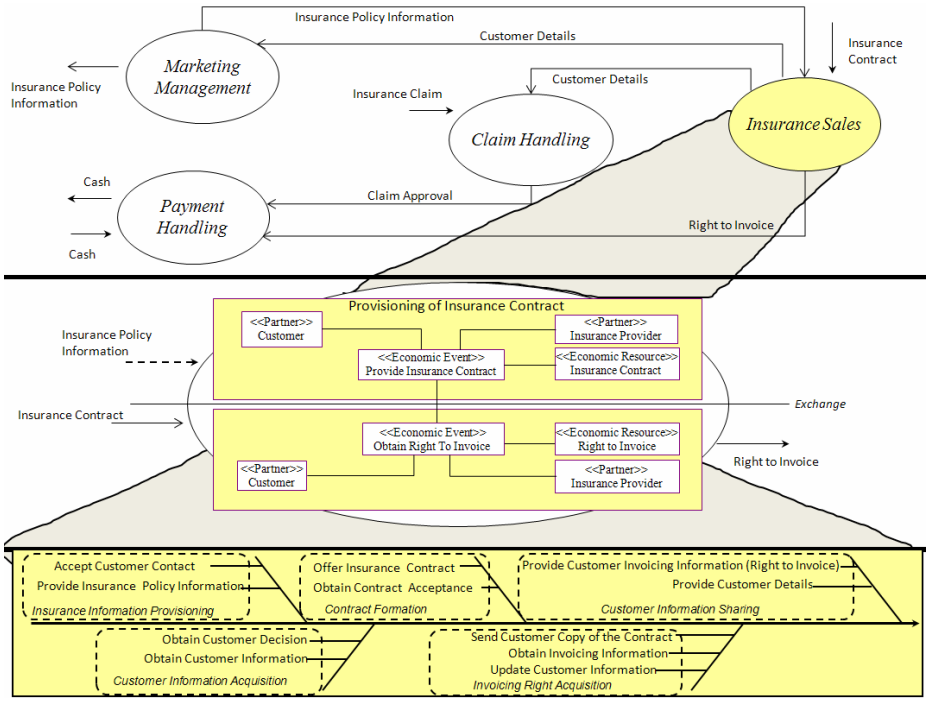

Fig. 4. A specification of value-adding business processes, economic events and business services for the insurance business scenario.

4 Conclusion

In this paper, we have proposed a method for identification of business services, based on the exploration of business models, from a collaboration life-cycle perspective.

In our approach, we have used Open-edi Business Transaction Ontology (OeBTO) proposed by the International Standardization Organization (ISO), as a conceptual basis. The ontology uses REA as business ontology for specifying the concepts and relationships involved in business collaborations along the major life-cycle phases as they are defined by Open-edi. A rationale for choosing OeBTO lies in two facts: a) the components of the REA business model are sufficiently well-defined, stable, and well-known; and b) service environments require for an exploration of business collaborations, which is the essence of Open-edi effort.

Our method guides the business service modeler to expand the REA business modeling framework along three abstraction layers, starting by identifying value-adding business processes of an enterprise; then expanding these processes to define the economic resources that will be exchanged between particular agents and published as top-level, aggregated services; and finally, expanding the aggregated services along the planning, identification, negotiation, actualization and post-actualization phases to elicit business services. The composition and the use of the

defined business services is guided by the business rules and service policies as directed from the commitments and obligations elements belonging to OeBTO.

The major strength of the proposed method is the use of the REA three-layered framework and OeBTO for identifying an entire enterprise-wide service portfolio on the business level, defined well-enough to be transformed further to a system-centric, i.e. an e-service model.

Topics for our future research are focused on a model-driven perspective to software service development. Thereby, the next research steps include creation of transformation rules from the business service model as proposed in this paper to a SOA-aligned e-service model, with capturing both declarative and behavioral service aspects.

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Describing Coordination Services with REA

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Coordination services are services, possibly implemented as web services, that support the coordination of (real-world) services that a consumer would like to take. To support users of a future Internet of Services, the effect of the coordination services must be described in such a way that users are not only able to discover services but also to detect and prevent possible conflicts in their composition. In this paper, REA is applied as a solution approach to this requirement. The REA business ontology has proven to be a good foundation for the description of services, but we argue that its conceptualization of commitments can be improved.

Keywords: REA, Internet of Services, coordination

1. Introduction

In spite of considerable progress that has been made in the area of Service Oriented Computing, the impact on society has still been limited. There is not yet such a thing as an Internet of Services that would allow users to integrate the services they want to use easily and seamlessly. It should be noted that for users, web services are merely interfaces to "real" services such as traveling, meeting support, or child care. So, as argued also by [16], research on an Internet of Services should focus on real services and the key assets these services relate to. Real services must be distinguished clearly from software services [15, 20]. [4] argues that much work on automatic discovery of services fails to provide a viable solution as it mixes up the two concepts, and assumes wrongly that complete and correct descriptions of (real) services are available.

Fig. 1 depicts a user-centric service coordination cycle: users (or service composers addressing a particular user segment) compose mashups and interact with the widgets in them to access web services. The web service typically supports the coordination with a service provider who provides a real-world service as part of a service bundle. The service affects a resource that concerns the user (the resource could be the user himself, for instance in the case of a hotel reservation). That web services themselves

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may be composite software entities is left out of this figure as being less relevant to the user, but is of course relevant to the software developer.

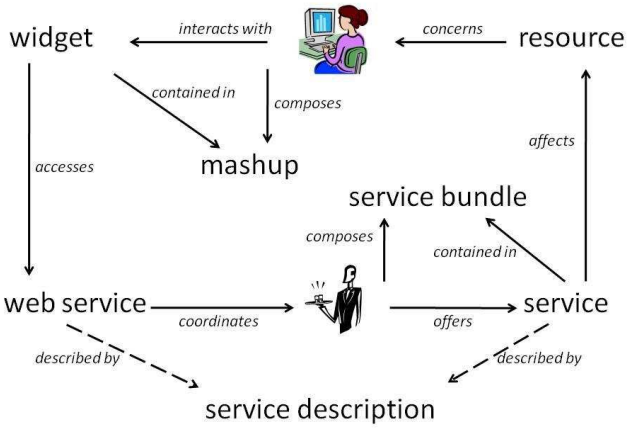

Fig. 1 User-centric service coordination cycle

Both web services and services need a description, but what should be in this description? In composing web services, a major challenge is to reconcile incompatible data representations. The *availability* of the data is not a problem, as data can be copied without virtually any limit. In composing services in the real world, a major challenge is to meet the constraints imposed by the fact that resources are scarce, can only be in one place at a time and often cannot be shared. For that reason, [16] argues convincingly that "asset-driven" service modeling will be a central concern in developing an Internet of Services and claims that "novel methodologies and tools are needed to support the modeling of the key assets of services". In our view, this modeling should be guided by at least two objectives: conflict prevention and conflict detection.

In order to make conflict prevention and conflict detection possible at all, we need a generic language to describe services, the resources they use, as well as planned and actual events on the type level, Web services can use this language to represent the preconditions and effects of the real services they connect to as well as their own semantics. A mashup environment can collect and combine this information, integrate it with other sources such as the user's agenda (that should be represented in the same format) in order to provide the user with the conflict prevention and conflict detection functionality described above.

In this paper, we propose to ground the service description language in the REA ontology [11] where we concentrate on coordination services. A coordination service is a service that supports an exchange of a good or a service [WJ09]. The use of REA has two advantages: first of all, we believe it can be a basis for user-based service composition as it is "as simple as possible, but not simpler than that". There is evidence that REA is easy to understand both for the users and for consultants and application developers [10]. Secondly, resources ("assets") are its core concept. In

earlier work, it has been shown that REA can provide a unified view of services [20] - both real services and web services.

This paper is structured as follows; in section 2 we will consider the OASIS reference model for SOA and derive that describing web services is centered around the management of commitments. In section 3 we introduce the REA business ontology. We continue with a discussion about commitments in REA and what fulfillment of a commitment amounts to, and we explain our view of the notion of service in REA. In section 4 we introduce the coordination service as a service that supports an exchange process. Two common patterns of coordination services are worked out. Finally, section 5 concludes the paper with a summarization and directions for future research.

2. Coordination as a Service

According to the OASIS reference architecture foundation for SOA, it is essential that participants can use a SOA-based system to realize actual effects in the world [13]. However, when talking about the real world, OASIS makes a sharp distinction between the social world and the physical world (note that this is fully in line with the Language/Action Perspective tradition and the communicative theory of Habermas adopted there [3]). It is said that many, if not most, effects that are desired in the use of SOA-based systems are actually social effects rather than physical ones. For example, opening a bank account is primarily about the relationship between a customer and a bank – the effect of the opened account is a change in the relationship between the customer and the bank. For that reason, OASIS talks about social actions that result in social facts. "A social fact is an element of the state of a social structure that is sanctioned by that social structure". Social facts include policies and commitments where "a commitment is a social fact about the future: in the future some fact will be true and a participant has the current responsibility of ensuring that that fact will indeed be true". A completed business transaction establishes a set of social facts relating to the exchange; typically to the changes of ownerships of the resources being exchanged.

The OASIS model describes the relationship between communicative actions performed by means of information systems and their social effects as follows. "When we state that a communicative action counts as a service action, we are relating a system of communication to a system of action against services. Since a participant cannot (normally) act directly on a service it must use some means of mediating the action. However, from the perspective of all the participants involved, when a participant uses a communicative action appropriately, the participants are *expected* to understand the communication *as though* a service action were actually performed. When a customer 'tells' an airline service that it 'confirms' the purchase of the ticket it is simultaneously a communication and a service action – two ways of understanding the same event, both actions, one layered on top of the other, but with independent semantics". (p.32)

OASIS is right that in most cases information systems (SOA based or not) produce social effects. Business transactions are not the result of a causal chain of instrumental

actions, but of a coordination process made up by communicative actions, and information systems are well-suited to support the latter. What remains a bit out of the OASIS picture is that these social facts refer to physical world events, such as the delivery of a product. For a full account of service effects, this relationship between social facts and the real world must be made explicit (Fig. 2).

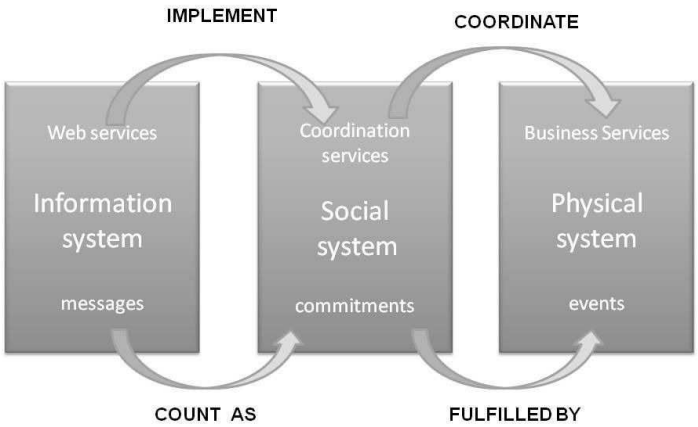

Fig. 2 Coordination services are the glue between web services and business services

In two kinds of situations, the "social effect semantics" are not relevant, or less so. First, in so-called pervasive environments, the system may contain devices that have a direct physical effect such as switching on the light [18]. This interaction is a case of instrumental rather than communicative action. Secondly, certain business transactions are fully automated, such as electronic payment, or digital music provisioning. They do involve a coordination process including a contract between service provider and customer, but the normal execution does not involve human or other non-digital resources anymore. In this case, the social effect semantics are still relevant for explaining what happens on the business level, but the social facts do not play a coordinating role operationally.

It is widely recognized that input and output descriptions of web services, or its operations, are not sufficient for capturing the semantics that users need. Precondition and Effect descriptions have been added. Although WSDL-S provides a mechanism to include these attributes, it does not give guidance on how to do specify their contents. The OASIS reference model views web services as coordination mechanisms and emphasizes the social effects. How these are to be represented, and how these social facts relate to real-world business events is still to be worked out. In the following, we address this research gap by proposing the REA ontology for coordination service description.

3. REA-based Service Description

3.1 REA background

The Resource-Event-Agent (REA) ontology was formulated originally in [11] and has been developed further, e.g. in [7, 10, 17]. It was originally intended as a basis for accounting information systems and focused on representing increases and decreases of value in an organization. REA has been extended with patterns to form a foundation for enterprise information systems architectures [10], and it has also been applied to e-commerce frameworks [17]. The following is a short overview of the core concepts of the REA ontology based abbreviated from [20].

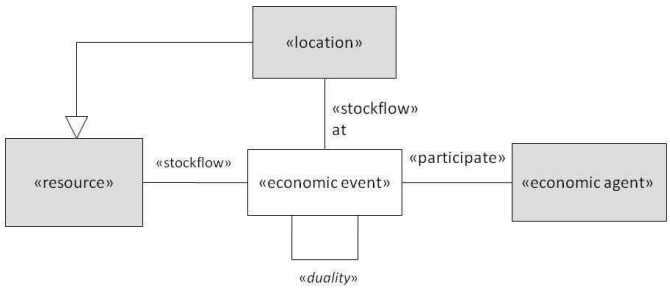

Fig. 3 REA basic categories including location. Events are rendered in white, the other objects in grey

A *resource* is any object that is under control of an agent and regarded as valuable by some agent. The value can be monetary or of an intangible nature, such as status, health state, and security. Resources are modified or exchanged in processes. A *conversion process* uses some input resources to produce new or modify existing resources, like in manufacturing. An *exchange process* occurs as two agents exchange resources. To acquire a resource an agent has to give up some other resource. An *agent* is an individual or organization capable of having control over economic resources, and transferring or receiving the control to or from other agents.

The constituents of processes are called *economic events*. An economic event is carried out by an agent and affects a resource. The notion of stockflow is used to specify in what way an economic event affects a resource. REA identifies five stockflows: produce, use, consume, take and give, where the first three occur in conversion processes and the latter two in exchange processes. REA recognizes two kinds of duality between events: conversion duality and exchange duality. Events can be assigned to a *location;* there is not a direct resource-location relationship, only via economic event. Sometimes the acronym REAL is used for REA plus location [14]. Locations can be considered as a special kind of resource, as in Fig. 3. They can be used and they may have a maximum capacity for use.

3.2 Commitments in REA

Commitments were added to the REA ontology in [7] as "important economic phenomena", and modeled as the pair-wise connection of requited commitments. The pair-wise connection is similar to the *duality* relationship between actual exchanges or conversions but as it is not between events, REA calls it a *reciprocal* relationship. In the following, we refine and extend the commitment concept of REA by adding explicit commitment events and by rethinking the "reserve" relationship. Starting point is that we consider a commitment as a special type of resource, so that it can be handled in the same way, that is, by manipulated and used in exchange and conversion events using stockflow relationships. One consequence of this approach is that the "resource" becomes equivalent to the FASB notion of "asset" and it is not necessary to make the exception anymore that McCarthy made in [11:562].

As discussed in section 2, a commitment is a promise regarding the future. Commitments are formalized as clauses in contracts and those commitments are subsequently fulfilled through economic events. A distinction can be made between increment commitments (assets in the agent's perspective) and decrement commitments (liabilities in the agent's perspective) [10].

Depending on the commitment type (decrement vs. increment) the relationship of the provider to the commitment is characterized as a give or take stockflow (Fig.4). When the customer promises to pay, this means that the provider receives an i-commitment. A customer can, in a *decommit* event, take a d-commitment that is received by a provider in the same event. This represents an absolving of a commitment. Similarly, the provider can give back a previously received i-commitment.

A structure involving increment commitments can be constructed as well (not illustrated here) for the customer's part of the contract, but still from the provider's point of view. In a commit event a provider becomes the receiver of an i-commitment (increment) through a take stockflow. The customer owes the provider. The provider can, in a decommit event, give the customer an i-commitment back, thereby cancelling the debt. Note that the customer cannot cancel this debt himself, but he can request for it. The exchange reciprocity between commitments reflects an exchange duality between commitment events.

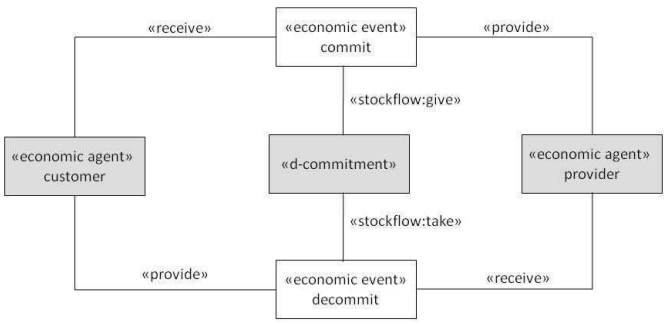

Fig. 4 REA commitment pattern for decrement commitment

Thus contract formation can be thought of as giving and taking corresponding d-commitments and i-commitments. Committing is modeled as an economic event. For standard REA, the creation and deletion of commitments are not economic events; they can be thought of as "system events" to be positioned at the implementation level. In our view, this approach has several disadvantages: first, the notion of provide/receive is ambiguous, as it is used to characterize both event/agent relationships and commitment/agent relationships. In our conceptualization, the definition is univocal. Secondly, in REA an economic event represents an "increment or decrement in the value of economic resources of the enterprise". This definition also applies to taking or giving a commitment, e.g. the commitment to a future payment. Thirdly, it can be remarked that already in [11], "claims" were discussed extensively. In the outline of the framework, resources were materialized as base objects while claims were not, but further on in the paper, it is remarked that "in practice this disparity is not always warranted". Interestingly, the paper continues by saying: "Should the accountant and database designer decide together to maintain certain claims as separate base objects, they also would have to include two additional events sets (inflow and outflow) for each one". Although commitments have been included in the REA ontology later, these "additional events sets" have not been recognized so far.

Commitments are returned in a *decommit* event. Two main types of decommit can be distinguished that maintain the duality axioms of REA. In the case of *canceling*, the commitment is returned in exchange with the reciprocal commitment being returned. For instance, a purchase order is cancelled and the payment is cancelled at the same time (of course, the contract may specify a penalty for the one who requests cancelation or even forbid cancelations altogether). In the case of *fulfillment*, the commitment is returned in exchange with some other economic event being provided, being the content of the commitment. For instance, when a delivery is made, the purchase order commitment is returned. In the following, we will adhere to the standard REA fulfill relationship as an abbreviation for this duality.

There is a second issue on which we have refined the standard REA ontology. Commitments are most often about resource *types* (e.g. a non-smoking hotel room, or a certain book title to be delivered), whereas the business transaction itself is about a resource instance, that is, a specific hotel room or a specific copy of the book. In some cases, the commitment is about the resource instance itself, e.g. in the sales contract of a house. Within the REA community, the reservation is handled in different ways. According to [7] *"Reserves* is a special kind of stockflow relationship that describes the scheduled inflow and outflow of resources". A sales order results in a reservation of the finished goods to be delivered. Gailly and colleagues [6] don't include this relationship between commitment and resource in their REA ontology; instead, they define a *specify* relationship between commitment and *resource type*. Yet another approach is followed by Hruby [10] when describing a commitment pattern. Here it is said that a commitment can be related to a resource type *and* to a resource. The commitment pattern expresses that the commitment (reservation) can be related to a resource type first, and related ("allocated") to an actual resource before the economic event starts.

Is it possible to do justice to the various positions and still have a univocal definition of reservation? To answer this question without resorting to complex

intensional logics, we propose to draw on the notion of resource group [8]. Let the object of the commitment be a resource group of a certain resource type. Cardinality of the set/quantity of the resource is the most important attribute of resource group, and additional constraints can be specified. The relationship between resource group and resource type is a *policy* relationship [8]. It specifies the type of resources that may go into the resource group. In the case that a particular resource is to be reserved, the *grouping* relationship is already made at commitment time. In all other cases, it is specified later when the purchase contract is being executed. Fig. 5 presents the revised "reserve" relationship.

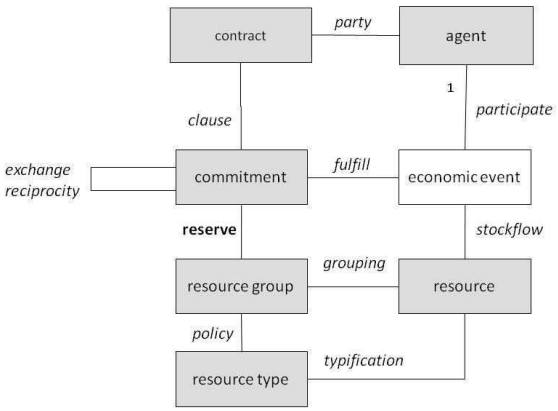

Fig. 5 REA relationship "reserve" revisited

For example, a reservation of two hotel rooms is formalized as a commitment being a clause in a contract. The object of the commitment is a group. The policy for this group says that it must contain "double non-smoking rooms", and 2 of these. In the economic event that fulfills the commitment two double rooms (resources of the specified type) are allocated to this group.

3.3 Services in REA

In REA, a service is a resource as it is viewed as valuable by some agent and can be transferred between agents [20]. As such, it inherits all features of resources, in particular that it can be exchanged between agents, that it is governed by a contract and that it is part of a conversion process chain. Although a service cannot be owned – the customer cannot resell it, only the right on a service may be resalable, as in the case of a hotel coupon – he does have a certain control over it and has a right to make use of it for some time. A service is produced by one agent for another agent using certain resources or capabilities. The production and consumption of the service are not independent events, as in the case of goods, but occur simultaneously. As a consequence, the customer participates in the service execution and a service is a typical example of co-creation of value.

As depicted in Fig. 6, the service is exchanged between agents in return for money (top right cluster). All the coordination services that can be used within an exchange process apply to service exchanges as well; we will use this feature below. At the same time, the service is a resource produced in a conversion process by the provider (top left cluster), and consumed in a conversion process by the customer (bottom cluster). REA usually renders only one agent perspective, but for the understanding of the service interfacing between the provider and customer, we have included both perspectives (indicated by dotted rectangle) in one figure. Note that Fig. 6 is simplified in order to reduce clutter. In particular, the usual agent boxes are not present in top left or bottom.

The economic increment event for creating the service stands in conversion duality to one or more resource use events. For example, a hotel service is realized by *using* the hotel room resources. At the customer side, we distinguish between service use and service consumption. Both can be used to add value (production event) to some target resource, typically in combination of some effort of the customer himself – that is why we also include a resource use event here. However, in the case of service consumption, the service is no longer available after the event, whereas service use draws on the existence of the service without changing its status. The service consumption may be conceived of as an atomic event or as a process over time. The latter is especially the case when the service is offered for a certain period. Then for economic purposes, the amount of service consumption is typically linear on the time having passed by.

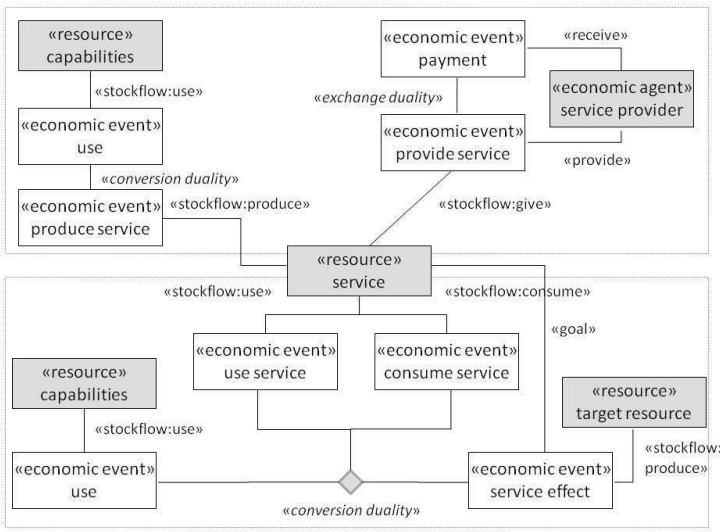

Fig. 6 REA application pattern for Service Exchange.
It is assumed that the «goal» stereotype is defined in the REA meta-model

The difference between service consumption and service use can be illustrated by the example of [5] of a fire brigade. This could be a service hired by a municipality for a certain period. Service consumption is here a matter of time: at the end of the period, it is completely consumed. During the period, the fire brigade may become

active in the case of an emergency, as stipulated in the service contract. This is service use. The effect of service use is a particular house (resource) being rescued, whereas the effect of the service consumption is the increased security of all houses in town (resource). Security of the resource in this case does not mean that no accident could happen but that the damage will be limited.

If we want the rescuing to be modeled as a service (e.g. because it can occur independently from the overall fire brigade service), this can be represented by coupling the service use to an event that creates a right on such a rescuing service. So then the service goal is no longer "rescue", but "create right on a rescuing service".

For the user-centric description of a service, the "*goal"* is important [WJ09]. A service aims to produce an effect on resources of the customer in such a way that the value increases. If the effect is not reached, this may cause the transaction to fail. Formally, the goal relationship can be seen as an extension of the REA meta-model. However, as it can also be seen as a derived relationship, since it is defined as "the production events at the customer' side that stands in conversion duality with the service use and consumption". When also the *consumption* events at the customer and provider side are relevant, we could add a "source" relationship, analogous to the "goal" relationship. Together, source and goal provide a reference to all resources affected by the service execution. As the description of all kinds of failures and exceptions is never exhaustive, we refrain from including that in the effect. It can be specified in the contract.

For web services and similar software artifacts to deserve the label "service", the service model elements should be clear. What is the goal of the web service, that is, what resources does it create or affect that have value to the client? Who are the actors involved in the exchange process? In the next section, we will consider coordination services as one important subclass of web services.

4. Coordination services

Coordination services are defined in [20] as services supporting an exchange process (a set of events) for a good or a service alike. Processes like identification, negotiation, order execution and after-sales take place in both cases. We introduce the notion of coordination object for the object of these processes: what *is* negotiated and executed? Well, the central coordination object in an exchange process is the purchase order, not in the sense of a document, but as the commitment to deliver, to be fulfilled by the exchange event. Complex processes can include more coordination objects. Reservation and appointment are two coordination objects that reoccur often, especially when services are concerned. The reason for that is simply that the delivery of a service affecting resources from both the provider and customer to be present at the same time and place requires more coordination than the delivery of a good.

In terms of REA all coordination objects can be specified in terms of commitments. Therefore, another way of characterizing coordination services is to say that these services manipulate commitments (their goal is to give, take and fulfill commitments). We assume that for all coordination objects there is a negotiation and contracting process first followed by an execution and evaluation process, that is, the

coordination process per coordination object takes the form of a "Conversation for Action" [22, 3, 9]. The message exchange in these conversations is not in the scope of this paper, but what is important is the effect of these conversations, since that is directly relevant for a user composing and using a certain mashup application.

Strictly speaking, a reservation in REA is any relationship between a commitment and a resource group. In the following, we use the term "reservation" more specifically for a commitment that *precedes* the purchase order (this is how the term is used in common speech when we talk about hotel reservation, for example). From an economic point of view, the main objective of this kind of reservations is to reduce uncertainty about the business transaction – to mitigate the risks involved, such as items being out of stock or functionality not available, or to reduce the need for slack [19]. So although the reservation has some costs in the form of less operational discretion, it increases the total value for both customer and provider.

The model in Fig. 7 contains and relates two coordination objects: reservation and purchase order. The reservation is a relationship between the reserve commitment and a resource set, being the resource set specified (purchased) in the intended purchase contract.

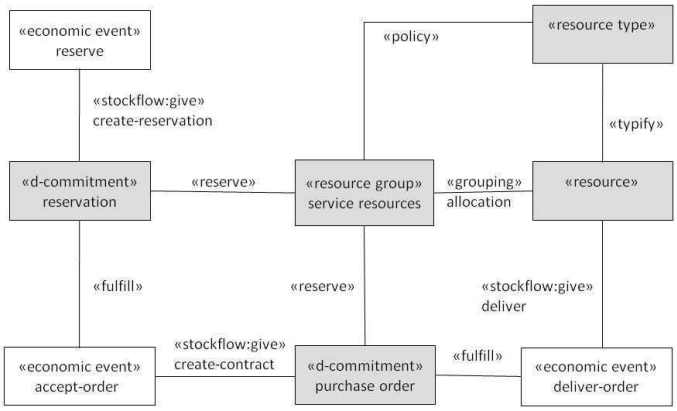

Fig. 7 REA Application Model linking "reservation" and "purchase order" coordination objects

A reservation is fulfilled by one or more economic event, but which events? It is consistent to model the fulfillment as the creation of the purchase contract (usually one, but could be more). In other words, the reservation commitment is fulfilled and ends at the moment of ordering – when the two agents engage in a purchase contract. There may be some time between this engagement and the actual realization (the good being delivered, the service being fully consumed), but in this period the coordinating role of the reservation is taken over by the purchase contract, and the reservation is not relevant anymore. If a delivery problem arises, the other party will fall back on the purchase contract, not on the reservation.

It should be noted that although the meaning of reservation and purchase order is quite stable over different domains, these two coordination objects are not always applied in the same way. In the case of a hotel, the purchase order is made when the customer checks in. At that moment, the reservation, if any, is fulfilled. In the case of a flight ticket, the purchase order is made when the ticket is sold, typically long before the check-in at the airport. What happens at the check-in is the allocation of a specific resource (a chair with a number). Sometimes, it is possible to take an option on a flight ticket for a few days before buying it. That is a case of reservation.

The complete reservation pattern is represented in Fig. 8 It shows the reciprocity relationships with other commitments that are grouped together in a contract.

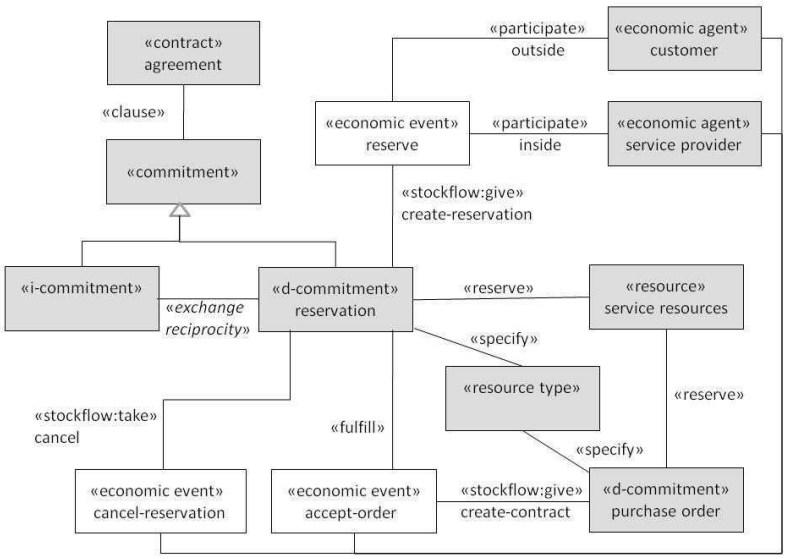

Fig. 8 REA Application Model for Reservation

An *appointment pattern* is used when two or more agents want to meet at a specific location. Appointments can be made for their own sake, but can also be part of a purchase contract, for example, when customer and provider have to agree on where to deliver the service or good. Fig. 9 shows an application model for show-up appointments where the commitment is from the side of the customer (so it is an i-commitment), typically reciprocal to an appointment of the other party to be there as well. Since the appointment includes at least a resource (the customer himself, or some resource related to the customer; and the location) there are two "reserve" links. In accordance with our "reserve" ontology, these links point to groups that specify the reservation on an abstract level and that are populated at some time with specific instances.

We have described three coordination objects, corresponding to three coordination services. Although they capture perhaps 80% of business coordination, the question

whether more coordination services exist remains open and should be addressed by both formal and empirical research. For instance, according to [1] it may be important for the business in certain cases to reserve (lock) not only resources, but also functionality or agents, in the sense that it will be guaranteed that the agent remains in existence or the functionality being offered. In the same paper, it is argued that agents not only have a need to commit but also to check. For instance, does the service that is described in this registry still exist? A check service does not change the social world, but it does change the cognitive status (subject world) of participants. A fully comprehensive set of coordination services is still to be determined.

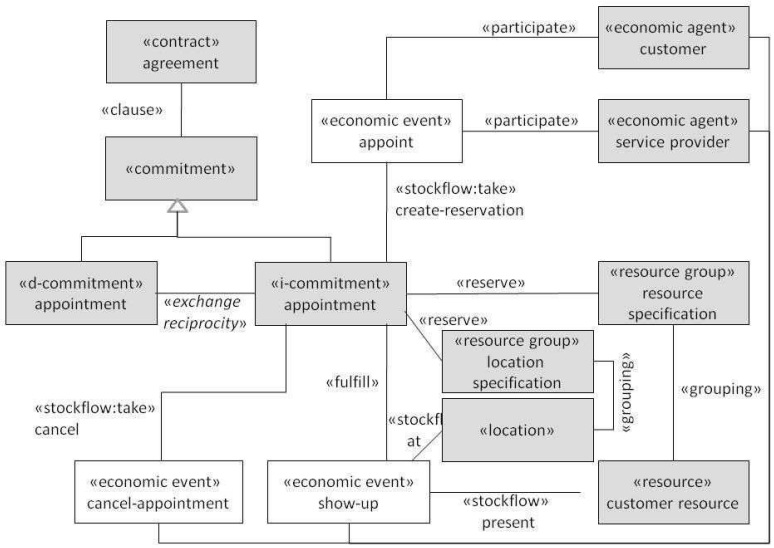

Fig. 8 REA Application Model for (show-up) Appointment

5. Conclusion

From an end-user perspective, coordination services form an important service class (cf. [2]), as these services allow the user to manage real services that matter to him/her. When using these services, he should be aware of the real-world effects, to detect and prevent possible conflicts with his own agenda (already existing commitments) or the agenda of other resources involved. In this paper, we have explored how REA can be used to describe the effect of services in general and of a representative set of coordination services. What this means for the IOPE (input-output-precondition-effect) parameters of a service description [23] is worked out in detail in a companion paper [21].

The focus of this paper has been on the description of coordination services which are the services that support an exchange process (a set of events) of a resource. Creating, executing and evaluating commitments is done in a combination of informational and material processes (in the sense of [12]). The Language/Action Perspective ([3, 9]) has explored a couple of standard micro-patterns on which the informational processes can be based. However, in this paper we have focused on the essential business level that abstracts from process and implementation aspects.

Although we adhere to the REA way of denoting the "fulfill" relationship, we have argued that it can be interpreted in terms of stockflow relationships when we distinguish a "take" commitment event that stands in exchange duality with the economic event that executes the commitment. At first sight, this event may seem superfluous, but what it expresses is that for the fulfillment of a commitment it is not only necessary that the commitment is executed, but also that the customer accepts this as execution of the fulfillment – and therefore absolves the claim. At this point we do not agree with [11] who interprets claims in terms of imbalances in the economic exchange only, for instance, when money has been received but the goods have not been shipped. When there is a contract, the other party has a claim independent of the time of payment. It is possible that a party balances one duality (e.g. shipping a good for which a corresponding payment was made) without balancing the other (e.g. because the shipping is not according to contract).

We see at least two directions for future research; the first line involves a deeper investigation of our proposed extension of the REA ontology regarding the 'resource-resource group-resource type' construct. The main rationale for this construct was to understand and model the notion of reservation while reconciling some previous proposals of solutions for the same problem.

The second line of research concerns the relationship between coordination objects and rights. The business scenario that we have described in section 4 assumes that first a commitment to reserve some resource is created (a hotel room, say). At the same time, a commitment to show-up is created. Subsequently, upon arrival the reserve commitment is returned and a new commitment, involving a specific hotel room is created. This second commitment is returned when the guest is satisfied with the hotel service having being delivered. What is interesting to explore is the interpretation of the commitments in terms of rights. When an agent commits (d-commitment), he gives away some right on the resources involved, which assumes that he did hold that right before. REA posits a "control" relationship between agents and resources. This control can be made more precise in terms of rights (ownership, custody, discretion). Viewed in this way, an economic exchange event represents not so much a change in the value of the resources but a change in the rights of the enterprise on the resources.

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