Value object analysis and the transformation from value model to process model

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1 Introduction

Interoperability is becoming a decisive competitive factor in business. Changing customer demands create new business opportunities that are met by adapting or creating new manufacturing or service processes. The increased complexity often requires that several enterprises, each excelling in its own specialty, are involved and work together. Enterprises participating in such collaborations should have reached such a level of interoperability that processes crossing the borders of the enterprise can be set up as quickly and reliably as processes set up within the enterprise itself.

Integration problems have traditionally been addressed at the message and database level, and more recently also at the process level where process models are the objects of analysis. However, recent research [8, 2, 1] indicates that when addressing business process integration, useful results may be obtained by starting to analyze the value models of enterprises. Value models, also called business models [9], describe who the business actors are, what they produce and consume in terms of value, and the conditions for doing so. When setting up a collaboration, agreeing on what to do precedes agreeing on how to do this. To alter the objects of analysis in this way represents a substantial change of abstraction level but the end result is the same – interoperable enterprises described in terms of process models. In this paper, the point of departure is one kind of business model, the e3-value model as described by Gordijn [6, 7].

The research question addressed in this paper is: how can a process model be derived systematically from a value model? Previous research on this question has drawn attention to the aspects of communication design [8] and risk mitigation [2, 13]. Reference [1] introduces the notion of Activity Dependency Model to bridge the gap between business model and process model. However, it notes that several components of the Activity Dependency Model are not

derivable from the business model, namely the flow, trust and trigger dependencies. The contribution of this paper is that it shows that to some extent these components *can* be derived from the value model, arguing

- that an analysis of the value object in terms of value resources and value transformations is a necessary first step
- that the derivation should address at least three process aspects: the resource management, the communication and the risk assessment and showing how the ontological gap between the value model and the aspect models can be bridged.

The paper is structured in the following way. In Sect. 2, we introduce a value model and outline the basic components of our framework. Section 3 contains an analysis on the notion of value object and in Sect. 4 we show how the logistic and communication design can profit from this analysis. In Sect. 5, the results are confronted with a test case and finally, in Sect. 6, we conclude with a discussion of results and future research.

2 Value Model and Methodological Considerations

In this section we first introduce the basic notions of the e3-value model and continue with a discussion on some methodological considerations.

In e3-value, an *actor* is an economically independent entity. An actor is often, but not necessarily, a legal entity. Examples: enterprises, end-consumers. A *value object* is something that is of economic value for at least one actor. Examples: cars, Internet access, stream of music. A *value port* is used by an actor to provide or receive value objects to or from other actors. A value port has a direction, in (e.g., receive goods) or out (e.g., make a payment) indicating whether a value object flows into or out of the actor. A *value interface* consists of in and out ports that belong to the same actor. Value interfaces are used to model economic reciprocity. A *value transfer* is a pair of value ports of opposite directions belonging to different actors. It represents one or more potential trades of value objects between these value ports. A *value activity* is an operation that could be carried out in an economically profitable way for at least one actor. A *value transaction* is a set of value transfers that should be carried out together or not at all.

We introduce the conference case as running example. The case concerns the organization and performance of a scientific conference. A program committee receives papers from authors and distributes them to reviewers. Accepted papers are printed in the conference proceedings and authors are invited to present their papers at the conference. When the conference is completed the program committee is paid for its work by the conference steering committee. An example of an e3-value model for the conference case is given in Fig. 1, where actors are shown by rectangles, value activities by rounded rectangles, value ports by triangles, value interfaces by oblong rectangles enclosing

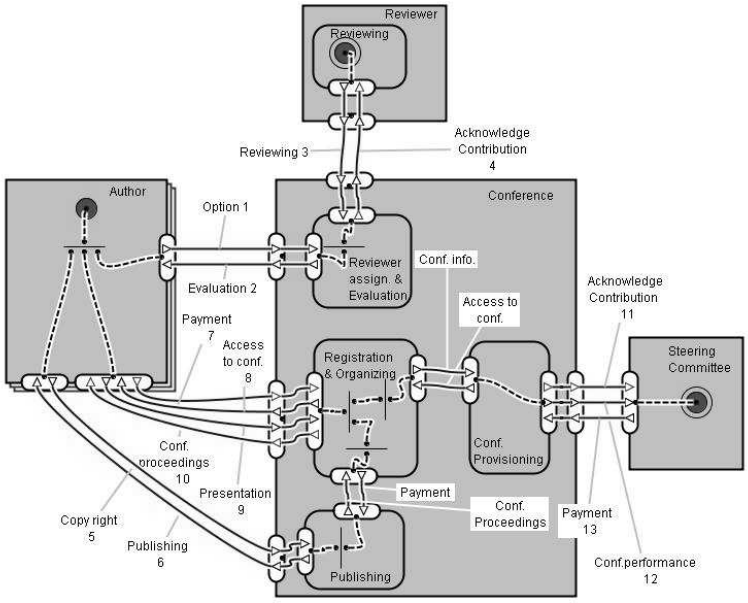

Fig. 1. An e3-value model for the conference case

value ports, and value transfers as lines between value ports with names of value objects as labels.

When constructing the process model from a value model, a number of design decisions have to be taken concerning the introduction and ordering of activities [3]. We have examined these decisions, and claim that they are based on three different aspects of a business case: resource management (logistics), communication, and risk, see Fig. 2:

- Resource Management aspect. This aspect concerns the physical flow of resources and the planning of the activities in time.
- Communication aspect. This aspect concerns the coordination between customers and providers that is needed to initiate and complete value transfers.
- Risk aspect. This aspect concerns risks that may result in value transactions not being completed or only partially completed, and the various ways to mitigate risks [2, 10].

Although the aspects are not completely independent, it is useful to distinguish them. They provide a separation of concerns, thereby facilitating design and traceability of the process model.

Figure 2 also shows that in our view the transformation of a value model into a process model should be supported by a pattern library (cf. [3]). Patterns are general solutions to specific analysis and design problems. As there may be several patterns to support a certain transformation, the transfor-

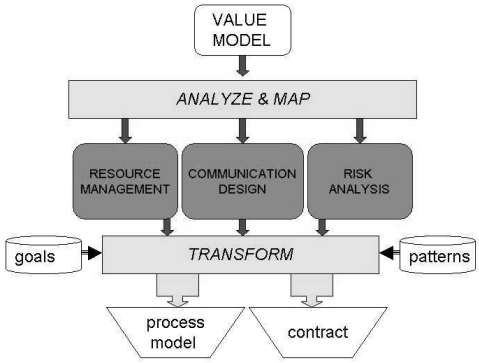

Fig. 2. From value model to process model

mation process may involve a selection process based on an alignment of the non-functional goals that the pattern aims at and the goals provided by the customer. Furthermore, we assume that the result of the transformation is both a process model and a contract that offers the conceptual and legal context, although the latter may be left implicit.

3 On the notion of value object

In this section we briefly discuss and analyze the notion of value objects. For more details, we refer to [12]. This analysis of the value object is needed in order to know how e3-value models can be transformed into process models, as we will see in Sect. 5.

According to [6], a value object is "a service, a product, or even an experience which is of economic value for at least one of the actors involved". Products and money are obvious value object candidates, but the value transfer should not be equated with the logistic transfer: basically, what someone acquires when buying a product is the *ownership* of the product. Ownership can be conceived as a bundle of rights, and other rights can be value objects as well. For example, when borrowing a book from a library, one gets the right to keep and read the book for a certain period of time, and on the Internet, one could acquire the right to use a certain piece of software for a limited number of users.

On the basis of examples like these, we may tentatively identify a value object with a certain right on some resource. A right of one party means obligations for the other party. The customer should be enabled to use the right. For example, a transfer of ownership of a product should be accompanied by a delivery of the product, or at least the customer should get the possibility to pick up the product somewhere. So we may define a value object as a certain right on some resource (owned by the provider) and the enabling to use that

right. This definition works not only for the goods and money, but also for certain services such as "internet access" (the right to send and receive data to and from Internet, where availability of the network is assumed). However, it does not work for all. Think for example of services like transportation, where some action is performed on an object belonging to the customer that increases its value. The customer prefers his goods to be at place B rather than at place A. If we call such an action a value transformation, an alternative definition of value object might be: "the value transformation of some object belonging to (or at least of interest to) the customer".

In this second definition, the focus is on the value transformation of some object, but this does not exclude that some resource of the provider is involved as well. For example, the transportation service involves the use of a truck or some other vehicle. More generally, the value transformation of some object belonging to the customer often involves a right (and the enabling thereof) on some resource owned by the provider. We therefore unify the two definitions as follows. Provider P transfers a value object to customer C when P brings in a resource R for the purpose of a transformation of some subject S in which C has an interest such that the transformation has value for C."Bringing in" the resource means that P transfers C some right on R and makes R available (enables C to execute the right). So the value object can be defined as an aggregation of value transformation and the right transfer, where usually but not necessarily both are present.

Example. We illustrate the value object model with an example of the conference case. One of the value objects offered is the Paper Review. In this case, the value subject is the *paper* whose value to the author is increased by the reviewing. The *reviewing* is a value transformation that makes use of the reviewers and produces a review report. The author is transfered the right to read the review report. We consider both the *reviewers* themselves and the *review report* as value resource.

4 From value model to process model

The derivation of a process model from a value model is considered to be a non-deterministic design process: often, there are many ways to achieve a certain goal, which differ in terms of costs and benefits. Process patterns suggest possible transformation steps; it is up to the designer, or his client, to compare the alternatives and select the most attractive one given his business goals. An example of a process pattern can be found in the Open-EDI [11] initiative where a Business Collaboration is divided into a number of phases: Planning, Identification, Negotiation, Actualization and Post-Actualization.

Our hypothesis is that the analysis of the value object in the above is useful in bridging the ontological gap between value model and process model, as it operationalizes the abstract notion of value object to concrete objects

(value resource, value subject) and activities (value transformation, making resources available). We have examined this hypothesis by considering each of the three business aspects introduced in Sect. 2, but for reasons of space we limit ourselves to the first two: resource management and communication.

4.1 From value model to resource management model

A value transfer includes a value resource, a value transformation, or both. If for a value transfer the focus is on access to a resource, then evidently the resource must be made available. In the case of transfer of ownership of goods, the resource usually has to be moved from the provider to the customer. The transport can be considered to be a necessary value activity (and value transformation) in the e3-value model that is performed by the provider himself or outsourced to a third party. In both cases, a logistic sub-process can be designed that either includes provider and customer or provider, customer and one or more intermediate parties. We call this a sub-process, as it should be combined with all the other sub-processes caused by other value transfers. For example, the resource sold by the provider may be bought by him from another supplier. In that case, the two logistic sub-processes can be linked into one chain. The chains obtained in this way model the "conceptual route" that the resource takes, which need not be the same as the physical route (for example, the provider may shortcut the transport chain and plan a direct delivery from his own supplier to the customer). It is also possible that the value transfers are linked via one or more internal value transformations.

The resource must be made available, but this does not always necessitate movement. In Internet business, sometimes resources can be accessed from a distance. In that case, the resource management boils down to an accessibility analysis of the server.

So far we have assumed each sub-process to be an interaction between one customer and one provider. In addition, there is a need for *coordination* of various sub-process instances from different actors. For example, a repair shop for electronic equipment may send items to a central service unit immediately after a consumer has handed it in. Alternatively, the repair shop may send it once a day or when a predefined number of items have been collected. The choice for a particular process pattern includes choices about *inventories* and inventory management.

Summarising, for each actor the following sub-processes are introduced for the resource management aspect:

Conceptual level

R1 For each value port and associated value transfer in which access to some value resource should be enabled, introduce one sub-process for receiving and one for providing the value resource from/to the other actor, respectively

R2 For each value activity, introduce one sub-process and connect it to the sub-processes from step 1 (the ones realizing a value transfer linked to the value activity)

R3 Optionally, introduce additional sub-processes for managing the internal logistics, such as the combination of multiple instances, between the processes introduced in the previous steps

Implementation level

R4 Map the "conceptual routes" to physical routes. Whereas a conceptual route shows the movement of a value resource from one actor to another, a physical route shows the movement of the resource from one physical location to another. It may contain further details, for example, about the transport means and time (e.g. guaranteed delivery time). Compare alternatives in terms of costs, reliability etc.

Example. The review report was identified as a value resource. This report should flow from reviewer to author, via PC. The physical route is dependent on the format of the review report (electronic or paper-based), and a file upload/download site is a possible pattern when the resource is electronic.

4.2 From value model to communication model

In general, the communicative aspect can be worked out as in the line of [8] and related work in the Language/Action Perspective field [5] where abstract communication models have been studied for many years. Central in these models is the *service* that an agent performs for another agent. Service providing requires coordination, which is achieved by an initiating conversation (negotiation) and an evaluative conversation. To transform a value model into a communication model, we associate a value transaction with a service. The name of the service is in most cases the name of the value object offered by one party in exchange for money.

For the evaluative conversation, a distinction can be made between the situation where the value transfer involves a transfer of rights and one where this is not the case. Rights are not tangible, so the transfer of a certain right should be performed communicatively. In many cases of simple transactions, where there is an instantaneous exchange of goods versus money, the transfer of rights is performed tacitly (and if evidence is needed afterwards, the proof of payment is often sufficient). But in other cases, a message or document is needed. If there is no transfer of rights, this typically means that there is no resource flowing to the customer either. In that case, an interaction is still useful so that the customer knows the service is ready and the provider knows the customer is satisfied ("closing the loop"). For better or for worse, such an evaluative interaction can be performed tacitly and may only become active when something goes wrong.

In the analysis of the communicative aspect, it is often overlooked that a distinction must be made between the communicative action as such and the message that realizes it. So there will be two major steps in the process model derivation: first, to identify the communicative actions, and secondly, to identify the messages (or other visible actions, as in principle any sign can "count as" a communicative action if this is agreed upon). One message may realize multiple communicative actions at the same time.

Summarising, for each actor the following sub-processes are introduced for the communicative aspect:

Conceptual level

C1 For each value transaction introduce one sub-process for negotiation (corresponding to the Negotiation step in the Open-EDI Initiative)
C2 For each value transfer that includes the transfer of a right to a particular value resource, introduce a sub-process for the transfer of rights
C3 For each value transfer that does not include a transfer of rights – so the focus is on some value transformation – introduce one sub-process for evaluation (corresponding to the Actualization step in the Open-EDI Initiative)

Implementation level

C4 Map the communicative actions to messages (or other signs)

Example. One of the value transfers is the transfer of the right to read the evaluation report (including the review reports). According to (2), a sub-process should be introduced for the transfer of this right. In practice, this can be done by sending a copy of the report to the author, or by sending him a secure link or password that he can use to access the report on the conference website.

5 Conference case

In this section, we apply our value object analysis to the test case, not for thorough validation but for illustration and to deepen our understanding. A *part* of the process model, expressed in BPMN, for Conference (PC), Reviewer and Author is shown in Fig. 3. Each sub-process in the diagram would be identified as follows. For each value transaction one pair of negotiation processes is added (shown as gray rectangles with thin edges), following step C1 above.

For each value transfer enabling access to a value resource, a pair of deliver/receive sub-processes is added (unfilled rectangles with thin edges). The purpose of these sub-processes is to handle the provision and reception of

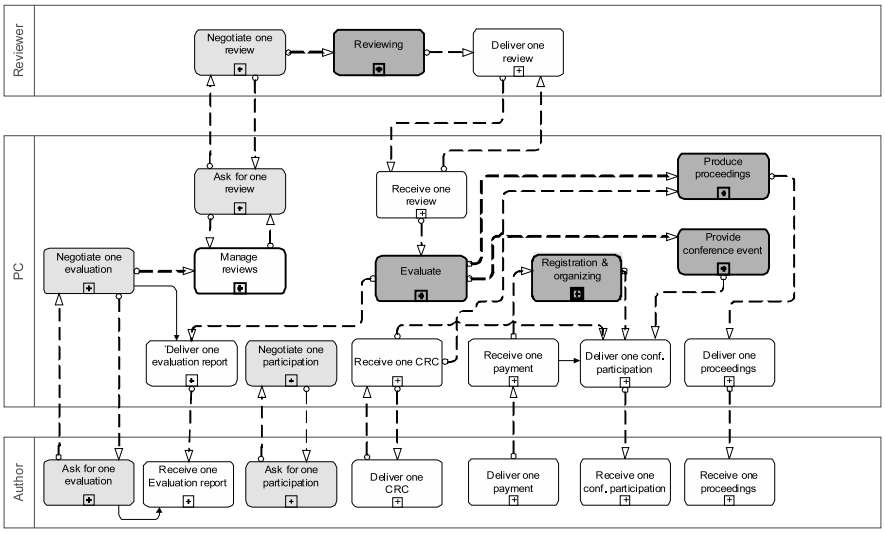

Fig. 3. Process model for the conference case

value resources from an ingoing and outgoing value port, respectively (step R1). When the value transfer does not involve access to a resource, there is no pair of deliver/receive sub-processes. For example, the acknowledgement of the reviewers contribution; instead this acknowledgement is carried out by means of activities within the "Produce proceedings" sub-process (this is not covered yet by our transformation process).

Some of the sub-processes that focus on access to resources will have distinct activities for right transfer and enabling, respectively. An example of a distinct right transfer (step C2) is the deliver/receive CRC. Other sub-processes will not explicitly distinguish the two – rather the enabling counts as a right transfer, e.g., the delivery of proceedings (R1 and C2 merged).

For each value activity one transformation sub-process is added (step R2), rendered as a gray rectangle with thick edges. This value transformation is performed on a value subject identified in the value object analysis. Finally, there are internal management sub-processes (step R3), rendered as unfilled rectangles with thick edges. In the example, there is one called "Manage reviews", which determines when requests for reviews should be sent (at a deadline, when a prespecified number of submissions have arrived, etc.) and to whom they shall be assigned.

The sequence flows are based on logistic and risk analysis. For example, the sequence flow from "Receive payment" to "Deliver proceedings" is based on a risk mitigation instrument (not worked out in this paper), i.e., proceedings are not delivered until payment has been received.

6 Concluding remarks

In this paper, we have contributed to a method for constructing process models from value models. The method is grounded in a renewed analysis of the value object notion. A value object can be seen as a combination of rights on value resources and transformations of value subjects. This analysis provides a basis for identifying the objects of concern in the process design. In future work, we plan to work out the details and formalize the method suggested. In particular, risk analysis and the use of patterns need to be worked out more, in the line of [10] and [2].

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