Designing an Ecosystem Value Model Based on a Process Model – An Empirical Approach

Isaac da Silva Torres[13], Jaap Gordijn[1], Marcelo Fantinato[2], and Joao Francisco da Fountoura Vieira[3]

[1] Vrije Universiteit, Amsterdam 1081 HV, Netherlands
{i.dasilvatorres,j.gordijn}@vu.nl
[2] Universidade de Sao Paulo, 03828-000, São Paulo, SP, Brazil
m.fantinato@usp.br
[3] Universidade Federal do Rio Grande do Sul, 90040-060, Porto Alegre, RS, Brazil
joao.francisco@ufrgs.br

Abstract. Ecosystems have inter-organizational process models and corresponding business value models that show how actors in the ecosystem make a profit. Whereas process models show *how* actors interact in terms of message flows and the time-ordering of activities, business value models present *what* is exchanged of economic value and abstracts away from operational activities and their control flows. Previous research derived a process model from a value model. In contrast, as organizations usually have process models but not explicit value models, we propose to derive a value model from a process model, i.e., the exact opposite. To do so, we hypothesize on how these two models conceptually correspond to each other. We employ a real-world case to verify our hypotheses and learn more about the applicability of the proposed design.

Keywords: Ecosystems · Value model · Process model.

1 Introduction

Ecosystems increasingly become more important. Following Moore [13], we define an ecosystem as a 'collection of companies that work cooperatively and competitively to satisfy customer needs'. Examples are Facebook, Google Android, Apple, Netflix, Spotify, and Uber. Although these ecosystems have a central party, namely the company with the name of the ecosystem, all these ecosystems cannot survive without other parties. Spotify needs artists, text and songwriters, and internet service providers to stream music to the end-user. Apple requires app developers and hardware manufacturers. There are also more decentralized ecosystems, e.g., Bitcoin, or OpenBazaar, a peer-to-peer market place.

All the ecosystems are only possible due to the extensive use of information technology and require a sustainable business model for all entities involved. We take the notion of 'model' very literally, as in a formalized abstraction of reality. We argue that at least two model perspectives are needed to develop such ecosystems: (1) the value model, and (2) the inter-organizational process model. The

value model shows how entities earn money (in the case of companies) or increase their economic utility (in the case of end-users). The focus is on the creation, distribution of things of economic value such as products or service outcomes. An example of a value modeling language is e^3value . The inter-organizational process model shows the sequence of interactions between parties, e.g., in terms of message flows. Usually, these interactions have an operational flavor, such as message flows in the Business Process Modeling Notation (BMPN).

Although e^3value and BPMN models (hereafter called BPMN models) represent the same ecosystem, their semantics differ significantly. For example, an e^3value model shows economic reciprocity (e.g., what is offered by someone of economic value to its environment and what is requested in return), whereas such reciprocity in a BPMN model can at best only be seen by carefully analyzing the control flow. Moreover, an e^3value model has no explicit time-ordering, whereas a BPMN model has extensive constructs for this.

As e^3value and BPMN models are related somehow, in the past, research was done to elicit a BPMN model given an e^3value model (see Sec. 2.3). Previous research was based on the idea that first, an e^3value model is designed and thereafter, a BPMN model. In situations where a new ecosystem has to be designed, this is often the case. However, often the ecosystem already exists (sometimes for a very long time), and there is a need to understand, redesign, or analyze that ecosystem. Usually, the e^3value model was never made explicit (as a conceptual model), but in quite some cases, there is a BPMN model.

In this paper, we explore if we can use an existing BPMN model to design the corresponding e^3value model. Apart from the general purpose of understanding the e^3value model and the value propositions it entails, we foresee in the near feature an application of 'value mining', analogous to the popular research topic of process mining. It is then necessary to use an adequate language to represent the business value aspects. The notion of economic value is not an explicit modeling construct in process modeling languages.

To study if a BPMN model is useful to find an e^3value model, exploratory technical action research is undertaken (Sec. 3). First, we set some qualitative hypotheses to be explored (Sec. 3.2). We work with a Brazilian centennial institution, which provided us with real-life BPMN models of one of its main processes (Sec. 3.3). By refining these BPMN models with a few rounds, we tried to derive its corresponding e^3value model and present our lessons learned (Sec. 3.4). Finally, we review our ETAR-cycle (Sec. 4) and present the conclusion (Sec. 5).

2 Background

2.1 Business Process Model and Notation

Business Process Model and Notation (BPMN) is a standard for the specification of business process models [9]. It is common to most part of process modeling users and has a wide-diffused graphical notation. In addition, it can represent the complex behavior of systems. This notation is in its current version 2.0. BPMN

2.0 [16] summarizes an industrial standard for the information technology (IT) support of business process management. It provides a set of elements to define the central artifact of a business process lifecycle [2].

BPMN recently acquired a clear relevance among the notations used to model business processes in academia and industry. Muehlen and Recker [14] showed that, although BPMN 2.0 has a variety of elements, only 20% of them are regularly used when designing process models. Our research attained to some BPMN basic elements. They are as follows, *swim pools* correspond to the actors involved in the process (e.g., customer). The *tasks/activities* represent how the process is operationalized, transforming inputs into outputs. *Events* describe something that happens instantaneously in a process. There are three types of events: *start event*, which indicates the start of an instance in a process; *intermediate event* is the event used when an event occurs during a process, and the *end event* which mark the end of an instance in the process. The *sequence flow* indicates the order of how each element is activated, and *message flow* shows how actors communicate with each other. *Gateways* define the routing rules of the operation. There are three types of connectors – the logical AND for concurrency, XOR for exclusive paths, and OR for inclusive choices.

2.2 *e*^{3}*value* Modeling

The *e*^{3}*value* modeling language [4] is an approach for value modelling. Other approaches include the Resource Event Agent (REA) [12] ontology and value stream mapping [6]. E^{3}value is, in particular, strong in representing and analyzing the ecosystem, or as it is called in e^{3}value, the networked value constellation [15] of companies which jointly satisfy one or more needs of an end-user.

We briefly explain, by means of an educational example (Fig. 1) the *e*^{3}*value* constructs relevant for this paper; for a more detailed discussion see [4]. *Actors*, such as Amazon.com, are profit-and-loss responsible and often legal entities. In many cases, it is useful to talk about multiple actors of the same kind, *market segments*, who assign economic value in the same way. Examples are readers (people who want to read a book) and publishers. Actors and market segments do *value transfers*, which each other; the subject of such a transfer is the *value object* (e.g., book, transportation, money), which of economic value to at least one of the actors/market segments. The latter transfer value object via *value ports*, which are grouped into *value interfaces*. These interfaces represent economic reciprocity; hence a value interface contains at least one *in-going* value port and one *out-going* value port. Actors/market segments perform *value activities* to earn money (companies) or increase economic utility (end-users). *Customer needs* (read a book) indicate a state of felt deprivation [10] by an actor to be satisfied by one or more value objects, indicated by *dependency connection elements*. At the end of the dependency chain, there are one or more *boundary elements* to indicate that further value transfers are not considered anymore. This does not imply that they are not there (e.g., the publisher needs to do transfers with writers); they are only considered out-of-scope for the model. Hence, boundary elements specify the model boundary.

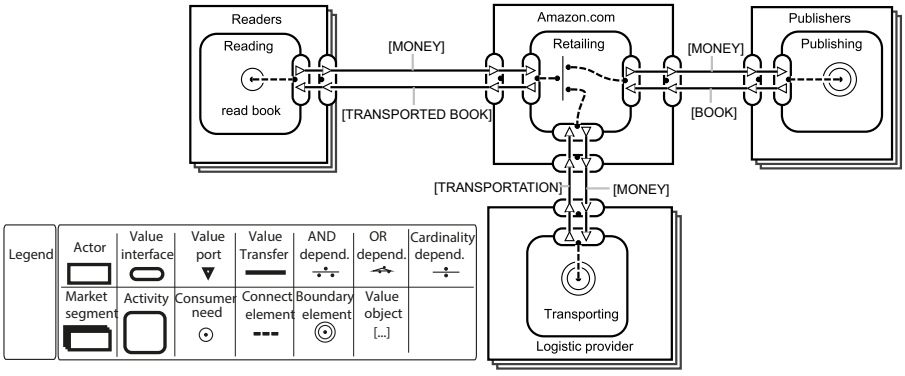

Fig. 1. An educational e^3value model

We can observe two important differences with BPMN. The notion of value interface models economic reciprocity and such construct is absent in BPMN. If –and only if– value transfers would correspond to message flows in BPMN, we could argue that economic reciprocity in BPMN could be derived from following the control flow. However, the value interface construct shows economic reciprocity explicitly, and, as we argue in this paper, value transfers do not always correspond to message flows. Second, e^3value activities result in a profit or economic utility increase for the performing actor, whereas activities in BPMN have an operational flavor, e.g., may incur costs only.

2.3 Relating Process Models and Value Models

The relation between process models and value models is the topic of ongoing research. We can characterize this research as *(1)* work investigating the links between process models and value models in general, and *(2)* how to derive a BPMN model from an e^3value model (or the other way around) specifically.

Although both e^3value and BPMN models try to capture a phenomenon in the real world (e.g., and ecosystem), they do so very differently. In [5], we identified that a BPMN model and e^3value model have very different ontological foundations. To mention a few, actors (in e^3value model) and resource lanes (in BPMN model) might look the same at first sight but are not. Actors are (legal) profit-and-loss responsible entities, whereas resource lanes are parties that execute work. Similarly, a value activity is something an actor executes to create added value (e.g., the total value of the objects flowing out is higher than the value flowing out), whereas a BPMN activity specifies some work to be done, which might have costs only. In [1], formal consistency rules between coordination models (a kind of process model) and e^3value models are defined. The idea is that value transfers can be matched with a (set of) message flow(s). An e^3value model is, if quantified, an engine that calculates the net value flows based on the number of needs, the number of actors in a market segment, and

dependency elements. This gives an indication of whether the e^3value model can be executed in a sustainable way by all the actors. As [1] assumes that a value transfer always matches with a (set of) message flow(s), the number of message flows can also be found, e.g., by means of s simulation. An e^3value model is then consistent with a process model is the number of times a transfer occurs, corresponds to the occurrence of (a set of) message flows.

Second, the e^3value model is used to derive other models. Zlatko uses e^3value models to elicit goal models [24]. In [21], the e^3value model is used to find Resource Agent Event (REA) models [12], and later also coordination models, e.g., cf. UN/CEFACT'S Modeling Methodology (UMM) [7] models [20]. With respect to the value object, a distinction should be made between the *ownership* of the product and the logistic transfer [17]. For e^3value model, the transfer of ownership is of interest (or the right to enjoy the outcome of a service), whereas the process model focuses on the flow of possession. Possession means physical access to the object (e.g., to transport it), but not ownership. In [22], this is generalized as a right on a certain resource, e.g., lending a book in a library. We tried to integrate all recent work on how to derive a process model based on an e^3value model in [8]. In brief, the proposed method distinguishes the two important design decisions: *(1)* trust, and *(2)* possession. Trust implies a particular flow, so time ordering of value transfers and the corresponding message flows, for example, whether a buyer has to pay first and then obtains his product, or the other way around. The notion of 'physical possession' is important, e.g., because a logistic provider needs to possess an object for a while in order to physically deliver a product to the customer.

Where quite some work was done on how to derive a process model given a value model, the opposite is not the case. As many (larger) companies have explicit process models, deriving value models from them is a logical next step, e.g., to do 'value-mining', as opposed to process mining.

3 Technical Action Research: A Research Instrument for Design Science

Recker [18] defines Design Science as a research activity where the interest lies in artifacts that improve a given problem in terms of a (partial) solution (e.g., finding a suitable e^3value model when a BPMN model is given). In our case, this concerns how to develop an e^3value model from a BPMN model.

As presented in Sec. 2, many attempts were made to relate process models and value models. However, these works either focus on relating value models and process models on a meta-model level or propose guidelines for deriving a process model from a value model. In this work, we explore the usefulness of these guidelines to derive a value model from a process model, so precisely the other way around.

Wieringa and Morali [23] propose the technical action research (TAR) method in which researchers learn in practice about a specific technique. TAR mainly focuses on the artifacts (developing an e^3value model using a BPMN model, and

each model individually). In this paper, we use a case from a Government Institution (GI) in Brazil, which has, in the past decade, changed its management to a process-oriented view. We choose this case because the BPMN models are known and available, but an e^3value model is lacking. In this particular case, we focus on the process of Research Project Contracts. We extend TAR with the notion of 'exploration' and call this 'E-TAR'. Our 'E-TAR' is best used if the solution to the problem at hand is largely unknown. Although there is a body of work how to relate value models and process models, we do not know very well yet on how to *design* an e^3value model given a BPMN model. We use exploration to understand the problem of how to come from a BPMN model to an e^3value model better. The TAR cycle consists of the problem statement *(1)*, to be answered by treatment, the treatment design *(2)*, the experimentation of the treatment in a real-life context *(3)*, and the evaluation and improvement of the treatment *(4)*. This section, therefore, is organized as these four steps.

We assume that the designer of the e^3value model based on the BPMN model is familiar with both BPMN and e^3value models; i.e., our approach is not a recipe for understanding or developing either of the conceptual models. In fact, the approach refers to on how to come from a BPMN model to an e^3value model. The first author, who addressed the models, first was taught e^3value .

3.1 Problem Statement

If two different languages are used to model an artifact is that they may overlap conceptually. Recker [19] argues that ontological overlap in models decreases the clarity of the representation. In contrast, two or more models expressed in different languages usually highlight different points of view and hence may represent more knowledge about an UoD than a single model. However, if the level of overlap increases, an additional cognitive effort is introduced in reading a combination of multiple models, e.g., a higher unnecessary intellectual weight is required to develop understanding towards a certain domain. This situation arises as users need to identify and discriminate elements appearing in various models that (partly) convey the same meaning about some real-world phenomena [3]. Users, in turn, have less mental capacity to receive and integrate relevant information from models. However, we assume that it is worth having an e^3value model and a BPMN model of the same case because they significantly differ content-wise as they serve totally different purposes, and hence provide a more comprehensive view of the case. The e^3value model represents actors exchanging things (*what*) of economic value (products, service outcomes and money) with each other, i.e., the concerns are financial sustainability of each individual actor [8]. In contrast, the BPMN model shows *how* the e^3value model is put into operation, in terms of activities, their time order, and how information is exchanged, i.e., the concern here is the *message flow* of tasks [5]. This flow of information throughout operations transforms inputs into outputs delivering *how* the process behaves. Note that in e^3value , the notion of 'time' is completely absent, except the idea of 'contract period', which states that an e^3value model is valid for a

particular time period. There are many more differences between e^3value and BPMN models in general, many of the are highlighted in [5].

We argue that creating an e^3value model based on a BPMN model should not be seen as a mere translation or (mechanical) modeling problem between both models. The semantic differences between models are too significant to allow for a straight-forward modeling approach. Consequently, we consider the process of coming from the BPMN model to an e^3value model as a *conceptual design process* during which many design decisions need to be taken. Although a sort of compiler that translates *automatically* a BPMN model into an e^3value model would be desirable by many, we do not expect that this is feasible.

In sum, the problem to be solved can be phrased as follows: 'how to *design* an e^3value model based on a given BPMN model'.

3.2 Treatment Design: From Value Model to Process Model

We suppose a BPMN model as a starting point. Therefore, the BPMN modeling step itself is outside the scope of our work. In contrast, our research provides steps on how to build an e^3value model from a given BPMN model. We have formulated a set of hypotheses in Table 1 that might be useful to find an e^3value model given a BPMN model, which are inspired by [1].

Table 1. BPMN model and e^3value model correspondences.

ID	Hypothesis description
H1	Pools and lanes may correspond to actors and market segments
H2	Message flows may correspond to value transfers.
H3	Start, intermediate, and end events may correspond to consumer needs, value objects, and boundary elements, respectively.
H4	Tasks/Activities and sub-processes may correspond to value activities.
H5	Gateways may correspond to dependency elements value interfaces, and value ports.

Note that we phrase our hypotheses in terms of 'may correspond'. This is because we expect that in some cases the correspondence is there, but sometimes not. This is caused by the different semantics of these constructs in e^3value and BPMN models. Moreover, the correspondence not necessarily is one-to-one. It might be very well the case that e.g., a *set* of message flows corresponds to one value transfer. The hypotheses are as follows.

H1 *Pools and lanes are candidates for actor and market.* Sometimes, a pool/lane element in a BPMN model may be designed as a source of profit – an actor/market – in an e^3value model. Changing the perspective of *how* things are done to *what* value is being exchanged is challenging when designing an e^3value model from a BPMN model. A BPMN model often does not explicitly externalize *what* exactly is being traded between two or more actors (e.g., it often shows only one side of the economic trade). Its job is to show

how the operation is done. For example, the resource pools/lanes in a BPMN model are indicated for purposes such as resource allocation and scheduling. However, in an e^3*value* model, we distinguish actors to facilitate reasoning about adding economic value and profitability. Therefore, actors are not individual resources performing activities, but cost-effective and legal entities that engage in business transactions. The question that arises is how exactly they relate, i.e., does every pool/lane result in an actor, does one pool/lane result to precisely one actor, or may one pool/lane have *multiple* instances in terms of e^3*value* model actors and thus should be a market segment?

H2 *Message flows may correspond to value transfers.* Value transfer is a concept inside e^3*value* modeling in which actors/entities exchange something of economic value. In BPMN models, the only way that two different entities can communicate is via message flows. This element is responsible for carrying the inputs (information, resource, objects, etc.) from one pool to another. However, differently than in the e^3*value* model technique, in BPMN models, a pool needs to *possess* the resource to fire the corresponding message flow. However, *possession* is different from *ownership* (see e.g., [17]. For example, a logistic party may possess a resource for a while but never owns it. However, communication about a change in ownership can be modelled with a BPMN model, e.g., by means of a message flow. This is because BPMN models map how the information is delivered, i.e., inputs are consumed and exchanged as the process is being executed. Since there can be *many* message flow connectors in a BPMN model, when designing a corresponding e^3*value* model, it is important to find which message flow(s) represent the actual transfer of value between actors, i.e., this is often not a one-to-one relation.

H3 *Start, intermediate, and end events may correspond to consumer needs, value objects, and boundary elements, respectively.* The event element allows representing a state transition that was consumed or transformed by the activities and takes place instantly in a process, i.e., without duration. Events elements are the starting point for discovering in an e^3*value* model what the consumer needs are, how many value objects are transferred between actors/markets, and whether the transfers do (not) result in other transfers. Although events need to yield value to someone to be considered as a value object, this guideline relates to **H2** since message flows can only be exchanged between pools (actors/entities) and their respective message events and tasks.

H4 *Tasks/Activities and sub-processes may correspond to value activities.* While BPMN models' tasks/activities and sub-processes describe an operation as how to produce outputs given some inputs and resources (timed and sometimes with no intrinsic business value), a value activity is only distinguished if they are profitable for the performing actor/market segment. The main reason for this is that in an e^3*value* model we want to address the important design decision which adds value (and hence can make a profit) by performing which value adding activity. For example, whether to outsource activity or not is such a decision; outsourcing is only possible if someone else can perform that activity in an economically sustainable way.

H5 *Gateways may correspond to dependency elements, value interfaces, and value ports.* Gateways in BPMN models are used to show deviations on the process sequence flow. In e^3value models, there are similar constructs, namely AND, OR, cardinality dependency elements, and value interfaces. These elements can only be used inside an actor, market segment, or value activity, to represent how customer needs, or value transfers with one party, can result into transfers with other parties. One factor that complicates matters here is the notion of 'economic reciprocity' ("one good turn deserves another"), which is fundamental for each e^3value model. The 'value interface' represents economic reciprocity: it should contain at least two opposite directed transfers, and both transfers should happen, or none at all. This notion of economic reciprocity is one of the reasons why an e^3value model is so different from a BPMN model. Hence, mapping a BPMN process flow with gateways onto an e^3value model is not trivial at all.

3.3 Treatment: The Real-World Case Scenario

Our selected case partner is a centenary institution in Brazil that has more than seven hundred registered research groups working on basic and applied research in all areas of knowledge. They manage a group of approximately fourteen thousand people involved in scientific and technological research activities. This partner operates in an ecosystem whose goal is consume and there produce knowledge. In Fig. 2, the Research Project Contracts process is detailed in a BPMN model, and various areas of the model were marked and labeled with hypotheses identifiers. This is to keep track of where precisely the hypotheses were confirmed or not. Please note that mainly the centenary institution is modeled and detailed; the rest is modeled only with the purpose to provide information for the institution's point of view. We acknowledge that it would be better to have all the information from all actors, which is a subject for further research.

The process covers the signing of agreements between the GI (here: a university), a Research Finance Support Agency, and an external Research Partner (company) for the development of a research project. The research partner is the contractor of the project; the GI, through its researchers (e.g., professionals, students, etc.), executes the project; and the support agency performs the financial part of the agreement.

The process is then divided into three stages: initial processing (signing of the agreement), execution, and accountability. The signing of the contract covers all steps, from the opening of the project by the coordinator (researcher) until the legal instrument that settles the agreement, including all instances of approval. After signing the contract, the project is ready to be executed. The research partner transfers the funds from the contract to the support agency that implements the contracting and payments of the project. The coordinator, together with his team, carries out the requested research. Necessary changes to the agreement may occur, such as an extension of the term or composition of the research team. Finally, after the research project is finished, accounts are given about the use of the funds transferred, and the project is carried out.

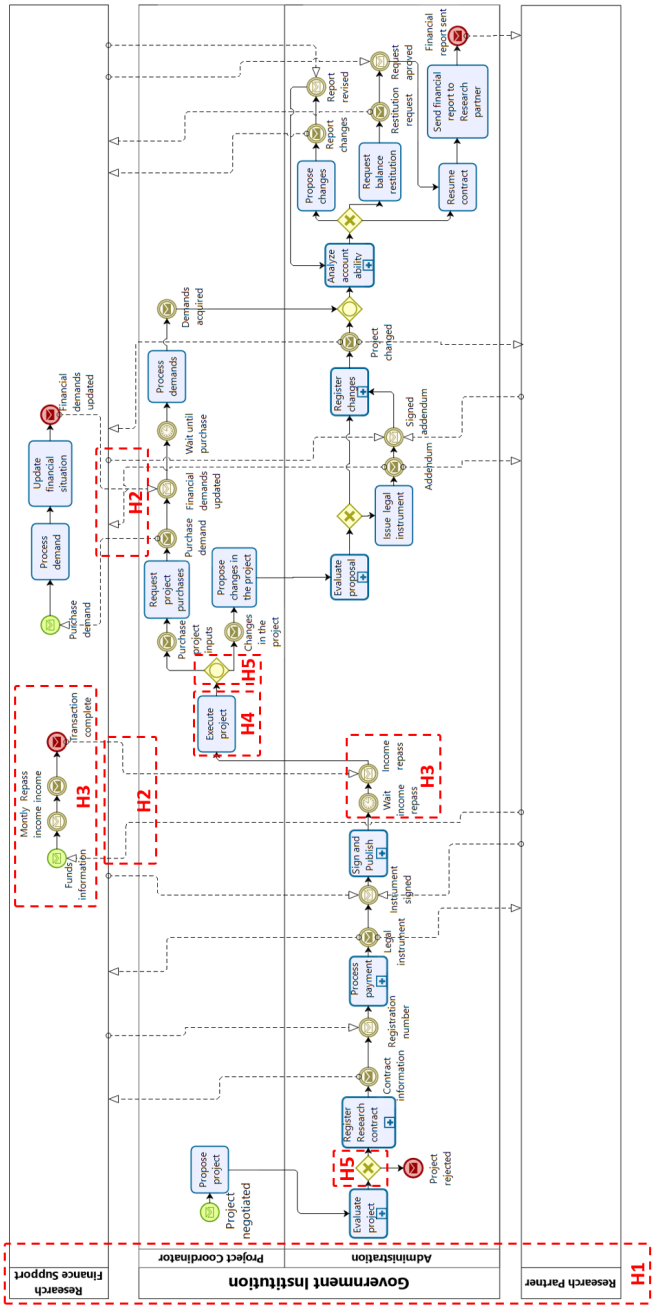

Fig. 2. BPMN model of the case with applied hypotheses identifiers

We then tried to construct the corresponding e^3value model using the hypotheses mentioned in Sec. 3.2. The proposed e^3value model is illustrated in Fig. 3. The Research Partner is the process customer and is modelled as a market segment since there are many of these partners. The Research Finance Support Agency (also a market segment) is responsible for handling the payments done by the Research Partner because the GI, due to laws, cannot directly take money from the sponsor. There can be many GI's; hence they are market segments in the e^3value model. Finally, we have added the 'Customers' market segment to reflect that Research Partners need income in order to finance research.

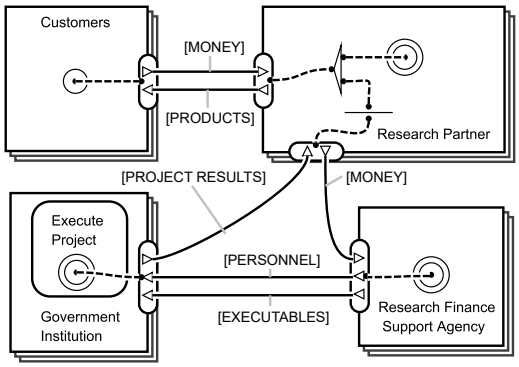

Fig. 3. e^3value model as designed and based on the BPMN model

The e^3value model have six value transfers that were found from the combination of message flow and event elements in the BPMN model. They were difficult to track since not all flows represented a change of ownership. Our option was to take the message flow elements that were linked to an event, which was also corresponding to a value object (money (x2), products, executables, personnel, and project results), to judge which one was going to be designed in the e^3value model, and which one was going to be disregarded.

The GI performs one value activity: 'execute project' – which should attract everything that is necessary to perform the project (e.g., infrastructure). Most of the activities and sub-processes in the BPMN model were of no use when aiming at the e^3value model; they were defined in operational terms and not in terms of value adding potential. In an e^3value model, we are only interested in activities that can add value and are profitable. The value activity 'execute project' by the GI was originated after the 'income repass' from the Research Finance Support Agency. Further investigation should be made in order to clarify if the activities in the BPMN model always precede a value activity in the e^3value model.

The OR AND dependency element in the e^3value model represents that not all cash flow that enters the Research Partner (through the selling of its products) is expended on 'research'. Although this may seem simplistic, it maintains the value interface principle and was not shown by the BPMN model.

The e^3value model can be summarized by means an example, e.g., an Energy Provider company that wants to discover new ways to find clean energy. The GI proposes a solution in the form of a project to which the Energy Provider agrees. However, to repass any monetary amount to the GI in order to accomplish the project, the Energy provider needs to send the money to one or some Research Finance Support Agencies (market) so that it can execute the value financially and return what the GI needs (e.g., technology, infrastructure, devices) to accomplish the consumer's (Energy provider) need.

3.4 Treatment Evaluation: Observations extracted from the case

We now review our a-priory defined hypotheses based on the execution of the treatment: the design of the e^3value model by using a BPMN model as input.

L1 *Pools and lanes are candidates for actor and market segment.* Pools can be included as an actor/market with the same name in the e^3value model. Although, distinguishing them between actor or market segment would not be possible without the BPMN model description knowledge, i.e., knowing that the GI's all do this process in the same way. We learned that the relation between pools to actor/market is not a one-to-one relation. Although this is a matter of interpretation, we could argue that this model is made from the viewpoint of the GI and the GI should map onto an actor and not a market segment. However, as in Brazil GI's are not entitled to receive direct funding of customers, the construction in the BPMN model and e^3value model is often used by other universities, hence the GI is a market segment. There was also an actor/market that did not appear in the BPMN model as a pool/lane. The Research Partner's *Customers* were not part of the BPMN model but were essential to maintain the balance in cash flow of the Research Partner. Unfortunately, we were unable to associate the element lanes in BPMN models to any other element in the e^3value model. This might be because they usually allocate *where* a series of activities should be place in the BPMN model, representing a role (e.g., departments); which has no direct related construct in the e^3value model. In some cases, a lane may relate to a value activity, as this can be interpreted as a value-adding role.

L2 *Message flows may correspond to value transfers.* We used the flows of information related to deliver something of importance, flows which change the course of the process drastically, for candidate value transfers in the e^3value model. To accomplish this, the events from the BPMN model transformed into value objects in the e^3value model, and served as a compass to define the exchange of ownership from one actor to another. However, sometimes due to the lack of information on the other actors of the BPMN model, the message flows were connected straight to the pool element, indicating that something went in (e.g., information input), but not necessarily added value. In these cases, since we did not know what exactly was exchanged, we disregarded them when designing the e^3value model. The value transfers occurred between the Research Partner and their Customers were not derived directly based on the constructs in the BPMN model, but through our

interpretation. The relation between these two constructs was confirmed as not a one-to-one relation.

L3 *Start, intermediate, and end events may correspond to consumer needs, value objects, and boundary elements, respectively.* Events were more constant when trying to design from one model to the other. Although changing the names was not very reliable, small changes were made (e.g., 'monthly income' to 'money'). However, it was interesting to see that each event was a mark of a value tree (or value chain), but only those with message flows attached were transferred to the e^3*value* model. Not all start and end events corresponded to a consumer need and a boundary element in the e^3*value* model. This was because there were some of these elements that were only inputs and outputs to control the information flow, and not necessarily added relevance in the model. We can then conclude that events are not a one-to-one relation when designing an e^3*value* model based on a BPMN model.

L4 *Tasks/Activities and sub-processes may correspond to value activities.* We were able to translate one value activity from the various activity elements in the BPMN model, the process activity 'execute project' was used. To get to this value activity we looked inside the most important phase described in the BPMN model – the execution. We observed that most of the (sub-)activities from the BPMN model were of no use to the e^3*value* model. However, the BPMN model activity 'execute project' is the first, and only, to receive an input of economic value – 'income repass'; and from there, the process becomes economically viable.

L5 *Gateways may correspond to dependency elements value interfaces, and value ports.* This hypothesis was not confirmed during the case application. We were unable to empirically find the link between these constructs. Although gateway elements were present in the BPMN model, none of them translated to AND/OR dependencies of the e^3*value* model. A possible reason would be the lack of frequent gateway elements (or gateway types) in the BPMN model, which might have compromised further investigation. The second reason would be the lack of detailing in the BPMN modeling. There was insufficient information from the Research Partner to extract the information from the BPMN model.

4 Discussion and Future Work

To gather empirical evidence to support our study, we analyzed the relation between the elements of BPMN models and e^3*value* models in a selected real-world case scenario. We manually analyzed how each element in the BPMN model, addressing the operation of Research Project Contracts, would relate when applied to the e^3*value* model perspective. The goal of our analysis was to study our hypotheses described in Sec. 3.2 and learn from it.

A lot of information about the value that was really being transferred might have been lost. This was an issue when creating the e^3*value* model as the customer is not detailed in the BPMN model at all. (only the GI's perspective was

considered). Our results indicate that the process modeling perspective affects the design transition in general. It is known that BPMN provides many ways to model a process (although there are best practices [11]). In our case, the modeler assumed the customer (Research Partner) as a 'white box' (i.e., only the trade of information is showed), which led us to not find, for example, the 'Customers' market segment in the e^3value model.

This work is in its early stages, and our current hypotheses findings are based on a single real-world case scenario. Hence, this research cannot be a basis for generalization. This was also not the goal of this research; the goal was exploration mainly. We need to refine and validate our hypotheses by doing more real-world case studies. Furthermore, our results refer exclusively to the investigated modeling notations: BPMN 2.0 and e^3value .

We glimpse some future steps for our research. First, we can try to relate how each process activity may cooperate to the earnings of a company when designing from a BPMN model to the value activity in the e^3value model. This would allow us to perceive the benefits of having the value perspective even when modeling in an operational level. Second, our approach can help track the value constellation of business processes and their contribution to stakeholders goals. If we can apply this approach more often and from a broader research perspective, we can also derive patterns from it. Finally, our plan is to come up with a method to support the co-creation of BPMN and e^3value models.

5 Conclusion

We presented results of an empirical study to explore the design of an e^3value model based on a BPMN model, focusing on the conceptual similarities of the constructs between both models. We hypothesized how the elements of these models would relate when designing one from the other. The design constructs were elicited by conducting a qualitative analysis of the hypotheses and using a real-world case scenario to evaluate them. Finally, we discussed the outcomes of the evaluation through lessons learned from the application in a real case.

Our results show that the design of a value model can benefit from an earlier defined process model. However, further investigation is needed in order to ascertain the accuracy of the design.

References

1. Bodenstaff, L.: Managing Dependency Relations in Inter-Organizational Models. Ph.D. thesis, University of Twente (2010)
2. Dumas, M., Rosa, M.L., Mendling, J., Reijers, H.A.: Fundamentals of Business Process Management. Springer, 2nd edn. (2018)
3. Gemino, A., Wand, Y.: Complexity and clarity in conceptual modeling: Comparison of mandatory and optional properties. Data Knowl. Eng. **55**(3), 301–326 (2005)
4. Gordijn, J., Akkermans, H.: Value Webs – Understanding e-Business Innovation. The Value Engineers (2018)

5. Gordijn, J., Akkermans, H., van Vliet, H.: Business modelling is not process modelling. In: Int'l Works. on Concep. Modeli. Approac. for E-Busin. pp. 40–51 (2000)
6. Hines, P., Rich, N.: The seven value stream mapping tools. Int'l J. of Operations & Production Management **17**(1), 46–64 (1997)
7. Hofreiter, B., Huemer, C., Liegl, P., Schuster, R., Zapletal, M.: UN/CEFACT'S modeling methodology (UMM): A UML profile for B2B e-commerce. In: 2nd Int'l Works. on Best Practices of UML. pp. 19–31 (2006)
8. Hotie, F., Gordijn, J.: Value-based process model design. Bus. Inf. Syst. Eng. **61**(2), 163–180 (2019)
9. Kopp, O., Binz, T., Breitenbücher, U., Leymann, F.: BPMN4TOSCA: A domain-specific language to model management plans for composite applications. In: 4th Int'l Works. on Business Process Model and Notation. pp. 38–52 (2012)
10. Kotler, P.: Marketing Management: Analysis, Planning, Implementation and Control. Prentice Hall, Englewood Cliffs, NJ (1988)
11. Mansar, S.L., Reijers, H.A.: Best practices in business process redesign: Validation of a redesign framework. Comput. Ind. **56**(5), 457–471 (2005)
12. McCarthy, W.E.: The REA accounting model: A generalized framework for accounting systems in a shared data environment. The Accounting Review **58**(3), 554–578 (1982)
13. Moore, J.F.: The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. Harper (1996)
14. zur Muehlen, M., Recker, J.: How much language is enough? Theoretical and practical use of the business process modeling notation. In: Jr., J.A.B., Krogstie, J., Pastor, O., Pernici, B., Rolland, C., Sølvberg, A. (eds.) Seminal Contributions to Information Systems Engineering, 25years of CAiSE, pp. 429–443. Springer (2013)
15. Normann, R., Ramírez, R.: Designing Interactive Strategy – From Value Chain to Value Constellation. Wiley (1994)
16. OMG: Business process model and notation, version 2.0 (2011), https://www.omg.org/spec/BPMN/2.0, Object Management Group (OMG)
17. Pijpers, V., Gordijn, J.: Bridging business value models and business process models in aviation value webs via possession rights. In: 20th Annual Hawaii Int'l Conf. on System Sciences (2007)
18. Recker, J.: Scientific Research in Information Systems – A Beginner's Guide. Springer (2013)
19. Recker, J.: Theorizing the use of multiple conceptual models in combination. In: 25th Australasian Conf. on Information Systems. pp. 1–10 (2014)
20. Schuster, R.: Requirements Management for B2B Processes: a Worksheet Driven Approach from e3-Value and REA to UMM. Ph.D. thesis, Vienna University of Technology (2010)
21. Schuster, R., Motal, T.: From e3-value to rea: Modeling multi-party e-business collaborations. In: IEEE Conf. on Comme. and Enterpr. Compu. pp. 202–208 (2009)
22. Weigand, H., Johannesson, P., Andersson, B., Bergholtz, M., Edirisuriya, A., Ilayperuma, T.: On the notion of value object. In: 18th Int'l Conf. on Advanced Information Systems Engineering. pp. 321–335 (2006)
23. Wieringa, R.J., Morali, A.: Technical action research as a validation method in information systems design science. In: 7th Int'l Conf. on Design Science Research in Information Systems. pp. 220–238 (2012)
24. Zlatev, Z.V.: Goal-Oriented Design of Value and Process Models from Patterns. Ph.D. thesis, University of Twente (2007)