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Remco Dijkman, Irene Vanderfeesten, Hajo A. Reijers

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Remco Dijkman, Irene Vanderfeesten, Hajo A. Reijers

Eindhoven University of Technology, The Netherlands
{r.m.dijkman, i.t.p.vanderfeesten, h.a.reijers}@tue.nl

Abstract. With the uptake of business process modeling in practice, the demand grows for guidelines that lead organizations to consistent and integrated collections of process models. The notion of a *business process architecture* has been explicitly proposed to address this issue. This paper provides an overview and comparison of the prevailing approaches to design such a business process architecture. Furthermore, it includes an evaluation of the usability and actual use of the identified approaches through our interaction with a large group of practitioners. Our findings suggest that practitioners heavily rely on a mix of guidelines instead of embracing any single approach wholeheartedly.

1 Introduction

When an organization seriously engages in modeling its business processes, inevitably questions arise. Which processes exist in my organization? Where does one process end and another begin? At what level of detail should I model my processes? Several authors have proposed the notion of a *business process architecture* to address such concerns [1–5]. Such an organized overview of the processes that exist within an organizational context along with the guidelines on how they should be organized is what can help individual modelers to arrive at a consistent and integrated collection of process models. However, the introduction of this concept clearly begs the question of *how* a business process architecture in any given situation should be established.

Given the availability of a variety of views on how to design a business process architecture, we identify a lack of understanding of the differences between these views and uncertainty among business users to make the right choices here. Yet, it has been recognized that not any business process architecture is equally effective. In a recent blog post, for example, Derek Miers notes how some process architectures may actually impede on the process-centered line of thinking that was behind the initiative to model process in the first place[1].

This paper aims to fill the identified gap by investigating which approaches and guidelines to business process architecture design exist and which of these are considered most useful in practice. More precisely, the paper offers the following contributions:

[1] See `http://bit.ly/fBnfzI`, last checked on February 28, 2011

1. An overview of the design approaches and guidelines that can be used to design a business process architecture; and
2. A comparison of the use and usefulness of these design approaches in practice.

As can be noted, the former contribution is of a conceptual nature, while the latter is empirical. Both serve the purpose of simplifying the design of a business process architecture in real-life situations. After all, if business users better understand the differences between the existing approaches they will be able to make a better choice of what approach to follow; the uptake of approaches in practice may be further used to support such a decision.

The overview of the design approaches is based on a structured review of the existing literature. The use and usefulness of the different design approaches in practice has been investigated in a workshop session with 39 practitioners who are active in the area of Business Process Management. During this session we presented the approaches, conducted a survey, and asked the practitioners about their experiences with the various approaches.

The remainder of this paper is structured as follows. Section 2 presents a precise description of what a business process architecture is. Section 3 presents and compares the approaches to designing a business process architecture, as identified through our literature study. Section 4 presents the evaluation of the use and usefulness of the approaches. Finally, Section 5 presents the related work and Section 6 the conclusions of this paper.

2 Business Process Architecture

We define a business process architecture as an organized overview of business processes with their relations and guidelines that determine how they must be organized. Having a business process architecture in place, the business processes themselves can then be modeled in a different stage of the Business Process Management life cycle.

Figure 1 shows an example of a business process architecture in the ArchiMate notation [6]. The figure shows a collection of business processes, represented by the rounded rectangles with the arrow icon, as well as different relations that can exist between these business processes.

There is no consensus about all the possible relations that can exist between business processes. However, the following types of relations are frequently used throughout the literature. The *decomposition relation* expresses that a process is decomposed into multiple subprocesses. In Figure 1 this relation is represented by the graphical containment of subprocesses within the parent process. The *specialization relation* expresses that one process is a specialized version of another. In Figure 1, this relation is represented by an arrow with an open arrowhead. The *trigger relation* expresses that the execution of one process can trigger the execution of another. In Figure 1, this relation is represented by an arrow with a filled arrowhead. The *use relation* expresses that one process provides services

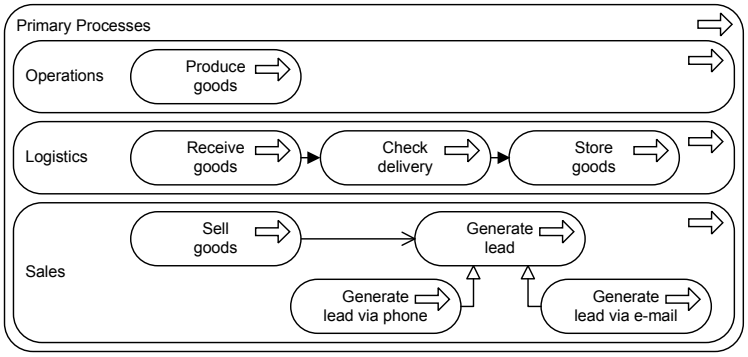

Fig. 1. Example Business Process Architecture

that are used by another. In Figure 1, this relation is represented by an regular arrow.

A business process architecture can be enriched by 'containers', such as layers or columns, along with guidelines for which processes can be contained in a particular container. For example, a distinction can be made between containers for primary and support processes [7], where the container for primary processes can only contain processes that directly add value for the client and the container for support processes can only contain processes that do not directly add value, but are necessary for the effective operation of the primary processes. As another example, Joosten [3] defines three levels of abstraction at which processes can be defined.

3 Business Process Architecture Design Approaches

There are a number of approaches to design a business process architecture. This section presents a classification of the different approaches that we identified through a literature study.

The literature study was performed using the keywords 'business process architecture' and combinations of the words 'business process' and 'identification', 'delimitation' or 'demarcation'. 'Google Scholar' was used initially as a source. For each approach that was found, references and citations were used to further identify approaches. As a result 45 approaches were identified. Of these approaches 30 originated from a survey [8] specifically aimed at the topic of using reference models to design a business process architecture. We validated the completeness of our results by using additional sources, in particular: 'Scopus', 'Web of Science', 'Inspec', 'ABI/Inform', 'IEEE Electronic Library', 'ACM Digital Library' and 'Springer' (in that order). 'Scopus' and 'Inspec' both returned one additional approach, but after that no additional approaches were found. Reference and citation analysis of the two additional approaches returned one more approach, leading to a total of 48 approaches to design a business process architecture.

The approaches that were identified in this manner, were subsequently classified by answering the question: 'On what basis are processes and their relations

identified according to this approach?' This led to five classes of approaches: goal-based, action-based, object-based, reference model based, and function-based. Table 1 shows this classification. In each approach (or class of approaches), a business process architecture is designed by first designing another structure, e.g. a goal structure. Such a structure should be designed in terms of the concepts and the relations prescribed by the respective approach. A business process architecture is subsequently designed based on that structure.

In the remainder of this section we discuss each of the five classes of approaches in more detail.

Note that the approaches are not necessarily mutually exclusive. For example, a reference model based approach can group business processes according to the business functions that they implement. Thus, it essentially combines a reference model based and a function-based approach. One approach in particular proposes a combination of different structures as a starting point for identifying business processes, see [9].

Table 1. Classification of Business Process Architecture Design Approaches

approach	**structure**	**organizing concept**	**concept relations**
goal-based	goal structure	goal (various subtypes)	various associations, including: - realization (inclusive, exclusive) - influence
action-based	action structure	action loop (various subtypes)	various associations, including: - decomposition - triggering - phasing - generalization
object-based	object model	business object (various subtypes, including: - permanent object - case object)	various associations, including: - decomposition - state transition - generalization
reference model based	classification	class (various subtypes, including: - business function - industry segment)	decomposition generalization
function-based	function hierarchy	function	decomposition

3.1 Goal-based

In goal-based approaches [10–15] a goal structure, consisting of business goals and relations between those goals, is designed first. Subsequently, a business process architecture is derived from it, based on the definition of a business

process as a collection of related activities to achieve a certain *goal*. Figure 2 shows an example of a goal structure and a business process architecture that is derived from it. The benefit of using the goal-based approach is that associating goals with processes also helps to determine *why* certain processes are important or at all needed.

The main organizing concept in goal-based approaches is the 'goal', but different approaches distinguish different types of goals. Antón, McCracken and Potts [10] provide an extensive discussion of different types of goals that can be identified. Subsequently, they show that focusing on different types of goals leads to a different goal structure and, therefore, potentially to a different business process architecture. In addition, different types of goals may be translated differently into processes when a business process architecture is constructed [14].

Different goal-based approaches also distinguish different types of relations between goals. Four of the approaches within this class consider a *realization* relation between goals, which expresses that a (higher level) goal can be achieved by achieving the (lower level) realization goals being related to it [10–13]. Kavakli and Loucopoulos [13] also distinguish the *influence* relation between goals, which expresses that one goal influences another goal. Lee [12] allows the modeler to freely define the types of relations that can be considered within a goal structure.

Goal-based approaches differ significantly in the way in which a process architecture relates to the goal structure. Lee [12] defines a relatively strict relation between goals and sub-goals and processes and subprocesses, stating that if goals are related, the processes that help realize those goals must also be related. Koubarakis and Plexousakis [11] and Kavakli and Loucopoulos [13] state that goals can be used to identify processes, but do not make statements about how relations between goals influence relations between processes. Antón, McCracken and Potts [10] and Yu and Mylopoulos [14] relate processes only indirectly to goals (i.e. via other concepts).

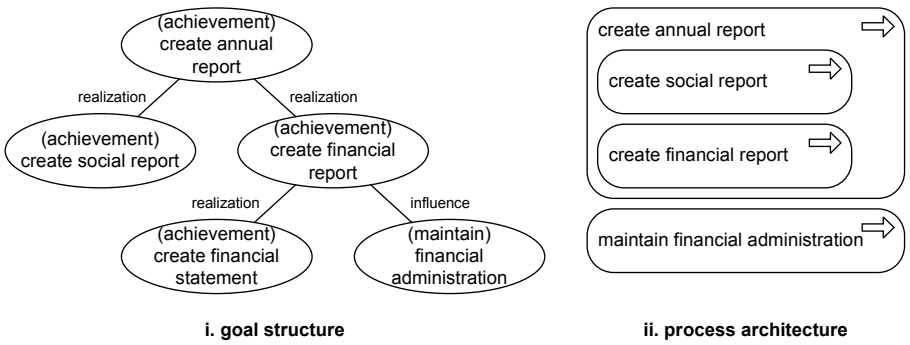

Fig. 2. Example of Goal-based Design of Process Architecture

3.2 Action-based

In action-based approaches [16–21] an action structure, consisting of business actions and their relations, is designed first. A business action is a loop of activity in which a provider completes some work for an internal or external customer.

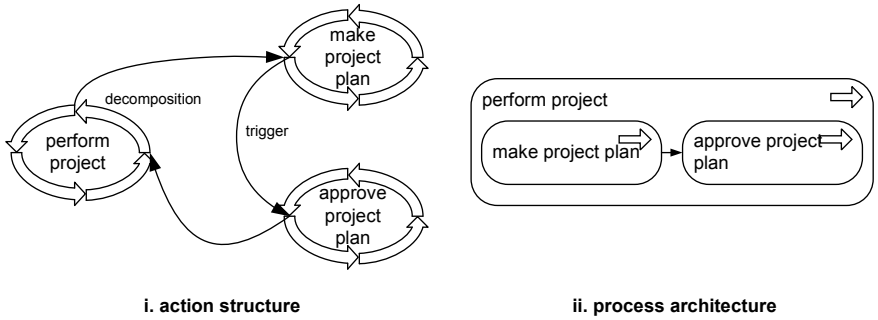

Fig. 3. Example of Action-based Design of Process Architecture

Thus, by definition, it is very similar to a business process. The main difference between a business process and a business action lies therein that business action theory assumes that all human action, and therefore also business action, follows certain standard patterns and phases. This makes business action theory particularly suitable for identifying processes, delimiting those processes (i.e.: determining where one process stops and the other starts) and dividing a process into subprocesses and/or variants [17, 18]; the patterns and phases help determine which (sub-)processes should exist according to a pattern and where a (sub-)process ends and another begins, because of a transition from one phase to another. Once an action structure is designed, a business process architecture can be derived from it, using the strong similarity between business processes and business actions. Figure 3 shows an example of action structure and a business process architecture that is derived from it.

The main organizing concept in action-based approaches is the 'action' and different approaches distinguish different types of actions. Nonetheless, all action-based approaches use the idea that each action goes through a number of phases. However, the exact number and definition of these phases differ per approach.

Different action-based approaches distinguish different types of relations between actions. All of the action-based approaches that we studied have a decomposition, a triggering and a phasing relation. A decomposition relation between actions represents that an action can be decomposed into multiple more detailed actions. A triggering relation represents that the completion of one actions triggers the start of another. A phasing relation represents that one phase of an action is completed and that the next phase starts. Lind and Goldkuhl [17, 18] also discuss a generalization relation, in which actions such as 'apply for car insurance' and 'apply for home insurance' can be generalized into a more general action 'apply for insurance'.

Action-based approaches differ significantly in the way in which a process architecture relates to the action structure. First, the approaches differ with respect to how they perceive the role of the business process concept. Most approaches use the action-based approach *instead* of business processes [16, 19–21]. Only one of the approaches discusses the relation between business processes and actions [17, 18]. Second, the approaches differ with respect to the scope of the action structure that is designed. Where a business process architecture

focuses on structuring all business processes within a certain scope, the scope of an action structure can vary. Case studies are performed for high-level business functions, such as purchasing [19], or workflow processes, such as hiring new personnel [16].

3.3 Object-based

In object-based approaches [22, 1] a business object model is designed first, for example in the form of a UML class diagram. Subsequently, a business process architecture is designed by studying the business objects that exist in the organization, as well as their inter-relations. Figure 4 shows an example of an object model and a business process architecture that is derived from it.

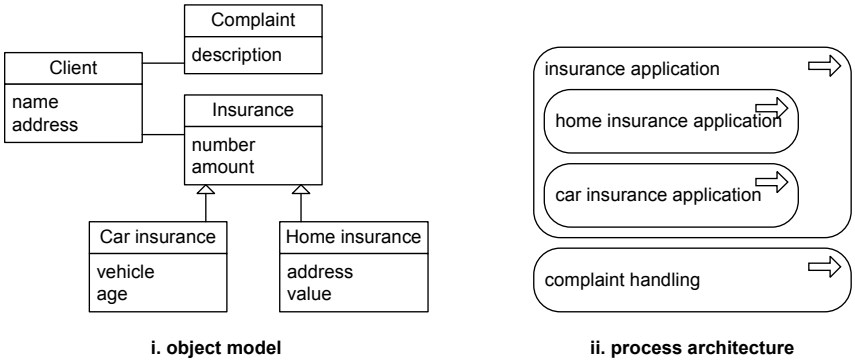

Fig. 4. Example of Object-based Design of Process Architecture

The main organizing concept in object-based approaches is the 'business object' and both identified approaches consider three types of business objects: 'permanent objects', 'case objects' and 'other objects'. *Permanent objects* are business objects that have a relatively long life cycle in the organization, such as the 'client' in most organizations. Processes can be identified from permanent objects by determining what can happen to these objects and defining processes to support these actions. For example, a new client can arrive or buy something, thus leading to the need for a process to register new clients and a sales process. *Case objects* are objects that guide the execution of a business process and thus directly identify a business process. An example of a case object is an 'order' or an 'application'.

Object modeling is a discipline in itself and the many object modeling techniques that exist distinguish many different types of relations between business objects. Some of these relations are of particular interest in the context of designing a process architecture. The relation between permanent objects and case objects can be used to identify a logical group of processes. A relation between states of one or more business objects can be used to delimit or relate business processes. For example, a state-change of an object from 'ordered' to'shipped' can be used to delimit and relate the 'order' and 'shipping' processes. A decomposition relation between objects can be used to identify a decomposition

relation between business processes. For example, the decomposition of a 'mortgage application' into 'client details', 'mortgage details' and 'securities' can lead to different subprocesses in the mortgage application process. Finally, a generalization relation can be used to identify a logical group of processes. For example, a generalization relation between 'apply for car insurance', 'apply for home insurance' and 'apply for insurance' can be used to identify a logical group of insurance application processes.

3.4 Reference Model Based

In reference model based approaches, an existing business process architecture (the reference model) is re-used and adapted to design a new business process architecture. Figure 5 shows an example. The benefit of this approach is that much time can be saved by starting from an existing model. Also, the reference model is meant to present best practices and may thus lead to better designs.

There exist a large number of business process reference models. Fettke, Loos and Zwicker [8] published a survey that covers 30 of these. However, the focus of these reference models is on presenting a collection of business process models, not on the business process architecture that structures the collection itself. In most cases, the business process architecture is a by-product of the reference model, although in some it is considered and published separately [23–25]. In the context of business process reference models, the business process architecture is commonly referred to as a business process (architecture) framework [4] and takes the form of a classification. What distinguishes the classifications are the concepts that are used for classification, the relations between elements in the classification, and the specification of abstraction levels in the specification.

Fettke, Loos and Zwicker [8] found that the two most-used concepts to classify business processes in a business process architecture are *business function* and *industry segment*. In addition to that, a classification can be done based on a predefined classification that is based on consensus rather than a single concept. APQC's Process Classification Framework defines such a classification [23]. The most prominent relations between business processes in reference models are those of generalization and decomposition [25], which are have been explained in Section 2.

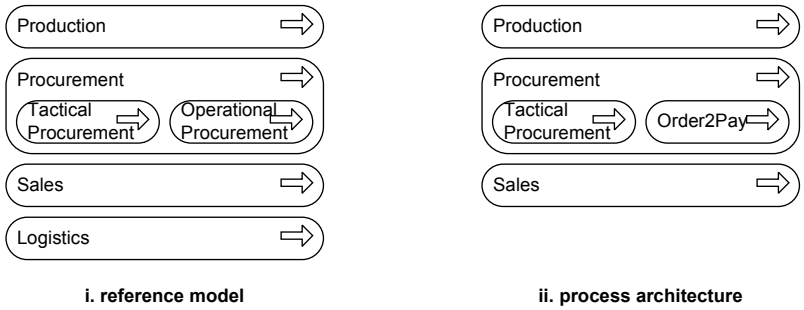

Fig. 5. Example of Reference Model Based Design of Process Architecture

3.5 Function-based

In a function-based approach a function hierarchy is designed, which represents the decomposition of business functions into more detailed business functions. Thus, the main organizing concept in the function-based approach is the 'business function', which is defined as a capability of an organization, such as 'production' or'procurement'. This relation that is considered is always a decomposition relation. A business process architecture can be subsequently structured according to the function hierarchy. Figure 6 shows an example of a function hierarchy and a business process architecture that is derived from it. The benefit of using business functions to identify processes is that, compared to business processes, business functions are relatively simple to identify and stable, because they focus on *what* an organization does rather than *how* the organization accomplishes that. Consequently, they arguably form a good starting point for designing a business process architecture.

The duality of business processes and functions is well known and frequently used in business process modeling frameworks [24, 26, 5, 27]. There are roughly two ways in which a function hierarchy can be related to a business process architecture. Firstly, the function hierarchy can be the primary way of organizing the business processes. In that case, functions are decomposed into more detailed functions until a chosen level of decomposition is reached from which the functions are further decomposed into processes [24, 27]. In this case, business processes are organized according to the functions to which they belong. Secondly, functions and processes can both be organized into hierarchical structures through decomposition relations, which should be closely aligned [26, 5].

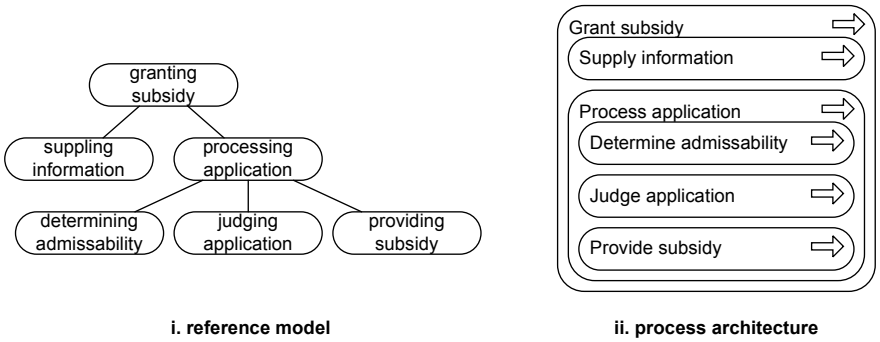

Fig. 6. Example of Function-based Design of Process Architecture

4 Evaluation of Business Process Architecture Approaches

As has been hypothesized and empirically proven, the intention to use an IT artifact is mainly a function of two pervasive beliefs: perceived ease of use and perceived usefulness [28]. This is the reason that, for our evaluation of the business process architecture design approaches that have been described int the previous section, we centered on these notions. We extended this view by also

acquiring the perception of respondents on the popularity of these approaches in practice. In this section, first the evaluation setup is presented, followed by a discussion of the results.

4.1 Setup

The evaluation of the five main classes of approaches was done among a group of 39 Dutch practitioners who are all active in the area of Business Process Management, for example as a dedicated architect within a company or as a consultant advising on this topic. The participants were personally invited to attend a session organized at Eindhoven University of Technology to discuss the topic of business process architectures. All participants were part of the business network of the authors of this paper. The evaluation consisted of three parts. The first part focused on the ease of use, usefulness, and popularity of the approaches in general, while the second part aimed to investigate the usefulness of specific guidelines, as they exist as part of an overall approach. A discussion of the results completed the session, which overall lasted for two hours.

During the first part of the evaluation the participants received a brief explanation and some examples for each type of approaches, similar to the explanations given in the previous section. After each explanation of an approach, the participants were asked to give their opinion on the following three statements: (i) this approach is easy to apply, (ii) this approach is useful to design a business process architecture, and (iii) this approach is popular in practice. We used a electronic voting system to record the scores 'agree', 'neutral , 'disagree', or 'don't know' on each of the statements. In total, 15 evaluation scores were stored per participant (5 classes of approaches times 3 questions).

In the second part of the evaluation, the participants were presented 18 specific guidelines as taken from the literature (see Table 2). For each of these guidelines, the participants were asked to give their opinion on the hypothesis that the guideline is *useful* for designing process architectures, by indicating whether they would agree, be neutral, would disagree, or did not know. Each of the five identified classes of approaches was represented by three guidelines, e.g. guidelines 5, 13, and 17 were taken from goal-based approaches. In addition, we added three guidelines that could not be classified under one of the five main classes of approaches. The participants were neither told which guideline belonged to which of the presented approaches, nor were they aware of the fact that there were three additional, unclassified guidelines.

4.2 Results

The results for the first part of the evaluation can be found in Table 3. It can be derived from this table that the reference model based approach is considered the most easy to use, useful and popular; 67% of the participants agreed with the statement that the approach is easy to use, 62% with the statement that the approach is useful, and 56% with the statement that the approach is popular in practice. In a similar way, it can be seen that the goal- and action-based

Table 2. List of specific guidelines

number	guideline
1	Identify logical units within a process (unit of time, place, resource,...), determine which of these logical units form a sub process.
2	Identify 'consists of' relations between documents, derive from that 'consists of' relations between business processes.
3	Use a reference model to describe processes completely.
4	Identify the start and end of a process by identifying the start and end of the corresponding transaction.
5	Identify the business goals, then identify the business processes that accomplish these business goals.
6	Each process belongs to at most one business function.
7	Identify the documents and files that exist in an organization, then identify the processes that describe what is happening to these documents.
8	Identify 'executed within' relations between transactions, derive 'executed within' relations between business processes from that.
9	Identify the value that is created for clients, then identify the processes that describe how this value is created.
10	Identify the business functions, then identify the processes that are executed within these business functions.
11	Identify transactions (which are executed by a provider for satisfaction of a consumer), then identify the business processes that accomplish these transactions.
12	Use a reference model to identify processes.
13	Identify 'consists of' relations between business goals, derive 'consists of' relations between business process from that.
14	Identify artifacts that flow through an organization, then identify the processes that belong to these flowing artifacts.
15	Graphical properties and relations between processes in a process architecture model have to have a clear meaning.
16	Identify 'consists of' relations between business functions, derive 'consists of' relations between business process from that.
17	A business goal has to be achieved by a business process, or should consist of sub goals that are achieved by a business process.
18	Use a reference model to identify relations between processes.

approaches are considered the least easy to use, useful and popular approaches (highest percentage of participants who *dis*agreed with these statements).

The second evaluation focused on the usefulness of specific guidelines as taken from the literature. Table 4 summarizes the results and shows some surprising outcomes. First, the guidelines that are identified as being the most useful are guidelines 9 (89% of the participants find it useful) and 15 (84%). Both are guidelines that cannot be classified within one of the approaches. Apparently, separate rules of thumb exist that are not part of a bigger approach to design a business process architecture, but are nonetheless considered highly useful when designing and defining business processes. Second, the guidelines that have been evaluated as the least useful (highest percentage of participants that disagree) are

Table 3. Overview of Business Process Architecture approaches. Each statement is scored on whether the participants agree with it (A), are neutral (N), disagree (D), or don't know (?).

approach	**ease of use**				**usefulness**				**popularity**			
	A	N	D	?	A	N	D	?	A	N	D	?
goal-based	30%	43%	22%	5%	39%	25%	28%	8%	6%	19%	33%	42%
action-based	41%	24%	32%	3%	42%	26%	21%	11%	19%	5%	35%	41%
object-based	37%	29%	29%	5%	57%	24%	19%	0%	29%	18%	18%	34%
reference model based	**67%**	21%	8%	5%	**62%**	16%	8%	14%	**56%**	13%	10%	21%
function-based	45%	34%	16%	5%	50%	32%	8%	11%	38%	21%	13%	28%

Table 4. Overview of Business Process Architecture Guidelines. Each guideline is scored on usefulness by asking the participants whether they agree (A), are neutral (N), disagree (D), or don't know (?)

guideline	**approach**	**source**	**usefulness**			
			A	N	D	?
1	not classified	[6]	51%	14%	24%	11%
2	object-based	[22]	36%	23%	31%	10%
3	reference model based	[8]	29%	26%	**39%**	5%
4	transaction-based	[18, 17]	51%	16%	22%	11%
5	goal-based	[11, 12, 14]	63%	26%	11%	0%
6	function-based	[24, 27]	0%	3%	**95%**	3%
7	object-based	[22]	38%	26%	33%	3%
8	transaction-based	[18, 17]	11%	26%	24%	39%
9	not classified	[6]	**89%**	6%	3%	3%
10	function-based	[24, 27, 5, 26]	47%	32%	18%	3%
11	transaction-based	[18, 17]	44%	31%	15%	10%
12	reference model based	[8, 4]	69%	21%	10%	0%
13	goal-based	[12]	26%	32%	24%	18%
14	object-based	[22, 1]	68%	16%	16%	0%
15	not classified	[6]	**84%**	3%	3%	11%
16	function-based	[5, 26]	26%	33%	18%	23%
17	goal-based	[12]	59%	24%	14%	3%
18	reference model based	[8, 4]	32%	24%	**37%**	8%

guidelines 3, 6 and 18. Two of them are from the reference model based category and the other one is from a function-based approach. This is remarkable, since actually the reference model based approaches were classified most often as useful in the first part of the evaluation (67%, see Table 3). Third, one guideline (6) was found useful by none of the participants, while all other guidelines found at least some support. Finally, guidelines taken from the same approach are not perceived as equally useful, e.g. guidelines 6, 10, and 16 are expressed to be useful by 0%, 47%, and 26% of the participants respectively.

After the evaluation with the voting system, the resulting patterns were discussed with the participants. In this discussion it became very apparent that

companies often do not use one of the identified approaches fully or even exclusively. Rather, a mixture of ideas from different approaches are applied. For example, one participant explained that the approach followed within his institute was to first follow a functional decomposition of processes, followed by an approach to identify the most important objects. The attractiveness of a hybrid approach may explain at least to some extent how it is possible that individual guidelines can be evaluated differently from their encompassing approach. It was also interesting that despite the broad appreciation of the reference model based approach, its usefulness was further qualified by several participants. One of them remarked: "Reference process models certainly provide a tangible starting point, but it should not be underestimated how much time must be spent on appropriating them to a specific setting. It's terrible!". Also, since we established the relative poor evaluation of the goal-based approach, a participant noted that this score is caused by the fact that "management becomes very quiet when asked for the actual goals that need to be fulfilled". This points to a practical barrier of linking goals to process models, as proposed by this class of approaches. From the approaches that were holding the middle ground between the most popular and the least popular approaches, the approach that attracted most discussion was the object-based approach. In particular, the "explosion of objects" was considered troublesome and affecting its ease of use negatively.

In conclusion of the discussion, we invited the participants to identify approaches that were not covered by the five main classes of approaches that were the subject of the session. The most important addition here may be coined as the *service oriented approach*. Based on the identification of important business services an organization provides, the main processes and their relations can be established as well. Business services were in particular mentioned as being more concrete than goals by some participants, even though the approach could also be seen as subsumed by the object-based approach according to others.

From the above observations and the results of the evaluation, we conclude that the reference model approach is considered most useful, easy to use, and popular; the goal-based and action-based approaches score lowest. However, none of the evaluated approaches to business process architecture is considered by practitioners as the perfect or even a dominant solution to structuring the process landscape in a company. Rather, the hybrid combination of guidelines seems to best represent the state-of-the-art. While such a position may have its appeal, it also points at a lack of any approach to satisfactorily deal with the demands of practitioners to define business process architectures.

5 Related Work

In comparison with the way we ordered the various approaches for business process architecture design, three different classifications exist. Two of these focus on a subset of the approaches that we consider, namely the reference model based approaches [8, 4]. Therefore, thus have a scope that differs from the one in our paper. In particular, our work covers an additional 18 approaches and provides

an empirical evaluation of the use and usefulness of all these approaches. The third classification [2] focuses on presenting the classification itself, according to which it discusses 4 approaches. The classification looks broadly at the area of business process architecture, presenting a plethora of aspects to classify them. Our paper looks specifically at means to design a business process architecture (an aspect that is also covered in [2]) and provides a more detailed discussion of that aspect. In addition, our paper provides an empirical evaluation of the use and usefulness of the approaches and covers a larger set of approaches.

Also related to designing a business process architecture is the work on enterprise architecture design approaches, and enterprise modeling languages. We will review these two streams shortly.

An enterprise architecture design approach addresses the design and subsequent use of an enterprise architecture, which is a description of the components of the enterprise and their interrelationships. Such components include at least organizational and IT aspects. Depending on the approach that is used, business processes may be included. For example, TOGAF [29], Zachman [30] and DYA [31] consider business processes as part of an enterprise architecture. Although, an enterprise architecture approach's ability to address the relation between a business process and other components of enterprise architecture (such as business goals or functions) would help to design a business process architecture, enterprise architecture approaches do not primarily aim to assist in the design of a business process architecture.

Enterprise modeling languages can be used (possibly in combination with an enterprise architecture approach) to graphically represent an enterprise architecture and, consequently, a business process architecture. The distinction between an enterprise modeling language and an enterprise architecture is not strict. Sometimes enterprise architecture approaches come with an enterprise modeling language (e.g.: ARIS [5]) and sometimes enterprise architecture approaches are closely related to an enterprise modeling language (e.g.: TOGAF [29] is closely related to ArchiMate [6]). We use the distinction here to talk about enterprise architecture design approaches and graphical means to represent the results. An enterprise modeling language can be used to represent business processes, their relations, and their relations to other concepts. Consequently they can help with, but are not primarily focused on, the design of a business process architecture.

6 Conclusions

In this paper, we have given an overview of the current approaches to design a business process architecture. We have identified five different classes of approaches from the literature: (i) goal-based; (ii) action-based; (iii) object-based; (iv) reference model based; and (v) function-based approaches. We evaluated their ease of use, usefulness, and popularity with a group of Dutch BPM practitioners. From this evaluation we gained some surprising insights. First, we were not able to identify one dominantly attractive approach. From the first part of the evaluation, the reference model based approach stood out as the most easy

to use, useful and popular approach, while in the second part of the evaluation other guidelines inspired by other approaches were selected as most useful. Second, from the discussion with the practitioners we learned that companies most of the time do not use one specific approach, but instead a mixture of different approaches and guidelines that seem useful to them.

Our findings should be seen against a number of limitations. While the coverage of the different types of approaches through our classification can be considered as comprehensive, this is certainly not the case for the empirical evaluation of these approaches. Our choice to restrict ourselves to the setting of Dutch practitioners limits the generalizability of our findings notably, perhaps to the more advanced regions where business process modeling is applied. Secondly, our approach to evaluate the usability and popularity of the various approaches may be considered as high-level, considering the many contextual issues concerned with designing a business process architecture. Considering the difficulty to gain access to highly specialized practitioners in the way we interacted with them, we do believe that the insights gained are valuable and unique.

Taken the noted limitations into account, we identify a clear demand for and interest in approaches to design business process architectures among practitioners. However, no single approach exists that seems to fulfill all practitioners' needs satisfactorily. Rather, they seem to look for appealing design guidelines that can be flexibly combined to suit their needs. For future lines of research, a focus on the lower-level *guidelines* for designing business process architectures – in contrast to all-encompassing approaches – seems to provide a better fit with the level of support that practitioners seek. Consequently, there is a potential for an approach that enables practitioners to combine some of the most popular guidelines that we identified. For example, this can be imagined by enabling end users to (graphically) represent a business process architecture along with related concepts and to have the selected guidelines be enforced or supported automatically.

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