A STUDY INTO THE CLASSIFICATION OF ENTERPRISE ARCHITECTURE BENEFITS

Research full-length paper

Track T00

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Abstract

While many authors have published on the subject, the question about the value of Enterprise Architecture (EA) remains unanswered. Using the four perspectives of the Balanced Scorecard as a starting point, 36 subcategories of organizational goals where benefits of EA could be expected were derived from literature. To validate these subcategories, an online Delphi study has been carried out. With the help of the experts contributing to the study, 24 subcategories of organizational goals are identified where the contribution of EA is assessed in the range from 'moderate' to 'very much'. The contribution allocated to these subcategories is more or less in line with other publications on the subject, with the notable exception of subcategories in the Customer perspective of the Balanced Scorecard. In our study these subcategories were deemed more important than in previous studies.

In the same Delphi study, we tried to differentiate between development-, implementation- and exploitation activities of EA with respect to the contribution of EA to these 24 subcategories, but the results are as yet inconclusive.

Keywords: Enterprise architecture, Enterprise architecture benefits, Benefits classification, Delphi study

1 Introduction

In a period of around thirty years, Enterprise Architecture (EA) has evolved to a means for translating the strategy of an enterprise into execution by providing a holistic view of the interactions between business operations and information technology (Ross, Weil and Robertson, 2006; Tamm et al., 2011; Foorthuis et al., 2016; Franke, Cohen, and Sigholm, 2018). While EA has found its implementation in many organizations (Simon, Fischbach and Schoder, 2013), some 'critical problems' (Kaisler, Armour and Valivullah, 2005) still remain and new challenges have emerged (Kaisler and Armour, 2017). One of Kaisler and Armour's (2017) so-called 'elusive questions' is about the value of EA, which is still uncertain despite many publications on the subject (Shanks et al., 2018). Because no common classification of benefits exists nor an agreed upon set of metrics to measure EA benefits (Niemi and Pekkola, 2016; Kurek, Johnson and Mulder, 2017), it is difficult to compare the results of studies on the subject. Moreover, literature on the costs of EA is scarce and to our knowledge no classification of EA costs has as yet been proposed.

The topic of the value of EA is of theoretical interest as a measurement system based on rigorous definitions of the underlying concepts provides a common language and reference framework for other studies on the value of EA and enables the comparison of results of EA benefit studies. The topic is of practical importance as well as a more precise view of the actual and potential contributions of EA to various types of organizational goals enables a more detailed evaluation of EA activities. As a result, the activities of architects can be better aligned to the organization's strategic choices.

These considerations motivated us to research the value of EA. As a first step, a benefit/cost classification model for EA based on precise definitions of the underlying concepts has been proposed (Plessius et al., 2018). This model, called the Enterprise Architecture Value Framework (EAVF), classifies benefits and costs of EA in terms of organizational goals, using the Balanced Scorecard (Kaplan and Norton, 1992) and architectural activities. However, for practical purposes it needs refinement as the four perspectives of the Balanced Scorecard (BSC) are still too wide-ranging for measurement purposes. In this paper we thereto address the question: *How can a refinement of the four perspectives of the BSC be constructed from literature and validated against the possible contributions of EA?* The refinement is based on a literature study into organizational goals and benefits of EA and validated by an online Delphi study in the first months of 2019 with experts from the Netherlands. The experts have reviewed the various subcategories and assessed the degree to which EA may influence each of them. The outcome of this research is a first step towards a measurement instrument that can give an indication of the added value of architectural activities.

This paper is structured as follows: in the next paragraph a short overview is given of literature related to the value of EA, followed by an overview of the Enterprise Architecture Value Framework in paragraph 3. In paragraph 4, the research methodology chosen is accounted for and in paragraph 5 the results of our research are presented. We end the paper with a discussion of the results and our conclusion, including limitations and planned future research.

2 Theoretical Background

One of the first authors who published on the benefits of EA is Buchanan (2001). Since then, many researchers have published on the benefits of EA from various perspectives. Overviews of these publications can be found in Niemi (2008), Boucharas et al. (2010b,) Tamm et al. (2011), Wan et al. (2013), Jusuf and Kurnia (2017) and Shanks et al. (2018).

Recurring themes in publications on EA benefits are: *improved business-IT alignment, better compliance, better decisions, lower (IT) costs, improved business processes, improved IT systems, better collaboration, increased agility* and *re-use of resources*. However, in most publications, basic concepts like goal and benefit are not defined nor do these publications make clear where the claimed benefits originate (Boucharas et al., 2010a). This limits the empirical as well as the theoretical foundation of their research (Rodrigues and Amaral, 2010; Espinosa, Boh and DeLone, 2011; Lange and Mendling, 2011). There exists no agreed upon set of metrics to value the results of EA (Schelp and Stutz, 2007; Lange and Mendling, 2011; Kurek, Johnson and Mulder, 2017) nor a commonly accepted classification of benefits of EA (Niemi, 2008; Boucharas et al., 2010b; Niemi and Pekkola, 2016). Most authors classify their reported benefits in a way that is directly derived from their results and as such, these classifications are not founded in a theoretical base, making it difficult to compare their results. *"While the literature focuses on listing a multitude of benefits, it does not clearly define and describe them. Furthermore, there does not seem to be an established model for classifying the benefits in the EA context, ..."* (Niemi, 2008, p. 2).

If a classification is derived from existing literature, authors mainly use the IS classification model of Giaglis, Mylonopoulos and Doukidis (1999), the benefit framework for enterprise systems of Shang and Sheddon (2002) or a performance framework like Kaplan and Norton's (1992) Balanced Scorecard (BSC) and its extension, the strategy map (Kaplan and Norton, 2001). Based on a review of five different frameworks for classifying benefits of EA, Boucharas et al. (2010b) conclude that the BSC and its derived forms best fit their requirements, despite the criticism on the BSC as a classification model for organizational goals. Norreklit (2000) for example argues that the focus of the BSC on financial results as the ultimate outcome does no justice to non-profit and public sector enterprises. As a reaction, Kaplan (2008) extends the financial perspective of the BSC with 'accountability to society'. Other critics (Mooraj, Oyon and Hostettler, 1999) emphasize that the BSC does not include categories for the contributions of suppliers and employees to the organization. However, following Norton and Kaplan (1993) a BSC can (and must) reflect the actual organization and if necessary, categories can and may be

subdivided. Effectively this makes the BSC a mold that may be adapted by an organization to stress the goals that are most important to the organization.

A more fundamental criticism on most classifications of benefits of EA is that these are not based on clear definitions of the underlying concepts (Niemi, 2008; Boucharas et al., 2010a; Jusuf and Kurnia, 2017). An exception is the work done by Lange and Mendling (2011), who define EA benefits as the degree to which the goals of an organization are met.

Finally, when discussing value, it is important to realize that value can be seen as the difference between benefits and costs. But while the literature on EA benefits is abundant, discussions on EA costs are very scarce in literature and the main EA frameworks offer no support in estimating and managing costs (Lindstrom et al., 2006).

3   The Enterprise Architecture Value Framework

As stated in the introduction, in an earlier publication (Plessius et al, 2018) we have derived a classification model for benefits and costs of EA based on precise definitions of the value concepts. These definitions, together with their source, are summarized in table 1 below.

Concept	Definition
(Organizational) Goal	A desired state of affairs which an organization attempts to realize (Etzioni, 1964).
EA activity	Activity (the work that a company or organization performs to create a certain output; BPMN, 2011) that is directly related to the EA, i.e. either creating or implementing the EA or resulting from the EA.
EA benefit	The positive contribution from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization (based on Renkema and Berghout, 1997).
EA cost	The negative contribution from (one or more) EA activities towards the desired state of affairs for an organization as stated by some goal of that organization (based on Renkema and Berghout (1997) who call this a sacrifice).

Table 1.   Definitions of the EA value concepts (Plessius et al, 2018)

In these definitions EA benefits (and EA costs) are characterized by both organizational goal and EA activity so it follows that they can be classified by these concepts. This is expressed in the Enterprise Architecture Value Framework EAVF (Plessius et al., 2018) where we have used the BSC to classify organizational goals and have discerned three types of EA activities: EA development-, EA implementation- and EA exploitation activities (figure 1). In the same publication we have also shown that the EAVF is in accordance with the necessary conditions for a taxonomy (Nickerson, Varshney and Muntermann, 2013).

BSC Activity classes	Finance and accountability	Customer and partnerships	Internal processes	Learning and growth
EA Development				
EA Implementation				
EA Exploitation				

Figure 1.   The Enterprise Architecture Value Framework EAVF (Plessius et al., 2019)

As can be seen in figure 1, we extended the original BSC perspectives 'Financial' and 'Customer' into 'Finance and accountability' and 'Customer and partnerships', in order '*to customize the BSC for its purpose*' (Norton and Kaplan, 1993, p. 135). Table 2 provides short descriptions of the goal categories and activity types in the EAVF.

Category name	Category description
Finance and accountability	goals that concern financial outcomes and/or the accountability of the organization to external stakeholders
Customer and partnerships	goals that concern the market and the customers to which the products and services of the organization are targeted as well as the partnerships in which the organization participates
Internal processes	goals relating to the current internal (business) processes, such as production, logistics and IT – including their support and management processes
Learning and growth	goals that are targeted to improvements in the long run
EA Development	EA activities in which an Enterprise Architecture for the organization as a whole is developed and maintained
EA Implementation	EA activities in which the implementation of (parts of) the Enterprise Architecture is carried out in the organization, usually via projects
EA Exploitation	EA activities when changes in the operations corresponding with the EA have been implemented and are in operational use

Table 2.   Categorizations used in the EAVF (from Plessius et al., 2018)

4   Research methodology

In the long run, we want to develop a measurement instrument for benefits and costs of Enterprise Architecture, based on the EAVF. To that purpose the EAVF needs refinement as each of its cells covers a lot of ground. Starting with the organizational goals, we formulated - incorporating the necessary criteria for a taxonomy as described by Nickerson, Varshney and Muntermann (2013) – the following conditions for a refinement:

1)   derived from literature,

2)   recognizable in EA practice,

3)   unambiguous,

4)   complete.

Based on the literature on EA benefits, we derived 36 different subcategories in the four perspectives of the BSC as explained in the next section. In order to validate this refinement, we decided to consult experts in the field of EA as we wanted the subcategories as derived from literature (condition 1) to be recognizable in EA practice (condition 2). Furthermore, we wanted the experts to react on each other, thereby working towards a result on which all (or at least a qualified majority) could agree. Given the large number of subcategories, we decided that an online Delphi study would fit best our purpose. A Delphi study is particularly useful '*to determine or develop a range of possible [program] alternatives*' and '*to seek out information which may generate a consensus on the part of the respondent group*' (Delbecq, van de Ven and Gustafson, 1975, as quoted by Hsu and Sandford, 2007). A Delphi study makes it possible to query experts and makes it possible for experts to react to each other as well, thereby working towards a common outcome on which consensus is reached (Hasson, Keeney and McKenna, 2000; Okoli and Pawlowski, 2004; Diamond et al., 2014; Giannarou and Zervas, 2014). The online

variant of a Delphi study gives the experts ample time to reflect on the various subcategories and their unambiguity and completeness (conditions 3 and 4).

In an online Delphi study, a series of structured questionnaires is presented to a number of experts (the expert panel). A Delphi study typically consists of a number of rounds where in each round anonymous feedback on the results of the previous round is given and participants (the expert panel) are invited to rethink their earlier answers set against the answers of the other participants. To guarantee methodological rigor, care should be taken in (Hasson, Keeney and McKenna, 2000):

- Clearly defined question(s)

- Number of rounds and minimal response rate

- The number, background and expertise of the participants

- Criteria for consensus

As explained above, the goal of our Delphi study is to validate the derived subcategorization of organizational goals in terms of unambiguity, completeness and relevance towards benefits of EA. To that end, we formulated the following questions to be answered in the Delphi study:

1) Are the subcategories fully disjunct from each other?

2) Is the set of 36 subcategories complete, i.e. do they together fully cover the domain of organizational goals?

3) Can EA benefits be found in every subcategory?

4) Is it possible to classify most (>= 80%) benefits of EA in a subset of the subcategories and if so, which subcategories should be included in this subset?

The first two questions ask for the completeness and unambiguity of the subcategorization while the last two questions concern the relevance of the subcategories for classifying the benefits of EA. In order to classify possible benefits of EA in the EAVF, which uses architectural activities as a second classification axis, we added two more questions concerning the relation between the subcategories and architectural activities.

5) What are the most important activities of the EA function (classified in development -, implementation - and exploitation activities) to create benefits to the organization?

6) To which subcategories of organizational goals can these activities be linked?

As most Delphi studies consist of 2 or 3 rounds (Diamond et al., 2014), we decided to conduct 3 rounds in our study with round 1 and 2 focussing on the subcategorization (question 1 to 4 above) and rounds 2 and 3 on the activities (question 5 and 6 above). Furthermore, to maintain academic rigor, we decided on a response rate of at least 70% in each round (Hasson, Keeney and McKenna, 2000).

According to Diamond et al. (2014), the number of participants in a Delphi study can vary from less than 10 to over a 100. There exists no consensus on an optimal number of participants, but in an overview study of the literature on the Delphi technique, Hsu and Sandford (2007) state that to minimize the amount of data analysis, researchers should use the minimal number of participants. If their background is more or less homogenous, 10 to 15 persons can be sufficient, but if various reference groups are involved, more participants are needed. Diamond et al. (2014) found in their research that in most studies the number of participants varied between 10 and 25. For our purpose we needed experts who have considerable experience with EA from various perspectives. Therefore, we focused on enterprise

architects, solution architects, information managers, project managers and business line managers as participants in the expert group. Additionally, we used the following criteria:

- Academic way of thinking

- Working knowledge of EA

- At least three years of experience in their current profession

- In the expert group experience with the development, implementation and exploitation of EA should be present

- In the expert group at least four different economic sectors should be present.

We started with 16 experts from which 13 participated in all three rounds (81%), well within the set response rate. The 13 participants came from the following economic sectors: industry and construction (1), education and research (2), health and community work (2) government (4), finance and insurance services (2) and information, communication, entertainment and recreation (2). None of the 13 participants was at the time of the study working as a solution architect or business line manager, but expertise on those topics had been gained in previous jobs so experience with the three types of activities as discerned in the EAVF was guaranteed.

To determine if consensus was reached, various methods are applied in literature ranging from formal, statistical methods to subjective decisions (Diamond et al., 2014). In our study we used three characteristics (out of the eleven described by Diamond et al., 2014) for the 5-point Likert-scale questions:

- Inter-quartile deviation <= 1

- Over 2/3 of the answers is in one, or two consecutive, categories

- After condensation of the 5-point Likert scale to a 3-point scale, more than 60% of the answers is in one of the three categories.

If two or three of these characteristics indicated that consensus was reached, it was decided that overall consensus was reached. Because of the relatively small number of respondents, one response can make a crucial difference in these characteristics. So, if only one characteristic indicated that consensus was reached, we looked at the frequency distribution of the answers: if the distribution clearly had one maximum when a continuous line was drawn over the frequency distribution, it was decided that consensus was reached. In all other cases it was decided that as yet consensus not was reached.

For the yes/no answers, consensus was established if 75% or more of the answers was either yes or no (Diamond et al., 2014).

5   Results

We started the refinement with a literature study of benefits and costs of EA. Using the breakdown given by Kaplan and Norton (2001) in their strategy map, we adapted their subcategories in the following way, based on the four conditions set in the previous section:

- *Financial and accountability*: In their elaboration of the BSC towards the strategy map, Kaplan and Norton (2001) differentiate between the following financial subcategories: 'shareholder value', 'costs,' 'asset utilization', 'revenues' and 'customer value'. We decided to omit 'customer value' as this may cause confusion with the Customer and partnerships perspective.

In the strategy map, the regulatory processes 'environment' and 'safety and health' from the Internal perspective only partly cover accountability. We renamed these to 'sustainability' and 'risk control' and added 'compliance' and 'governance' as subcategories of accountability as these are mentioned frequently in literature on EA benefits and in the practice of EA.

- *Customer and partnerships*: in the strategy map, this perspective is subdivided in eight subcategories. As the number of reported EA benefits in this perspective is quite modest, we have summarized these in four subcategories: '(customer) experience', '(customer) relationships', '(product) position' and '(market) strategy'.

  As nowadays many products/services are the result of a value chain of suppliers and distributors, organizations have to maintain relationships with other organizations in a customer role. We decided to incorporate this in the Customer and partnerships perspective with the subcategories 'collaboration' and 'supply chain'.

- *Internal processes*: for this perspective, we combined the subcategories of the strategy map with the categories of Porter's value chain model (Porter, 2008), creating nine subcategories: 'logistics', 'operations', 'marketing and sales', 'service', 'technology and infrastructure', 'administration', 'procurement', 'innovation' and 'HRM'.

  As IT related topics occur very frequently in literature on EA benefits and in the practice of EA, we decided to split 'technology and infrastructure' into 'data', 'information systems', 'information technology', 'information support', 'project management' and 'technology (non-IT)', thereby creating overall 14 subcategories in this perspective.

- *Learning and growth*: in the strategy map, a subdivision is made in 'human-, information- and organization capital' where the last subcategory in turn is divided in 'culture', 'leadership', 'alignment' and 'teamwork'. We decided to combine 'human capital' with 'leadership' and 'teamwork' into 'competences' and splitting 'information capital' into 'communication', 'knowledge management' and 'evaluation'. Finally, based on benefits as reported in literature and practice, we added 'agility' and 'technology use'.

So, with the strategy map as a starting point, we created 36 subcategories in the four perspectives of the BSC in which benefits of EA as reported in literature can be mapped.

Next, we started an online Delphi study to validate the unambiguity and the completeness of this subcategorization and test their recognizability in practice. As stated in the previous section, the first round focused on the subcategorization of the BSC: are the subcategories disjunct and complete? To what extent can EA contribute to the subcategory?

For each of the 36 subcategories, the following two questions were asked:

- *In your opinion, to what extent can Enterprise Architecture contribute to this subcategory (you may use the comment-field to explain your answer)?*

- *Is the description of the subcategory as given above clear and unambiguous? If not, please explain in the comment-field.*

Furthermore, for each of the four perspectives of the BSC, the following two questions were asked:

- *In your opinion, is there any overlap between the various subcategories as given above? If so, in your opinion, which subcategories overlap?*

- *In your opinion, do these subcategories cover all organizational goals in this perspective of the BSC? If not, what kind of organizational goals from this perspective cannot be classified in these subcategories?*

In the first round, 13 out of the initial 16 respondents completed the questionnaire fully and 2 partially; well within the set response rate of 70%.

Various changes in subcategories were made in this round, based on the remarks made by the respondents; these changes are summarized in table 3 below.

BSC perspective	Subcategory	Adaptation
Finance and accountability	Shareholder value	Removed as it is the result of the (financial) subcategories in this perspective
	Asset utilization	Removed as there is overlap with the subcategories 'operations' and 'logistics' in the perspective Internal processes'
	Investments	Added, based on the remarks
	Ethics	Added as a broader subcategory including 'sustainability'
	Risk control	Renamed to 'risk management'
Customer and partnerships	Position	Renamed to 'product position'
	Strategy	Renamed to 'market strategy'
	Collaboration Supply chain	Combined into 'ecosystem'
Internal processes	Operations	Renamed to 'production'
	Service	Renamed to 'service delivery'
	Data	Renamed to 'data management'
	Information systems Information technology Information support	Combined into 'information management' as according to the expert panel it is difficult to separate these subcategories
	Administration	Renamed to 'management'
	Quality management	Added as a broader subcategory including 'project management'
Learning and growth	Knowledge management	Removed and included in the existing subcategory 'communication'
	Evaluation	Renamed to 'evaluation and re-use'

Table 3.   Changes in the subcategories made after round 1

All in all, in this round 10 subcategories were deleted or replaced by a new subcategory and 5 new subcategories were added. After round 1 the number of subcategories was 31 and several subcategories had been given a slightly adapted description, based on the comments given with the second question.

As for the first question, consensus was reached on 21 of the 36 initial subcategories corresponding with 17 of the final 31 subcategories. In table 4 below an overview is given of all (final) subcategories and the results.

Round 2 was completed by 13 respondents (81%), again well within the set response rate. In the first part of round 2, the first two questions of round 1 were repeated for the 14 subcategories where as yet no consensus was reached. These subcategories were presented together with the remarks made in round 1, so the respondents would be able to rethink their previously given answer based on the remarks made

by the other respondents. In this round consensus was reached on 8 more subcategories (see table 4). Furthermore, the subcategory 'ethics' was renamed to 'societal responsibility' and 'technology use' to 'technology research', based on the remarks of the respondents.

In the second part of round 2, the subcategories on which consensus had been reached in round 1, were linked to architectural activities. For each of these subcategories the question was asked if EA Development, EA Implementation and/or EA Exploitation activities could contribute and if so:

- *In your opinion and to the best of your knowledge, can you specify the architectural activities that can contribute to this subcategory of organizational goals?*

For support a (non-limiting) overview of possible architectural tasks was provided.

Consensus on the question if EA could contribute to a given subcategory/activity class was reached in 19 of the 17*3 subcategory/activity class combinations presented; mainly (11 out of 19) on the EA Development activities. The question to specify architectural activities on the whole did not result in very useful answers; most answers focused on conditions instead of activities.

In round 3, the same 13 respondents completed the questionnaire fully. In the first part of this round, for the six remaining subcategories where as yet no consensus had been reached the contribution question was repeated, together with the comments made in round 2. As a result, in this round on 4 more subcategories consensus was reached, so only 2 subcategories remained undecided (see table 4).

In the second part of this round, the subcategories where the contribution of EA was at least scored moderate, were linked with EA activity types:

- *In your opinion, to what extent can architectural activities in the three subclasses [EA Development, EA Implementation and EA Exploitation] contribute to this kind of organizational goals?*

In many subcategory/activity combinations, consensus on the contribution of EA was reached (55 out of 27 * 3 combinations). However, differentiating between the three types of activities proved not possible as the contribution scores given to the three activity types were quite close for most organizational subcategories.

A conspicuous result of this round concerns the subcategory 'technology (non-IT)'. Where no consensus was reached in the first part of this round on the subcategory, in the second part consensus was reached on this subcategory for activities concerning EA Development and EA Exploitation (both moderate).

Summarizing, our research resulted in a refinement of the four perspectives of the BSC in 31 subcategories. In table 4, the final set of subcategories is presented together with their potential contribution by EA, according to the expert group.

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Finance and accountability			
Costs	… the expenses made by the organization (usually a reduction)	1	Moderate/ quite a lot
Revenues	… the income that an organization has from its activities (usually an increase)	3	A little bit/ moderate
Investments	… the commitment of capital in an asset with the expectation of obtaining additional revenues	3	Moderate
Compliance	… how the organization operates in accordance with laws and regulations	1	Very much

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
Governance	… how rules, norms and actions are structured, sustained, regulated and held accountable in the organization	1	Very much
Risk management	… how risks are identified, minimized, prevented and controlled by the organization	1	Moderate/ quite a lot
Societal responsibility	… the moral justifiability and sustainability of the processes, products and services of the organization	3	A little bit
Customer and partnerships			
Experience	… how customers experience their interactions with the organization	1	Quite a lot
Relationships	… how current and future interactions with customers are structured by the organization	2	Quite a lot
Product position	… the place that the products and services of the organization occupies in the minds of their customers and how these are distinguished from the products and services of competitors		
Market strategy	… the strategies chosen by the organization to approach markets and customers	2	Moderate/ quite a lot
Ecosystem	… a network of organizations that creates products and services for customers and where the organization takes part in	1	Very much
Internal processes			
Logistics	… managing the flow of products and services from suppliers to customers by the organization	1	Very much
Production	… the creation of the products and services of the organization	2	Quite a lot
Procurement	… finding and acquiring materials and services from external sources	3	Moderate
Marketing and sales	… the processes responsible for promoting, pricing and selling the products and services of the organization to customers	1	Moderate
Service delivery	… the activities carried out by the organization after delivering their products and services to customers	2	Moderate
Data management	… to the processes and means that store, maintain, retrieve and safeguard data important to the organization	1	Very much
Information management	… the processes and means used to collect, organize, manipulate, store and distribute information by the organization	1	Very much
Technology (non-IT)	… the (non-IT) techniques, skills, methods and processes used in the production of the goods and services of the organization		
Management (or Administration)	… deciding on the strategy of the organization and coordinating the efforts of the employees to accomplish the objectives	2	A little bit/ moderate
Quality management	… ensuring that outputs, benefits, and the processes by which they are delivered, meet stakeholder requirements and are fit for purpose	2	Quite a lot

(Sub)category	Short description (Goals related to …)	Consensus (round and contribution)	
HRM	… the recruitment, management and development of employees in the organization	1	A little bit
Innovation	… implementing renewal of the products, services and processes of the organization	1	Moderate
Learning and growth			
Competences	… developing the potential of individuals to perform tasks within the organization	2	Moderate
Culture	… the system of shared assumptions, values, and beliefs, governing how people behave in the organization	1	Not at all
Communication	… how information and knowledge are gathered and shared between individuals and groups	1	Quite a lot
Alignment	.. adjusting subsystems (e.g. strategic/operational or business/IT) in the organization	1	Very much
Agility	… the ability of the organization to respond to change or initiate change for competitive advantage	1	Very much
Technology research	… evaluating the possibilities of (new) technology for the organization	1	Very much
Evaluation and re-use	… the systematic determination of the value of processes and results, using criteria governed by a set of standards and indicating for re-use artifacts that comply with these standards	2	Quite a lot

Table 4.   Subcategories of the BSC with the contribution of EA to these subcategories

6 Discussion

The results show clearly that according to our respondents, EA can contribute to almost all subcategories, albeit in different degrees (table 4). The exception are the more social subcategories like 'societal responsibility', 'culture' and 'HRM'. It seems that the majority of the respondents do not regard EA as a means to affect the social aspects of the organization.

In earlier research (Boucharas et al., 2010b; Plessius, van Steenbergen and Slot, 2014) hardly any benefits were reported in the Customer and partnerships perspective. In this study, the expert panel indicates that EA benefits can (and should) be found in the Customer and partnerships perspective. Apparently, the outside world has become more important for EA – at least in the eyes of our respondents. This is emphasized by their consensus –reached in the first round - that EA contributes very much to goals in the subcategory 'ecosystem'.

Overall, according to our respondents, the contribution of EA to the goals of the organization seems to be quite strong. The subcategories where the contribution of EA is scored as 'very much', are: 'compliance', 'governance', 'ecosystem', 'logistics', 'data management', 'information management', 'alignment', 'agility' and 'technology research'. These seem rather uncontentious as on all these subcategories consensus was reached in the first round. With the exception of 'ecosystem' (as mentioned above), these are all mentioned in at least one publication on the benefits of EA (Niemi, 2008; Boucharas et al., 2010b; Tamm et al., 2011; Wan et al., 2013; Jusuf and Kurnia, 2017 and Shanks et al., 2018). Other important benefits in these publications can be mapped into the subcategories 'costs', 'quality management' and 'communication' which have scored 'moderate' to 'quite a lot' in our research. The high score on 'quality management' in our research may be explained by the major influence of EA on project management that other publications show; it may make sense to include 'project management' as a separate subcategory again.

Not included in our research, but often mentioned in literature, is the fact that EA leads to better decisions. We have intentionally not included such a subcategory as it is too broad to be useful for classification purposes: decision making is presumed in (almost) every subcategory.

For the second part of our research, in which we tried to combine organizational goals with EA activities, the results were not conclusive. The participants hardly made any difference between the three types of activities regarding the contribution of EA. A possible explanation may be that in the eyes of the respondents, all kind of EA activities yield benefits and as a result, they did not make much difference between the three types of activities. In practice the difference for a given organization may be greater as in a given period of time, the distribution of activities over development-, implementation- and exploitation activities is not necessarily equal. Moreover, the outcomes and results of EA activities can be important in establishing the subcategories in which benefits can be found.

7   Conclusion

In this research we have created and validated a refinement of the BSC consisting of 31 subcategories relevant to EA. According to the experts who have validated this subcategorization, in 24 of the subcategories at least a moderate contribution of EA to the goals concerned may be expected. These 24 subcategories will form the base of our intended measurement instrument for the value of EA. Of course, not for every organization all subcategories are equally important. But the list in table 4 may help to determine where (most) EA benefits can be found in an organization.

This research has its limitations. In the first place it has been conducted in the Netherlands only but as the results are in line with other studies (Niemi, 2008; Boucharas et al., 2010b; Tamm et al., 2011; Wan et al., 2013; Jusuf and Kurnia, 2017 and Shanks et al., 2018), we expect the results to be valid in other countries as well. A second limitation may stem from the fact that all respondents were (c.q. had been) actively involved in EA, which may have given rise to an overestimation of the contribution of EA to the various subcategories. However, the relative importance of the subcategories is not affected by a possible overestimation and the 24 subcategories will still be the most likely candidates when looking for the contribution of EA to organizational goals.

In future research we plan to identify indicators for each of the subcategories in the list with which we can establish the achieved EA benefits in an organization. We expect that the results of an earlier survey (Plessius, van Steenbergen and Slot, 2014, 2015) may be helpful in this process. The indicators will then be used in a set of case studies to determine the contribution of EA to the various subcategories as discerned in this study.

Acknowledgement

References

Boucharas, V., van Steenbergen, M., Jansen, S., and Brinkkemper, S. (2010a). "The contribution of enterprise architecture to the achievement of organizational goals: a review of the evidence". In: *Trends in Enterprise Architecture Research*. Springer, Berlin-Heidelberg, pp. 1-15.

Boucharas, V., Steenbergen, M. van, Jansen, S., Brinkkemper, S. (2010b). *The contribution of enterprise architecture to the achievement of organizational goals: Establishing the enterprise architecture benefits framework.* Technical Report UU-CS-2010-014, Department of Information and Computing Sciences, Utrecht University.

BPMN (2011). Business process Model and Notation, version 2.0. OMG document number: formal/2011-01-03.

Buchanan R. (2001). *Assessing Enterprise Architecture Program Value: Part 2/*. META Group Report, Stamfort CT.

Delbecq, A. L., Van de Ven, A. H., and Gustafson, D. H. (1975). Group techniques for program planning. Glenview, IL: Scott, Foresman, and Co.

Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M., and Wales, P. W. (2014). "Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies". *Journal of clinical epidemiology*, 67(4), 401-409.

Espinosa, J., Boh, W. and DeLone, W. (2011). "The organizational impact of enterprise architecture: a research framework". In: *System Sciences (HICSS), 2011 44th Hawaii International Conference on System Sciences*, Hawaii, pp. 1-10.

Etzioni, A. (1964). *Modern Organizations.* Foundations of modern sociology series. Prentice Hall, Englewood Cliffs, New Jersey.

Franke, U., Cohen, M., and Sigholm, J. (2018). "What can we learn from enterprise architecture models? An experiment comparing models and documents for capability development". *Software and Systems Modeling*, 17(2), 695-711.

Foorthuis, R., Van Steenbergen, M., Brinkkemper, S., and Bruls, W. A. (2016). "A theory building study of enterprise architecture practices and benefits". *Information Systems Frontiers*, 18(3), 541-564.

Giaglis, G., Mylonopoulos, N., and Doukidis, G. (1999). "The ISSUE methodology for quantifying benefits from information systems*". Logistics Information Management*, 12(1/2), pp. 50-62.

Giannarou, L., and Zervas, E. (2014). "Using Delphi technique to build consensus in practice". *International Journal of Business Science and Applied Management* (IJBSAM), 9(2), 65-82.

Hasson, F., Keeney, S., and McKenna, H. (2000). "Research guidelines for the Delphi survey technique". *Journal of advanced nursing*, 32(4), 1008-1015.

Hsu, C. C., and Sandford, B. A. (2007). "The Delphi technique: making sense of consensus". *Practical assessment, research and evaluation*, 12(10), 1-8.

Jusuf, M., and Kurnia, S. (2017). "Understanding the Benefits and Success Factors of Enterprise Architecture". In: *Proceedings of the 50th Hawaii International Conference on System Sciences.* Hawaii, pp. 4887-4896.

Kaisler, S. H., Armour, F., and Valivullah, M. (2005). "Enterprise architecting: Critical problems". In: *Proceedings of the 38th Annual Hawaii International Conference on System Sciences* (pp. 224b-224b). IEEE.

Kaisler, S., and Armour, F. (2017). "15 Years of Enterprise Architecting at HICSS: Revisiting the Critical Problems*". In: Proceedings of the 50th Hawaii International Conference on System Sciences*.

Kaplan, R. (2008*). Conceptual foundations of the balanced scorecard*. Handbooks of Management Accounting Research, 3, pp. 1253-1269

Kaplan, R. and Norton, D. (1992). "The Balanced Scorecard - Measures that Drive Performance". In: *Harvard Business Review*. 1992, Jan-Feb, pp.71-79.

Kaplan, R. and Norton, D. (2001). "Transforming the balanced scorecard from performance measurement to strategic management: Part I*". Accounting horizons*, 15(1), pp. 87-104.

Kurek, E., Johnson, J., and Mulder, H. (2017). "Measuring the value of Enterprise Architecture on IT-projects with CHAOS Research". In: *MSCI*, Orlando, USA.

Lange, M., and Mendling, J. (2011*). "*An experts' perspective on enterprise architecture goals, framework adoption and benefit assessment". In: *Enterprise Distributed Object Computing Conference Workshops* (EDOCW), 2011 15th IEEE International, pp. 304-313.

Lindström, Å., Johnson, P., Johansson, E., Ekstedt, M., and Simonsson, M. (2006). "A survey on CIO concerns-do enterprise architecture frameworks support them?". *Information Systems Frontiers*, 8(2), pp. 81-90.

Mooraj, S., Oyon, D., and Hostettler, D. (1999). "The balanced scorecard: a necessary good or an unnecessary evil?*". European Management Journal*, 17(5), pp. 481-491.

Nickerson, R., Varshney, U. and Muntermann, J. (2013). "A method for taxonomy development and its application in information systems". *European Journal of Information Systems* 22, pp. 336-359.

Niemi, E. (2008). "Enterprise architecture benefits: Perceptions from literature and practice". In: *Proceedings of the 7th IBIMA Conference Internet and Information Systems in the Digital Age*, 14-16 December, 2006, Brescia, Italy, pp. 1-8.

Niemi, E. I., and Pekkola, S. (2016). *Enterprise Architecture Benefit Realization: Review of the Models and a Case Study of a Public Organization*. ACM SIGMIS Database, 47(3), pp. 55-80.

Norreklit, H. (2000). "The balance on the balanced scorecard: a critical analysis of some of its assumptions". *Management accounting research*, 11(1), pp. 65-88.

Norton, D., and Kaplan, R. (1993). "Putting the balanced scorecard to work". *Harvard Business Review*, 71(5), pp. 134-140.

Okoli, C., and Pawlowski, S. D. (2004). "The Delphi method as a research tool: an example, design considerations and applications". *Information and management*, 42(1), 15-29.

Plessius, H., Steenbergen, M. van and Slot, R. (2014). "Perceived Benefits from Enterprise Architecture". In: *Proceedings of the Eighth Mediterranean Conference on Information Systems*, Verona, pp. 1-14

Plessius, H., Steenbergen, M. van and Slot, R. (2015). "Towards an Enterprise Architecture Benefits Measurement Instrument". In: *Advanced Information Systems Engineering Workshops*, pp. 363-374. Springer International Publishing.

Plessius, H., van Steenbergen, M., Slot, R. and Versendaal, J. (2018). "The Enterprise Architecture Value Framework". In: *Proceedings of the Twenty-Sixth European Conference on Information Systems* (ECIS2018), Portsmouth, UK, 2018

Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance*. Simon and Schuster.

Renkema, T. and Berghout, E. (1997). "Methodologies for information systems investment evaluation at the proposal stage: a comparative review". *Information and Software Technology*, 39(1), pp. 1-13.

Rodrigues, L. and Amaral, L. (2010). "Issues in Enterprise Architecture Value". *Journal of Enterprise Architecture*, 6(4), pp. 27-32.

Ross, J., Weill, P. and Robertson, D. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution.* Harvard Business Press.

Schelp, J. and Stutz, M. (2007). "A balanced scorecard approach to measure the value of enterprise architecture". *Journal of Enterprise Architecture*, 3(4), pp. 8-14.

Simon, D., Fischbach, K. and Schoder, D. (2013). "An exploration of enterprise architecture research". *Communications of the Association for Information Systems*, 32(1), pp. 1-72.

Shang, S. and Seddon, P. (2002). "Assessing and Managing the Benefits of Enterprise Systems: the Business Manager's Perspective". *Information Systems Journal*, 12(4): pp. 271-299.

Shanks, G., Gloet, M., Someh, I. A., Frampton, K., and Tamm, T. (2018). "Achieving benefits with enterprise architecture". *Journal of Strategic Information Systems*, 27(2), 139-156.

Tamm, T., Seddon, P., Shanks, G. and Reynolds, P. (2011). "How does enterprise architecture add value to organisations". *Communications of the Association for Information Systems*, 28(1), pp. 141-168.

Wan, H., Luo, X., Johansson, B. and Chen, H. (2013). "Enterprise architecture benefits: the divergence between its desirability and realizability". In: *14th International Conference on Informatics and Semiotics in Organizations* (ICISO2013, IFIP WG 8, 1 Working Conference), pp. 62-71. SciTePress.