

Areas where Enterprise Architecture Contributes to Organizational Goals – A Quantitative Study ¹

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Abstract. Nowadays, many organizations have adopted an agile way of working where agile teams are responsible for the architecture, design and implementation of transformations in business processes. To get some recent empirical data on how the value of EA is perceived in organizations, a survey has been created based on the Enterprise Architecture Value Framework (EAVF), a model to categorize value items. The survey has been distributed among (enterprise) architects and stakeholders of EA. Only small differences were found between the answers of these groups and the overall picture is that the respondents find the contribution of EA (average) important. A more detailed exploration of the outcomes shows that in areas which have a long-standing tradition with EA such as compliance, risk prevention, data management and information systems, the contribution of EA is perceived as (very) important, while in areas such as sustainability, market strategy and technology research the contribution of EA is assessed as less important. The results also suggest that the maturity of the EA processes can be improved.

Keywords: Enterprise Architecture, Enterprise Architecture Value, Enterprise Architecture Value Framework, Enterprise Architecture Value Survey.

1 Introduction

Since the proliferation of agile practices in organizations, the discussion about the usefulness and value of Enterprise Architecture (EA), has revived [1, 2]. Some authors claim that EA has to adapt itself to new ways of working [3-5], while others state that members in agile teams should be able to think like an architect [6] or even that EA has outlived its usefulness [7]. The discussion about the value of EA originated around the turn of the century with the emergence of EA as a means to achieve better alignment between the business and the information technology function in an organization [8, 9]. In practice EA has many interpretations that result in major differences between the

¹ This version is a pre-production version and differs slightly from the published version as referenced

way EA is organized and governed in organizations [10, 11], making the value of EA, in the words of Kaisler and Armour [12], an ‘elusive question’.

In discussions about the value of EA, it is important to keep in mind that value is not restricted to financial value alone, but has many more dimensions [13]. EA can bring value in areas such as risk reduction, innovation capability, logistics management, compliance and many more. While some of these areas are measurable (given adequate accounting), many are not quantifiable [8]. Moreover, while the visible outcomes of EA are mainly documents, its real value lies in what is done with the artifacts created [14]. Because many different stakeholders are involved in the process leading to implementation, it is difficult to say to what extent success can be explained by EA alone [8]. To mitigate these limitations, we decided to ask (enterprise) architects and stakeholders of architecture how they assess the value of EA. While the results of such an approach are subjective, literature shows us that self-assessments are a reliable instrument [15] and can be quite useful in practice where architects get feedback on their efforts and may use the results to optimize the alignment of their activities to the strategy and goals of their organization. Moreover, as empirical data about the value of EA are scarce [9, 16], the results may provide a detailed insight in the current state of EA, especially in an agile world. Motivated by the need for empirical data, this paper addresses the research question: “*Where can the most important contribution to the value of enterprise architecture be found, according to architects and stakeholders of enterprise architecture?*”

To answer the research question, we created a survey consisting of 62 questions about the perceived value of EA, complemented with 10 questions about the background of the respondents. The questions about the perceived value of EA are based on the Enterprise Architecture Value Framework (EAVF) [17, 18], in which benefits and costs of EA are classified along two axes: organizational goal and architectural activities. We discuss this model in the next section, followed by a short overview of relevant literature. In section 4, the research method including the construction of the questionnaire is explained and section 5 is dedicated to the outcomes of the survey. We end the paper with a discussion of the results.

2 The Enterprise Architecture Value Framework

After a structured literature research, Boucharas et al. [19] conclude that EA value concepts such as goal, benefit and cost are not defined in most research papers and that the way in which EA benefit categories are derived, lacks transparency. This makes it almost impossible to compare studies into the value of EA or to develop a common set of metrics [19-23]. Hence, we started earlier research into the value of EA [17] with definitions of the basic concepts of EA value, based upon definitions of these concepts in business literature, particularly the definitions as given by Renkema and Berghout [13]. For example, an EA benefit/cost is defined as “*The positive/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*” where an EA activity is defined as: “*The*

work that a company or organization performs to create a certain output that is carried out by the EA function of the organization”.

From this definition it follows that EA benefits and EA costs can be classified by organizational goal and EA activity. Peppard and Ward [24] argue that organizational goals and performance measures are often made explicit by means of a balanced scorecard (BSC) analysis [25], so we decided to use the four goal-perspectives of the BSC to classify organizational goals. This decision is supported by the fact that the BSC is widely used in practice [26] and by the research of Boucharas et al. [27] who have assessed several frameworks for classifying organizational goals and found the BSC the most suitable in the context of EA value.

To classify EA activities, we used the three organizational processes to which EA activities according to Ahleman and El Arbi [28] are closely related: strategic planning in which the EA is *developed*, the project life cycle in which the EA is *implemented* and operations and monitoring in which EA *exploitation* activities take place. Based on these classifications we have created a two-dimensional framework to classify EA benefits and costs: the Enterprise Architecture Value Framework (EAVF) as depicted in figure 1.

Organizational goal	Financial and accountability	Customer and partnerships	Internal processes	Learning and growth
EA Activity				
EA Development				
EA Implementation				
EA Exploitation				

Fig. 1. The Enterprise Architecture Value Framework [17]

A more substantial discussion on the EAVF and its background can be found in [17]. In that study it is also shown that the EAVF complies with the necessary conditions for a taxonomy as formulated by Nickerson, Varshney and Muntermann [29] and that it can be used as a reference model for other classifications of EA benefits as well. An important aspect of the EAVF is that it is based on the outcomes of EA activities and not on the way these activities are carried out, making the EAVF independent of how the EA function is organized or which methods and tools architects use.

In a follow-up study [18], the four categories of organizational goals were subdivided in 31 goal-subcategories where a contribution of EA may be expected. In table 1 these goal-subcategories are summarized (in this table ‘Costs’ should be read as: goals concerning costs’, etcetera). Definitions of the various goal-subcategories can be found in [18], including their validation by a panel of 13 (Dutch) EA experts in a Delphi study. While, according to these experts, EA may contribute to all goal-subcategories, it remains unsure whether they are complete.

Table 1. Goal-subcategories of the EAVF [18]

Financial and accountability	Customer and partnerships	Internal processes	Learning and growth
Costs	(Customer) experience	Logistics	Competences
Revenues	(Customer) relationships	Procurement	Culture
Investments	Product position	Business processes	Communication and knowl. mgt
Compliance	Market strategy	Marketing and sales	Alignment
Governance	Ecosystem	Service delivery	Agility
Risk management		Data management	Technology research
Societal responsibility		Information mgt	Evaluation and re-use
		Technology (nonIT)	
		General mgt	
		Quality mgt	
		HRM	
		Innovation	

3 Related Work

As stated in the introduction, there are many interpretations of what EA is (or should be), both in practice as well as in the literature. Interesting overviews can be found in [30, 31]. In this study, building on the definitions given in [31], we view EA as ‘*a discipline that directs enterprise transformations*’, which implicates that we are effectively accepting a very broad range of interpretations of the concept of EA. This is in line with the diversity of EA implementations in practice [11].

When studying the value of EA, we have to take into account both the benefits of EA and the costs of EA [32, 33]. Papers on the benefits of EA are numerous, including a number of meta-studies. However, papers on the costs of EA are almost non-existent. If costs are mentioned, it is in the context of cost reductions by the implementation of EA [34-36], which we consider a benefit of EA.

As a complete overview of all that is written about EA benefits is out of scope for this paper, we will limit ourselves to meta-studies about the topic. One of the first papers giving an overview of existing literature on the subject of EA benefits is by Niemi in 2008 [8]. In an extensive literature study, he identified 27 classes of EA benefits, which are validated by a focus group. Next, Niemi uses the IS classification model of Giaglis, Mylonopoulos and Doukidis [37] to classify these benefits, resulting in four classes of EA benefits. Somewhat later, Boucharas et al. [19, 27] conducted a systematic literature review and they identified 100 mutually exclusive benefits which they classified in the strategy map [38] - an extension of the balanced scorecard [25]. In 2011 Tamm et al. [39] counted 213 benefits in a systematic literature review which they classify in 12 different types of EA benefits, but they do not explain how these categories were developed. More recently, in 2017, Yusuf and Kurnia [40] identified 40 different types of EA benefits which they classify in 5 categories, based on the benefit framework for enterprise systems of Shang and Sheddou [41]. In 2019, Niemi and Pekola [42] discerned 250 EA benefits which they – without further explanation – classify

in 40 types. In the same year, Gong and Janssen [9], based on a structured literature research, discern nine different categories of EA benefits, without explaining where this classification is based upon.

The meta-studies above are grounded in literature research. However, only a small number of authors have used a survey as a means to get empirical data on EA value. Shanks et al. [16] in 2018 found eight publications where a survey was used as the research method. Only the survey conducted by Foorthuis et al. in 2010 [34] and an earlier survey by us conducted in 2014 [43] are aimed at gathering data about the perceived value of EA. The other studies focus primarily on how EA benefits are achieved, rather than on the benefits themselves.

4 Research Design

As shown in the research of Shanks et al. [16], older literature on EA value/EA benefits is mainly conceptual in nature. Empirical studies about how the value of EA is perceived in organizations are still scarce [16] and we did not find any recent empirical studies even though in the last decade a proliferation of agile implementation methods has occurred [1]. In order to get an overall picture of the current perception about the value of EA and at the same time get an impression of the adaptation of EA to agile implementation methods, we decided to use a survey as our research method. Based on the EAVF, we decided to discern three target groups:

- *EA Developers*: architects who create, adapt and maintain (parts of) the enterprise architecture such as enterprise architects, domain architects, business architects and information architects.
- *EA Implementers*: architects and non-architects who are accountable for the implementation of parts of the enterprise architecture, usually in projects. Examples are solution architects, system architects, program- and project managers.
- *EA Users*: non-architects who in their line of work are confronted with the results of enterprise architecture, such as business line managers, staff and project owners.

While there may exist some overlap between the three groups, in the survey we let respondents decide for themselves whether they are developing, implementing or using EA (or none of these) and in this way choose their viewpoint towards EA.

The survey for each of these groups consists of two parts: the first part contains general questions about the background of the respondents (this part is the same for all respondents) while the second part implements the questions about the value of EA. As we wanted the questionnaire to be based on value items as reported in literature, we started the construction of the second part of the survey with an inventory of EA benefits, using studies as mentioned in the previous section. In this way we gathered 112 specific EA benefits, which were categorized in the 31 goal-subcategories as depicted in table 1. In order to keep the survey comprehensive, in the overloaded subcategories we combined various benefits into one value item. For example, benefits such as 're-

duce costs in general', 'reduce specific costs like IS/IT costs' and 'reduce administrative costs', were combined in one item 'lower operational costs.' This resulted in 62 unique value items where each item is a statement about the contribution of EA, for example 'lower operational costs c.q. higher revenues', 'the (expected) effects on customer experience and customer satisfaction' or 'the willingness and ability to cooperate in the organization'.

Next, for each item we established the relevance for the three groups of potential respondents. For example, an item about the manageability of projects is relevant for EA implementers, but not for EA developers. The value items and their distribution over the three groups can be found with the outcomes of the questions (see section 5).

The value items can be scored on a 5-point scale ranging from 'not important at all' (score 1) to 'very important' (score 5), supplemented with the option 'don't know' for items where the respondents are not aware of the value delivered by EA to that item. For each of the three groups of respondents, a base question was formulated asking for the perceived value of EA on the value items. In the version for the EA developers this base question is: 'Please state with a score from 1 to 5 the importance of the next items in developing and updating the overall architecture'. In the version for the EA implementers this is replaced by: 'Please state with a score from 1 to 5 the importance of the next items in preparing solution/systems architectures during implementation processes' and in the version for EA users by: 'Please state with a score from 1 to 5 the importance of the contribution of architecture with respect to the next items'. The items were ordered within the four goal-perspectives of the EAVF and to each set of questions an open question was added asking for the completeness of the questions in the eyes of respondents. To prevent a systematic bias from weariness, the four sets of questions were presented to the respondents in random order. After all questions were answered, the questionnaire ended with the calculated average scores on the four goal-perspectives from the EAVF and respondents could comment on this feedback. Finally, the questions were made ready for distribution using Limesurvey (<http://www.limesurvey.org>).

The survey was tested by 2 persons and based on their remarks, 'contribution' was used instead of 'value' as to the testers, 'value' was too strongly associated with financial value alone.

After completion, the survey was accessible for a period of two months in the spring of 2021. In this period potential respondents were approached via different channels such as the 'Nederlands Architectuur Forum NAF (<http://www.naf.nl>), a community of practice for architects, the research groups 'Digital Ethics' and 'Process Innovation and Information Systems' of the University of Applied Sciences Utrecht as well as via colleagues of the authors. Furthermore, it was brought to attention in LinkedIn groups on architecture.

The survey was conducted anonymously, but after completion of the survey respondents were given the possibility to receive the analysis and conclusions. To guarantee anonymity, the email address of the respondents was stored separately from the survey data.

5 Results

In the period the survey was accessible, 256 people opened the link to the survey but only 136 of these started with the questionnaire. This resulted in 105 full responses from which 7 indicated that they were not in any way involved with architecture. The outcomes on all questions can be found on <http://eduples.nl/index.php/results2021>.

The statistical analysis of the data has been done with the statistical package SPSS, version 28.

5.1 Characteristics of the Organizations of the Respondents

Almost all economic sectors were present in these responses, with an emphasis on the governmental sector (table 2). Compared to other surveys on EA value in the Netherlands [34, 43], we see more respondents from the industrial sector, but less in the financial and insurance sector. As over the past decade the financial and insurance sector in the Netherlands has diminished considerably, we assume the distribution to be representative.

Table 2: Distribution over economic sector

The organization I work for can be classified in the following economic sector:	This survey	[34] (2010)	[43] (2014)
No answer	0%	0%	0%
Agriculture, fishing, forestry and mining	0%	1%	2%
Industry (nutrition and manufacturing) and construction	13%	6%	3%
Energy, water and waste production/ processing	4%	5%	5%
Education and research	7%	2%	6%
Health and community work	11%	3%	5%
Government (including Defense)	28%	31%	24%
Financial and insurance services	14%	30%	35%
Information, communication, entertainment/recreation	7%	12%	6%
Trade, transport and other services	15%	10%	13%

In line with other research [34, 43], in terms of size larger organizations are in the majority (table 3), which is to be expected as smaller organizations usually do not employ architects.

Table 3 also shows the distribution of the number of architects over architectural task areas. As we expect the number of architects to grow with the size of the organization, we performed a correlation test on the variables ‘organizational size’ against ‘number of architects’. In correspondence with the ordinal character of the variables we used Spearman’s rank correlation and found moderate positive correlations: $\rho_s = 0.435$ for organizational size vs. number of enterprise/domain architects and $\rho_s = 0.524$ for organizational size vs. number of solution/systems architects; both with $p < 0.001$.

Table 3. Distribution over organizational size and architectural task area

How many employees are there in the organization you work for?		How many architects does the organization you work for employ?	enterprise/ domain architects	solution/ system architects
Don't know / No answer	0%	Don't know / No answer	4%	7%
Less than 10	2%	0	4%	11%
10 to 100	6%	1	15%	9%
101 to 500	14%	2 to 5	22%	16%
501 to 2000	27%	6 to 10	22%	11%
More than 2000	50%	11 to 20	14%	15%
		More than 20	19%	31%

Almost half of the organizations (49%) have more than 10 years experience with architecture, but still 7% of the respondents state that the organization they work for has less than 1 year of experience with architecture. Most respondents (60%) have ample (over 6 years) of experience in their current function but we found no significant correlation with the architectural experience of the organization. Finally, in about 10% of the organizations the focus of architecture is on business and information only, while in one-third the focus is on application and infrastructure. In the remaining half of the organizations, the respondents indicate an equal focus on business/information and application/infrastructure architecture. These results are comparable to those in [43].

Of the 105 respondents, 56 (53%) indicated they are EA developer, 27 (26%) as EA implementer and 15 (14%) as an EA user. The remaining 7 respondents found they have no or insufficient experience with architecture. Their responses will not be used in the next sections as they did not answer the questions about the contribution of EA. The number of respondents is relatively low, especially in the group of EA users, but when taking the three groups together we have in our outcomes - with a confidence level of 95% - a margin of error less than 10% (using the sample size calculator of SurveyMonkey on <https://www.surveymonkey.com/mp/sample-size-calculator/>),

5.2 Perceived Contribution of EA

In the survey, the questions about the contribution of EA are divided over the four goal-perspectives of the BSC. In table 4 the averaged results in these goal-perspectives, categorized by group of respondents, are given, together with the percentage of the respondents who found the contribution of EA important to very important (score 4 or 5).

As the differences between the values in table 4 are very small, not much can be concluded from these results - except the fact that in all four goal-perspectives and for all three groups the contribution of EA to the organizations of the respondents is considered between average important and important. Although the averages of the EA developers are marginally higher than those of the other two groups, the differences are very small and due to the relatively small number of respondents, no hard conclusions can be drawn from the outcomes.

Table 4. Averaged results and positive percentages by group and goal-perspective

Category	Number	Finance and accountability	Customer and partnerships	Internal processes	Learning and growth
EA Developers	56	3.6 / 56%	3.4 / 54%	3.6 / 59%	3.6 / 59%
EA Implementers	27	3.6 / 58%	3.4 / 53%	3.5 / 56%	3.3 / 49%
EA Users	15	3.4 / 50%	3.3 / 53%	3.5 / 54%	3.4 / 52%
All	98	3.5 / 55%	3.4 / 53%	3.6 / 57%	3.5 / 55%

More can be learnt by looking at the answers to the individual questions – especially the outstanding ones, the positive (average score ≥ 4 , important to very important) as well as the negative results (average score < 3 , less than average important). These results are shown in tables 5 and 6 and they give a good picture of the items where the contribution of EA to the goals of the organization is perceived high (table 5) or low (table 6).

Table 5. Outstanding positive scores

Items with average score ≥ 4	Dev N=56	Imp N=27	Exp N=15	All N=98
<i>Finance and Accountability</i>				
Compliance with laws, regulations and internal standards	4.4	4.7	(3.9)	4.4
Prevention of risks in business and information processes	(3.9)	4.2	(3.6)	(3.9)
<i>Customer and Partnerships</i>				
The exchangeability of data with partners	(3.9)	(3.8)	4.1	(3.9)
<i>Internal processes</i>				
Digitization of business processes	4.1	(3.7)	4.2	4.0
The quality of stored data	4.3	(3.9)	(3.9)	4.1
The interoperability of data between information systems	4.3	4.2	(3.9)	4.2
The quality of information systems and IT infrastructure	(3.7)	4.4	(3.8)	(3.9)
The security of information, systems and infrastructure	4.4	4.6	(3.5)	4.3
'Outsourcing' and 'cloud'	(3.9)	4.1	(3.4)	(3.9)
The involvement of stakeholders	4.0	(3.6)	(3.4)	(3.8)
<i>Learning and Growth</i>				
Insight into current and desired situation and the road map	4.2	4.1	(3.7)	4.1

The outstanding positive scores (table 5) show that the contribution of EA to the goals of the organization are found in particular with value items that are linked to information management and with compliance, risk prevention and providing insight in planned developments; areas that have a long-standing tradition with enterprise architects and can already be found in older meta-studies on EA benefits [8, 27, 39]. On the other hand, the outstanding negative scores (table 6) where the contribution of EA to organizational goals is perceived low, are concentrated in more recent areas of interest to architecture such as societal responsibility, markets and market strategy, organizational culture, (agile) project management and technology research. However, value

items from evaluation and re-use are found here as well, which may indicate that the maturity of the EA processes can be improved.

Table 6. Outstanding negative scores

Items with average score < 3	Dev N=56	Imp N=27	Exp N=15	All N=98
<i>Finance and Accountability</i>				
Sustainability	(3.1)	2.7	(3.0)	(3.0)
Decent working conditions (internally and with partners)	(3.2)	2.7	(3.5)	(3.1)
<i>Customer and Partnerships</i>				
The expected effects on markets and market shares	2.5	2.4	2.3	2.4
Alignment with the market strategy of the organization	(3.4)	(3.0)	2.7	(3.2)
Supply chain integration	2.9	(3.5)	(3.6)	(3.2)
<i>Internal processes</i>				
The support of business processes with logistics software	2.8	2.8	(3.4)	2.9
The “time-to-market” of new products and services	(3.1)	2.9	(3.1)	(3.0)
The use of customer journeys in modelling	-	2.8	-	-
Support with ‘agile’ project implementation	(3.3)	(3.3)	2.9	(3.2)
<i>Learning and Growth</i>				
The professionalization of project management	-	2.9	(3.4)	-
The culture in the organization	-	-	2.9	-
Research of and gaining experience with new technology	(3.2)	2.8	(3.4)	(3.1)
Experiences with previous results of architecture	2.8	2.9	-	-
Evaluations of project results	-	2.7	2.9	-
The creation of artifacts for reuse	(3.1)	2.8	-	-

In both tables we observe a reasonable agreement between the three groups. To research if a consensus between the three groups is supported and can be found for all value items, we performed a Spearman’s correlation test. We found moderate positive correlations between the three groups: $\rho_s = 0.689$ for EA developers vs. EA implementers, $\rho_s = 0.538$ for EA developers vs. EA users and $\rho_s = 0.487$ for EA implementers vs. EA users – all with $p < 0.001$, so a moderate degree of agreement between the three groups may be assumed.

Another way to look at the scores is to classify the responses in the goal-subcategories of the EAVF (table 1). To test whether the outcomes are not the result of coincidence, we performed a one-sided binomial test on these goal-subcategories. We divided the responses by goal-subcategory in two sets: the first set being the responses corresponding with a positive perceived contribution of EA (responses 4 and 5) and the second set where no positive contribution was perceived (responses 1, 2 and 3). We then tested the hypothesis: no positive effect of EA is perceived versus the alternative hypothesis: a positive effect of EA is perceived by the respondents.

The hypothesis is accepted when in the first set (responses 4 and 5) the percentage of responses is not significantly more than 40%. The alternative hypothesis is accepted if significantly more than 40% can be found in this set.

Table 7. Distribution of answers over all respondents (legend below table)

Goal subcategories	<=3 #	>3 #	0 #	<=3 %	>3 %	Sig	<3 %	<3 #
<i>Financial and accountability</i>								
Costs and revenues	38	58	2	39.6	60.4	<0.001	24.0	23
Investments	37	55	6	40.2	59.8	<0.001	16.3	15
Compliance	16	80	2	16.7	83.3	<0.001	5.2	5
Governance	34	61	3	35.8	64.2	<0.001	23.2	22
Risk management	35	62	1	36.1	63.9	<0.001	8.2	8
Societal responsibility	46	42	10	52.3	47.7	0.086	34.1	30
<i>Customer and partnerships</i>								
Customer experience	35	57	6	38.0	62.0	<0.001	18.5	17
Customer relationships	40	53	5	43.0	57.0	<0.001	19.4	18
Product position	68	21	9	76.4	23.6	>0.999	52.8	47
Market strategy	48	46	4	51.1	48.9	0.049	37.2	35
Ecosystem	29	66	3	30.5	69.5	<0.001	25.3	24
<i>Internal processes</i>								
Logistics	43	52	3	45.3	54.7	0.003	31.6	30
Business processes	18	80	0	18.4	81.6	<0.001	12.2	12
Marketing and sales	63	33	2	65.6	34.4	0.891	34.4	33
Service delivery	39	58	1	40.2	59.8	<0.001	26.8	26
Data management	19	77	2	19.8	80.2	<0.001	13.5	13
Information mgt	15	82	1	15.5	84.5	<0.001	9.3	9
General management	42	54	2	43.8	56.3	<0.001	19.8	19
Quality management	32	64	2	33.3	66.7	<0.001	19.8	19
HRM	43	53	2	44.8	55.2	0.002	11.5	11
Innovation	41	55	2	42.7	57.3	<0.001	21.9	21
<i>Learning and growth</i>								
Competences	33	63	2	34.4	65.6	<0.001	19.8	19
Culture	34	62	2	35.4	64.6	<0.001	20.8	20
Alignment	18	79	1	18.6	81.4	<0.001	11.3	11
Agility	27	71	0	27.6	72.4	<0.001	18.4	18
Technology research	63	34	1	64.9	35.1	0.864	24.7	24
Communication and KM	45	52	1	46.4	53.6	0.004	17.5	17
Evaluation and reuse	58	38	2	60.4	39.6	0.572	41.7	40
<i>Legend:</i>								
<=3 #	- number respondents scoring 1, 2 or 3		<=3 %	- perc. respondents scoring 1, 2 or 3				
> 3 #	- number respondents scoring 4 or 5		>3 %	- perc. of respondents scoring 4 or 5				
0 #	- number respondents scoring 0 (unknown / no answer)		Sig	- significance				
			<3 %	- perc. respondents scoring 1 or 2				
			<3 #	- number respondents scoring 1 or 2				

Given the relatively low number of respondents, especially in the group EA users, we tested on the total population as there are moderate positive correlations between the three groups. In table 7 the results are given. In the tests, responses 0 (unknown/no answer) were excluded.

For most value items, the tested hypothesis can be dismissed with certainty > 95% in favor of the alternative hypothesis with the exception of the goal-subcategories: societal responsibility, product position, marketing and sales, technology research and evaluation and reuse. These results match with the outcomes as found with the outstanding negative scores (table 6) as in these areas the scores given are generally low.

5.3 Perceived Value and the Characteristics of the Respondents

To determine if a relation exists between the outcomes on the questions about the perceived value of EA and the characteristics of the respondents and their organizations (as discussed in section 5.1), we performed chi-square tests. In these tests, we combined again the three groups of respondents and tested against the four goal-perspectives. Given the relatively low number of responses, the number of 0's in the cells of SPSS crosstabs was in all cases above the threshold for a Pearson's chi-square test, so we used the Fisher-Freeman-Halton Exact Test instead. We found only three relations with $p < 0.05$ (table 8) which could by all means be accidental.

Table 8. Relations between the respondents' background and goal-perspective

Respondents' background	Goal-perspective	p (2-sided)
Economic sector	Internal processes	0.008
Number of employees	Financial and accountability	<0.001
Number solution architects	Learning and growth	0.018

The outcomes on the questions about the perceived value of EA seem independent of the characteristics of the respondents. Whether this also holds true for the three groups separately cannot be established due to the relatively low number of responses.

5.4 Open questions

After each of the questions in the four goal-perspectives, an open question was added asking if there were any items missing that could be important in determining the value of the contribution of EA. A few suggestions were given: privacy, deprecating old-fashioned technologies, large projects with specific architectures, commitment of stakeholders and development of architecture as a competence throughout the organization. The current survey is based on benefits as found in literature, but these may change and some of these items could be added in a new version of the survey.

After the questions about the value items, feedback was given on the scores averaged by goal-perspective. Almost 20% of the respondents found these scores did not give a valid and reliable view on the contribution of EA. An interesting remark made here is:

‘the average is not interesting, the differences are’. While this may be true within an organization, in a survey like this we see in many items the full range of possible answers (with the exception of items where the average score is quite high or low), so we choose to show these outstanding high and low scores (tables 5 and 6) instead.

Other examples of remarks made here are: *‘I think having an architect is a bit of old school’*, *‘the summary above reflects how we value and approach architecture, but not necessarily the priorities’* and *‘EA in my organization is an ivory tower, out of touch with customers and stakeholders, only concerned with their own bureaucracy and artifacts, self-serving’*. Comments like these suggest a lack of communication between the enterprise architects and the rest of the organization resulting in low scores as well.

6 Discussion and conclusions

In this paper we have presented the outcomes of a survey concerning the contribution of EA to organizations. When relating these outcomes to the results of other surveys, it should be noted that the questions used in [34], [43] and this survey are not the same, so detailed conclusions cannot be drawn. However, Boucharas et al. [27] in 2010 found no benefits in the customer perspective of the balanced scorecard but in our earlier survey in 2014 [43] and in this survey we see an increasing contribution of EA to value items concerning the customer in this goal-perspective. This could be an indication that the focus of EA has shifted from the internal workings of the organization alone to include the organization’s environment as well. The same could happen in the future with areas such as ‘societal responsibility’, ‘(organizational) culture’ and ‘technology research’. This would be in line with the trends identified in recent EA publications in [44]. However, the low scores in the goal-subcategory ‘evaluation and re-use’ cannot be explained by the available data but could point to a low maturity of the EA processes; in the words of Robertson et al. [45]: *“an EA programme exists but it is executed without complete structure and accountability”*.

Foorthuis et al. [34] found that EA creators (EA developers and EA implementors) were more positive about the contribution of EA than EA users. In contrast – and in line with our earlier results [43], we found only small differences between these groups, but a clear conclusion in this aspect cannot be drawn as the number of EA users in this survey is small. Also, we did not find convincing relations between the characteristics of the respondents and the outcomes as categorized in the four goal-perspectives of the balanced scorecard (table 8), which suggests a commonly accepted view on what may be expected of EA, independent of the organizations the respondents work for.

As empirical data on EA value are scarce [16], this research contributes to the scientific community by providing empirical data about the value of EA, as perceived by architects and stakeholders of architecture. Based on these data, insights about the value items that currently score high and those that score low, is gained. Value items where the contribution of EA to organizations scores high (table 5) may be characterized as belonging to areas that have a long-standing tradition within EA such as compliance, risk prevention, providing insight and information management. It seems that

architects put much effort in these areas. The value items where in the eyes of the respondents the contribution of EA is below average such as societal responsibility, markets, culture, project management and technology research cover in majority areas that are more recently recognized as potential areas of interest to EA. These areas may become more important with time as discussed above.

In practice, organizations can use the questionnaires to assess the contribution of EA as perceived by their architects and stakeholders of architecture. Using the questionnaires in this way gives an organization the opportunity to prioritize some items and/or to add extra questions about aspects that are of interest to that organization. In upcoming research, we have elaborated this line of thought by developing an instrument to assess the contribution of EA in organizations. We are testing this instrument in case studies, where more in-depth qualitative research may give insight into the ‘why’ of the answers.

Overall, the results give a picture of the current state of EA in the Netherlands and the outcomes answer the research question: “*Where can the most important contribution to the value of enterprise architecture be found, according to architects and stakeholders of enterprise architecture?*”

This research has its limitations. First of all, as already stated above, the relatively low number of respondents is responsible for a relatively high margin of error and makes it impossible to say anything reliable about the group of EA users. Secondly, the respondents to our survey are self-selected and as such are not necessarily a random sample of those working in or with EA. As a consequence, some bias in the answers may be present. Finally, as the survey involves only respondents from the Netherlands, care must be taken in generalizing the results.

Acknowledgement. The authors want to thank all respondents for their contribution to this research.

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