The Enterprise Architecture Realization Scorecard: A Result Oriented Assessment Instrument

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Abstract. Enterprise Architecture (EA) is a well-accepted, but relatively young discipline. Since most practices are in the early stages of maturity, our research is aimed to develop an assessment instrument to measure and improve the EA management function's ability to realize its goals. In this paper, we propose the Enterprise Architecture Realization Scorecard (EARS) and an accompanying method to discover the strengths and weaknesses in the realization process of an EA management function. During an assessment, representative EA goals are selected, and for each goal, the results, delivered during the different stages of the realization process, are analyzed, discussed and valued. The outcome of an assessment is a numerical EARScorecard, explicated with indicator-values, strengths, weaknesses, and recommendations. The concept and composition of the EARS is primarily inspired by the principles of CobiT and TOGAF's Architecture Development Method. Two cases are discussed to illustrate the use of the instrument.

Keywords: Enterprise Architecture, Assessment, CobiT, TOGAF.

1 Introduction

The Enterprise Architecture (EA) management function forms a means to enhance the alignment of business and IT and to support the managed evolution of the enterprise [4]. EA can be defined, according to the ISO/IEC 42010 [11], as "the fundamental organization of [the enterprise] embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution". A number of enterprise architecture frameworks have been proposed, including The Open Group Architecture Framework [26], DoDaf [6], GERAM [10], the Zachman Framework [30], and many more, as described by Chen, Doumeingts and Vernadat [5].

Over the last decades, EA management is introduced in many large organizations, but most practices are in the early stages of maturity, and the introduction and

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elaboration often do not proceed without problems ([3], [25]). Moreover, the performance of the EA management function typically is not measured [29]. Existing research aimed at evaluating the maturity and performance level of EA (e.g., [17], [16], [19], [24]) and improving the effectiveness of EA (e.g., [7], [15]) holds promise of practical uses.

Our study builds on this line of research and contributes to it by the development of the Enterprise Architecture Realization Scorecard (EARS), a result oriented assessment instrument, focused on measuring and improving the effectiveness of an EA practice in realizing its goals. Our research aims to deliver a product with practical relevance and focuses on the research question: How can we measure the EA management function's ability to realize its goals? Two core concepts call for some elaboration: 'EA management function' and 'effectiveness of EA'.

The EA (management) function is extensively defined by van der Raadt and van Vliet [20]: "The organizational functions, roles and bodies involved with creating, maintaining, ratifying, enforcing, and observing Enterprise Architecture decision-making – established in the enterprise architecture and EA policy – interacting through formal (governance) and informal (collaboration) processes at enterprise, domain, project, and operational levels."

The effectiveness of EA management can be viewed, defined and measured in many different ways [16]. The EARS approach states that an EA management function is effective, when it is able to transform a given baseline situation into a target situation as specified by one or more goals, set out to the EA management function. These EA goals, or in terms of TOGAF [26] “requests for architecture work”, should be aligned with the corporate strategy, as shown in Fig. 1. There is a huge variety in type and scope of goals set to different EA management functions. An example of an EA goal of a governmental organization is, "The organization should be able to implement a change in legislation within three months".

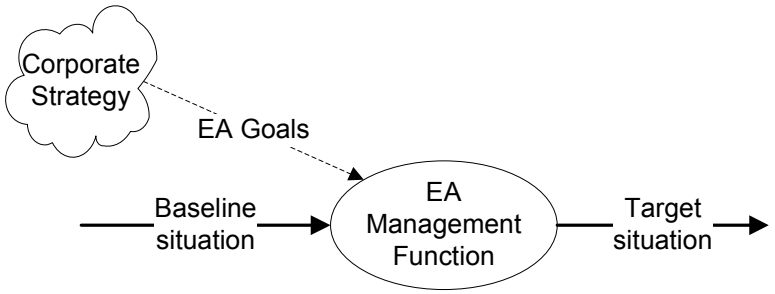

Fig. 1. The role of the EA management function

The objective of the EARS approach is to assess how well an EA management function is able to realize its goals; independent of the type of goals. The approach aims to do this by selecting some representative goals, by successively investigating the results produced in the context of an EA goal, and by scoring the results on different aspects. An EARS assessment may be used for awareness and improvement, but also for governance with respect to the progress and quality regarding an EA goal.

A number of instruments with similar objectives is developed and proposed, like EA balanced scorecard [23], EA maturity models ([9], [17], [21], [24]), and EA analysis approaches ([4], 14]). The main difference between the balanced scorecard approach and the EARS approach is that the balanced scorecard approach is concerned only with the outcome (added value) of EA management, while the EARS approach is also concerned with how the outcome is reached. The main difference with the maturity approach is that this approach aims to measure the effectiveness of the EA realization process indirectly (assuming that when a certain maturity level is reached for each key area, the EA function will operate effectively), while the EARS approach aims to measure the effectiveness of each step in the EA realization process directly, by assessing the results. The main difference with the EA analysis approaches is that, expressed in terms of Buckl's classification schema [4], most of them have a specific Analysis Concern, have a related specific Body of Analysis, and are not Self-Referential, while in the EARS approach the Analysis Concern and the Body of Analysis will vary per EA goal, and the approach is Self-Referential. Furthermore, the EARS approach is not only focused on EA artifacts, but on all activities and results of the EA realization process, including acceptance of the architectural decisions, outcome of architecture conformance checks, etc.

The research approach applied to develop the EARS is that of design-science research ([8], [18]), since the research was intended to deliver artefacts relevant to the professional practice. The applied approach conformed to the seven guidelines of Hevner et al [8]. For instance, the design of the EARS was evaluated with experts from the professional and scientific fields, and EARS assessments were conducted at large organizations to evaluate its applicability.

In this paper, the EARS instrument is presented in section 2, where the major decisions regarding the design of the EARS are explained as well. Section 3 describes the method and section 4 the application of the EARS at two organizations. Section 5 discusses the strengths and weaknesses of the EARS approach and the research so far, while section 6 presents the conclusions and an outlook to future work.

2 The Enterprise Architecture Realization Scorecard (EARS)

2.1 Concept of the EARS

The research question "How can we measure the EA management function's ability to realize its goals?" can be answered in different ways. One option is to measure the final result (changes in business operation) only and answer the question: To which extent is the operational performance matching with the target values of the EA goal?

The advantage of this approach is that it seems to be straightforward and relative simple. However, there are a number of disadvantages. Only goals that are realized completely will be eligible for a measurement. Additionally, it is not made plausible that the final results may be attributed to EA management. Moreover, the resulting score does not give any grips for the causes and so for improvement. Therefore the option 'measuring the final result only' was rejected and the alternative option was chosen: measure at a more detailed level. To find the best way to do this, the body of knowledge of (IT) governance was used, since measuring the organizational and IT performance is a well-established practice within this field. CobiT [12] appeared to be

especially useful for this study. It is an open standard for IT Governance, well accepted both in practice and in the academic world. The CobiT framework is based on the following principles: business-focused, process-oriented, controls-based and measurement-driven. These principles are extensively explained in the CobiT 4.1 Excerpt [13]. Transfer of these CobiT-principles to the field of EA resulted in a metamodel, shown in Fig. 2, and a set of principles. Together they form a concept, which enables measurement of the EA management function in achieving its goals, at a detailed level.

- *EA goals* are derived from the business goals and enterprise strategy. *EA goals* should best be specific, measurable, actionable, realistic, results-oriented and timely.
- *EA goals* are realized through a (repeatable) *EA realization process*.
- The *EA realization process* is composed of a logical sequence of *EA activities*.
- Per *EA activity* an *activity goal* and related *metrics* are specified. The metrics are primarily focused on the *result* of the *EA activity*.

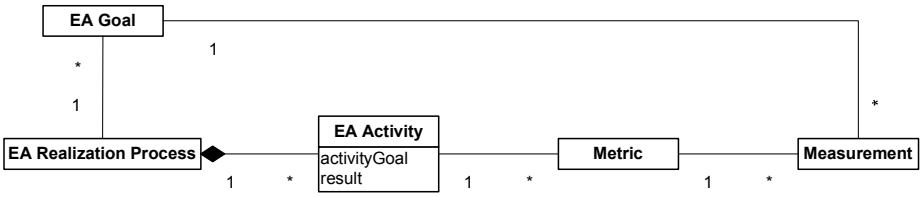

Fig. 2. Metamodel of the EARS concept

2.2 EA Activities and Results

After the concept of the EARS was established, the following sub-question became relevant: Which EA activities and results should be distinguished? Since no commonly accepted reference process exists, one could evaluate the EA management against [4], we designed an EA realization process suitable for the EARS concept. Five EA activities, depicted by rectangles, with their results were identified, which are shown in Fig. 3 and further explained in Table 1.

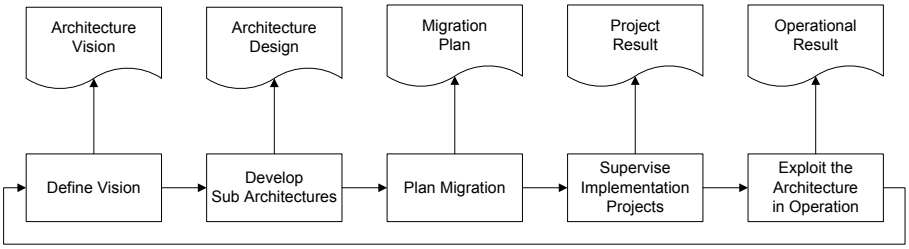

Fig. 3. The five EA activities with their results distinguished in the EARS

The EA activities were primarily derived from the Architecture Development Method (ADM) of TOGAF 9 [26], because it offers an architecture development cycle that covers all life cycle aspect as required by GERAM [22]. Furthermore, TOGAF is "probably the most well-known framework for EA management" [29]. To ensure completeness of the set of EA activities, other sources (e.g., [20], [27], [28]) were also studied and the proposals were validated during expert meetings.

Although EARS is based on TOGAF, its EA realization process differs from TOGAF's ADM. EARS distinguishes five EA activities while ADM recognizes nine phases, so the mapping (shown in Table 1) is not one to one. The first two EARS EA activities simply can be linked to four ADM phases. For the last three EA activities, coupling is more complex. The reason is that ADM often defines different types of output for a phase, while these types of output should be measured and assessed separately according the EARS approach. For instance, within ADM Phase G, Implementation Governance, the architecture is implemented within the solution under development and afterwards the solution is implemented in the operational environment. However, these two results are considered as very different within the EARS and consequently they are measured separately.

Table 1. The characteristics of the five activities distinguished in the EARS

Id	EA Activity	EA Activity Goal	Result	ADM Phase
#1	Define Vision	Determine the EA goals within scope of the architecture iteration, develop a high level, integrated and approved solution direction towards matching these goals and create a concise plan to realize them.	Architecture Vision	A
#2	Develop Sub Architectures	Develop the required subsets of architectures to support the agreed architecture vision.	Architecture Design	B, C, D
#3	Plan Migration	Search for opportunities to implement the architecture and plan the migration.	Migration Plan	E, F
#4	Supervise Implementation Projects	Ensure conformance to the architecture during the development and implementation projects.	Project Result	F, G
#5	Exploit the Architecture in Operation	Assess the performance of the architecture in operation, ensure optimal use of the architecture, and ensure continuous fit for purpose.	Operational Result	G, H

2.3 Valuing the Results: Aspects and Indicators

During an assessment a few representative EA goals are selected. For each goal is determined to which extent the EA management function was able to realize the goal (up to the moment of the assessment). This is done by valuing the results so far. EARS distinguishes five results, one per EA activity, as shown in Table 1. Furthermore, three aspects (product, acceptance, scope) of a result are distinguished

to enable an objective way of measuring and scoring. This is done, because an architect can design a top quality solution (product aspect), but if it is not accepted (acceptance aspect), nothing is gained. On the other hand, if the solution is limited (scope aspect) to one architectural domain, e.g. technology, the goal may never be realized. The three aspects with their focus, question and scale are defined in Table 2.

Table 2. The aspects to be valued per result

Result Aspect	Description/Question	Scale
Product	Focus: The completeness, in terms of depth, and the quality of the outputs. Question: To which extent will the EA-goal be realized with it?	1-10
Acceptance	Focus: The acceptance and commitment of the stakeholders. Question: To which extent do they know, understand and agree with the product, and do they act committed?	1-10
Scope	Focus: The completeness, in terms of width, of the outputs. Question: Is the output width sufficient to realize the goal?	1-10

For each EA activity result, the three aspects are scored separately, and these scores are recorded at the EARScorecard. An EARScorecard summarizes the assessment result. An example of a scorecard (with the scores of case 2 in section 4) is shown in Table 3. Most scores are at a scale of 1-10, where 1 stands for low and very incomplete, and 10 for high and complete. The totals in the scorecard are calculated, based on the aspect scores of product, acceptance and scope. The derivation of the totals is described in the next sub section.

Table 3. EARS scorecard of the EA goal of Case 2

Id	Result	Aspect	Aspect score	Scope score	Aspect total	Result total
#1	Architecture Vision	Product	8	8	6	5
		Acceptance	5		4	
#2	Architecture Design	Product	3	6	2	2
		Acceptance	2		1	
#3	Migration Plan	Product	5	2	1	1
		Acceptance	5		1	
#4	Project Result	Product	7	1	1	1
		Acceptance	6		1	
#5	Operational Result	Product	4	1	1	1
		Acceptance	3		1	
	Goal total				19	

The different scores represent the collected evidence, and should enable reasoning about the strengths and weaknesses of the EA management's realization process:

- Aspect score and Aspect total express the contribution of an aspect to a result of a specific EA activity;

- Result total expresses the contribution of the EA activity to the realization of the goal;
- Goal total expresses the extent, creditable to EA management, to which the EA goal is realized. The goal total is the most abstract, and the least precise score of all. It is influenced by many factors and consequently, comparison of the goal totals of different EA management functions is not useful. However the goal total can be used to track the progress in time, regarding a goal.

During the judgment of a result, a number of considerations should be taken into account, like the EA-goal, the activity goal and the three aspects with their questions. To support the assessors and to objectify the rating, indicators were developed for each combination of result and aspect. The indicators for the aspects *Product* and *Scope* were mainly derived from TOGAF's ADM [26], since it provides elaborate descriptions of objectives, intent, approach, activities, artifacts, inputs and outputs for each phase [22]. The technique of scaled coverage percentage [31] was used to classify and prioritize the indicators. As an example, the set of indicators with their relative weights (W) for result *Architecture Vision* is shown in Table 4. For reasons of space, the indicator sets of the other EA activity results are not included in this paper, but a manual with all the indicators can be requested from the first author. The process of evidence collection and scoring (based on indicators and arguments) is explained in section 3 and illustrated in section 4.

Table 4. Set of indicators of result #1, Architecture Vision

Aspect	Id	Indicator	W
Product	1	The EA-goal is related to the business strategy and included in the vision.	0,2
	2	The EA-goal is SMART and (if needed) decomposed into high level stakeholder requirements.	0,2
	3	A high level solution direction is described and the solution direction to the goal is correct and realistic/realizable.	0,2
	4	The solution direction to the goal is integrated with the solution directions of the other goals (integrated vision).	0,3
	5	A comprehensive plan exist to realize the solution direction.	0,1
Acceptance	1	The architecture vision is well known by the stakeholder.	0,2
	2	The stakeholders understand the vision, the solution direction to the goal and its implication.	0,2
	3	The stakeholders agree with the solution direction to the goal and its implications.	0,3
	4	The stakeholders feel committed to (this part of) the vision.	0,3
Scope	1	The architecture vision covers the business, data, application and technology domains, related to the goal.	1,0

2.4 Formal Description of EARS

The EARS instrument is composed of the instantiations of *EA Realization Process*, *EA Activity*, *Aspect*, *Metric* and *Indicator* in the final metamodel, shown in Fig. 3. There is only one *EA Realization Process* and its processGoal is, to realize an *EA goal*, regardless of what the goal may be.

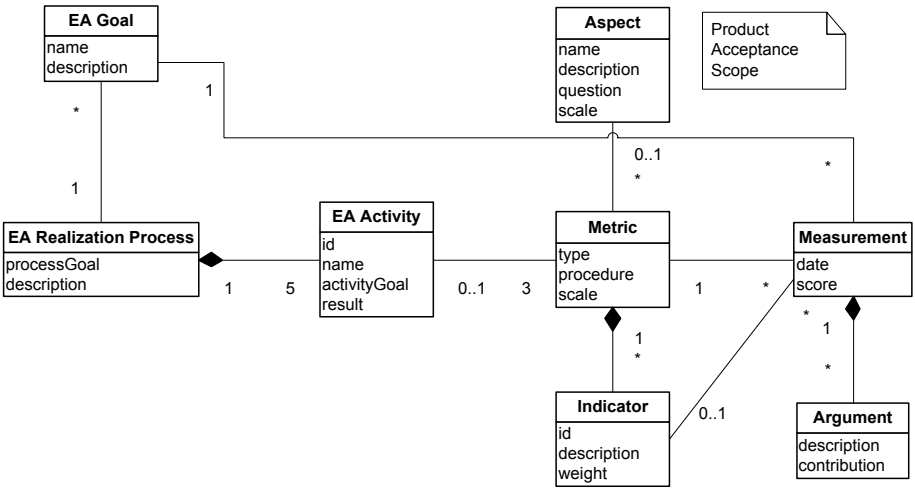

Fig. 4. Final EARS metamodel

Instantiations of *EA Goal*, *Measurement* and *Argument* are specific to an assessment. The Goal Question Metric approach [2] was taken into account, but no separate entity Question is included, because the questions at Aspect do satisfy in combination with the activity goals and the EA goal. The terms metric and measurement are often used in a quantitative approach, but in CobiT [12] they are also used for qualitative usage, which is also the usage within the EARS approach.

Most metrics within the EARS describe how an aspect of a result of an EA activity can be measured. The metrics, needed to calculate the totals of the EARS scorecard, are described below.

First, the notations are introduced:

- Let $G = \{g_1, g_2, ..., g_n\}$ be the set of EA goals.
- Let $R = \{r_1, r_2, ..., r_5\}$ be the set of Results of the EA Activities of the EA Realization Process.
- Let $A = \{product, acceptance, scope\}$ be the set of Aspects.
- Let $PA = \{pa_1, pa_2\}$ be the subset of A containing *product* (pa_1 and *acceptance* (pa_2 only.

Subsequently, the scores and totals can be defined as follows:

- The aspect score expresses the score for the product or acceptance aspect for a result of a goal:
  aspect_score is a function from *G* x *R* x *PA* to {1, …, 10}
- The scope score expresses the score for the scope aspect for a result of a goal:
  scope_score is a function from *G* x *R* to {1, …, 10}
- The aspect total can be calculated as the multiplication of the aspect score (product or acceptance) with the scope score for a result of a goal, divided by 10:
  aspect_total is a function from *G* x *R* x *PA* to [1, 10]
  $aspect\_total(g, r, pa) = (aspect\_score(g, r, pa) \text{ x } scope\_score(g, r))/10$
- The result total can be calculated as the average of the aspect totals for a result of a goal:
  result_total is a function from *G* x *R* to [1, 10]
  $result\_total(g, r) = (aspect\_total(g, r, pa_1) + aspect\_total(g, r, pa_2))/2$
- The goal total can be calculated as the sum of all the aspect totals of a goal:
  goal_total is a function from $G \rightarrow [1, 100]$
  $goal\_total(g) = \sum_{i=1,j=1}^{5,2} aspect\_total(g, r_i, pa_j)$

The scales of the EARS are chosen as specified, because decimal scales are often used and quite understandable. Therefore, they enhance correct valuing and correct interpretation of the scores. Since the scores do represent substantiated opinions and not exactly measured data, the numbers are rounded off to integers.

3 Method

The purpose of an EARS assessment is to provide an analysis of the strengths and weaknesses of the EA management function's realization process. Furthermore, to provide recommendations to the responsible manager and his team. The process to execute an EARS assessment is summarized below. The main line corresponds with the main line of Johnson's et al. [14] "overall process of enterprise architecture analysis".

1. Prepare the assessment with the responsible manager.
   a. Determine the objective of the assessment.
   b. Determine the position of the EA function within the organization.
   c. Select the EA goal(s).
   d. Select the architect(s) and stakeholders, suitable to the selected goal(s). Include at least one relevant stakeholder per EA activity. A typical set interviewees contains a business manager, information manager, enterprise architect, portfolio manager, solution architect, software engineer, expert from the business.
   e. Plan the assessment.
2. Collect evidence.
   a. Study relevant documents (strategy, goals, architecture, roadmaps, project portfolios ...).

   b. Interview the architects and stakeholders.
   c. Process the findings into arguments per indicator.
3. Interpret the evidence and set up a report.
   a. Process the arguments into scores within the scorecard.
   b. Set up an assessment report with strengths and weaknesses, and recommendations.
4. Present the outcomes of the assessment.
   a. Discuss the report and the findings with the responsible manager.
   b. Present the results to the architects and stakeholders.

Some topics related to step 2 and 3 do need some elaboration. During these steps, the assessor searches for information, interprets the information, and processes the information into arguments and scores. Scores within the EARScorecard will often represent substantiated opinions. The substantiation of the score of an aspect of a result is constituted by the weighted average of the related indicator scores. The indicators aid the assessor, but nevertheless have a high level of abstraction, since they should be useful for very different types of EA goals. Consequently, an indicator score needs substantiation as well, which is enabled by arguments and its contribution. The arguments per indicator are assembled in step 2 and recorded in tables, preferably with their source (interviewee or document). An example set of arguments is shown in Table 5. The arguments are not exclusively used for scoring, since they also form the basis for the description of the strengths and weaknesses, which explain the scores, and the recommendations in the assessment report.

Table 5. Example set of arguments belonging to result #2, Architecture Design

Aspect	Indic.	Contr.	Argument description
Product	1	+ -	Baseline Application architecture is described. Baseline Business, Data and Technology architectures are not described.
	2	...	...

To score the results, the assessor should be able to determine and value the artifacts (depth and width) required to realize a specific goal. Questionnaires and indicators are available to support the assessors, but since the indicators have a high level of abstraction, other sources should be used as well. The EARS-indicators are derived from the TOGAF ADM input and output descriptions per phase [26], so detailed knowledge of ADM is desirable. Besides, TOGAF contains an "Enterprise Content Metamodel" that describes the core classes, properties and relationships that make up an EA model. Furthermore, other sources, like 'Essential layers, artifacts, and dependencies of EA' [28] and 'An engineering approach to EA design' [1], are useful as well.

No goal specific expertise is expected from the assessor, because an EARS assessment is a retrospective study. The effectiveness of the architectural choices and solutions is revealed by the opinions and the information of the interviewees.

4 Application

To evaluate and improve EARS, the instrument was used in various organizations, located in the Netherlands. One assessment was conducted at a governmental organization and another at a financial organization. These assessments will be discussed below. A third assessment was conducted at an industrial company. It contributed to the research, but will not be discussed here, as EA management was not functioning long enough for a complete assessment.

Case 1: A Large Governmental Organization

This governmental organization is practicing enterprise architecture for some years. The study focused on the EA management function responsible for a large organizational domain with more than 10,000 employees. The case study aimed to deliver the organization an assessment focused on awareness and improvement of the EA function.

Two goals were selected in dialog with the client, namely 'Provide clarity to customers more quickly' and 'Reduce the complexity of the processes'. These goals were selected because they were representative for the complete set of EA goals, and because the organization was well on its way achieving these goals. Thereafter, the responsible architect was consulted, documents relevant to the goals were collected and studied, and ten architects and stakeholders were interviewed. Finally, a report was prepared, which was discussed with, and approved by the responsible manager and some key stakeholders. The EARScorecard of the EA goal 'Provide clarity to customers more quickly' is shown in Table 6, and a graphical representation of the aspect totals and result totals is shown in Fig. 5.

Table 6. EARS scorecard of the EA goal: 'Provide clarity to customers more quickly'

Id	Result	Aspect	Aspect score	Scope score	Aspect total	Result total
#1	Architecture Vision	Product	9	10	9	10
		Acceptance	10		10	
#2	Architecture Design	Product	4	10	4	4
		Acceptance	4		4	
#3	Migration Plan	Product	10	10	10	10
		Acceptance	10		10	
#4	Project Result	Product	4	10	4	5
		Acceptance	6		6	
#5	Operational Result	Product	1	5	1	1
		Acceptance	1		1	
	Goal total				39	

The EARS scorecard shows large differences between the five results. The scores for the *Architectural Vision* are very high, because there is an approved, high-level description of what is necessary to realize the goal. Additionally, the impact of the

changes is known. The high acceptance score is due to the fact that the architects work in close cooperation with the decision makers.

The score for the *Architectural Design* is relatively low. At the moment of the assessment, the architecture was focused on the baseline architecture, which sufficed to perform a proper impact analysis of the intended changes. An integrated target architecture, needed to realize all EA goals for the coming years, was mostly missing, while considerable changes were expected. Consequently, the projects related to the goal could not anticipate on the target architecture, which will result in higher than necessary transition cost in the near future.

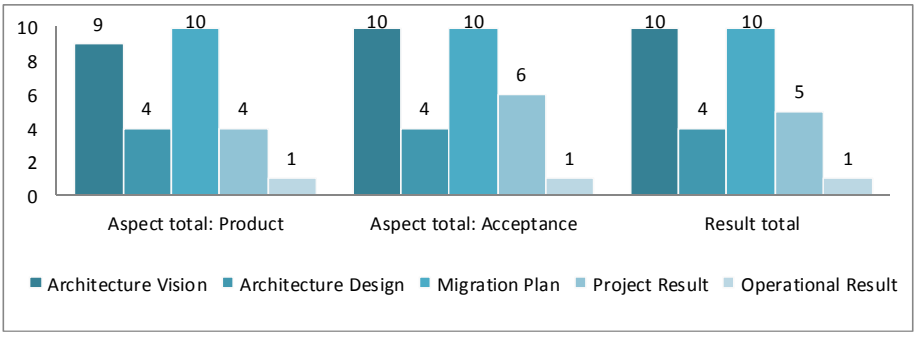

Fig. 5. The result totals of the EA goal 'Provide clarity to customers more quickly'

Migration Plan scores high, because a realistic roadmap was developed and acceptance and commitment of the stakeholders was high and remained high. All four projects, needed to realize the selected goal, were included in the project portfolio, and were already under development or beyond.

The low score for *Project Result* is partly related to the missing target architecture, as discussed under Architecture Design. Consequently, the projects were not provided with architectural definitions and requirements. Positive was the collaboration with the project architects in the early stages of the project. Negative was the lack of checking of the conformance of the implementation to the architecture.

Finally, the low score for *Operational Result* is because the most important implementations were not yet operational. Positive returns were expected in the next calendar year.

Case 2: A Large Financial Organization

This financial service provider is in transition from a decentralized organization, composed of more than ten companies and brands, to one centralized company, striving for one way of working and for operational excellence. For this assessment, the following EA goal was selected, "Implement a corporate data warehouse". Sub goals included not only corporate wide business intelligence, but also the provision of integrated production data to portal and output service. This goal was part of an

architecture master plan, which was approved approximately three years before. Evidence collection included a total of two days of document study and ten interviews, which mostly lasted 30-60 minutes. The scores in Table 3 and Fig. 6, 7 show the outline of the assessment outcome.

The *Product aspect* of *Architecture Vision* and *Project Result* contribute most to the goal. It shows the focus of the EA management's attention.

Architecture Design was largely skipped as part of a bottom-up strategy. The deficiency of the *Architecture Design* is probably one of the reasons why the first projects in the roadmap encountered huge problems in various areas. Complexity appeared much greater than anticipated. Consequently, the initial projects ran out of time, trust disappeared and follow-up projects were not approved.

The *Acceptance aspect* scores significantly low, compared to the *Product aspect*, due to insufficient communication with the business. Furthermore, the end users in the business were not satisfied with the delivered solution.

The *Scope aspect* shows the decline in the width of the architecture, the percentage of the roadmap executed, and the percentage of the goal covered by the final solutions.

The *Result Totals*, shows the decline in contribution to the goal, predominantly due to the decline of the *Scope aspect*.

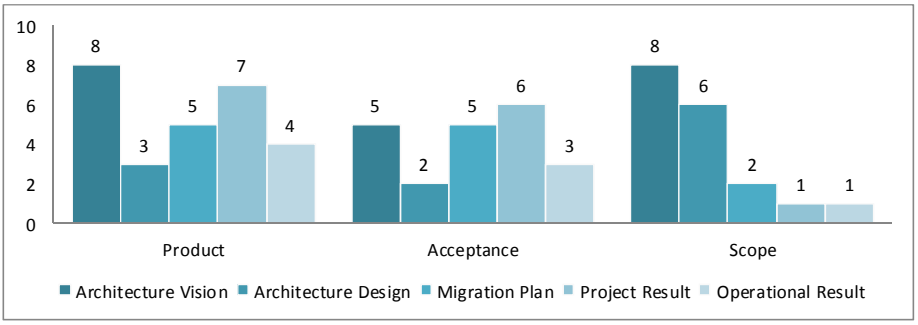

Fig. 6. Product, Acceptance and Scope scores per EA activity result

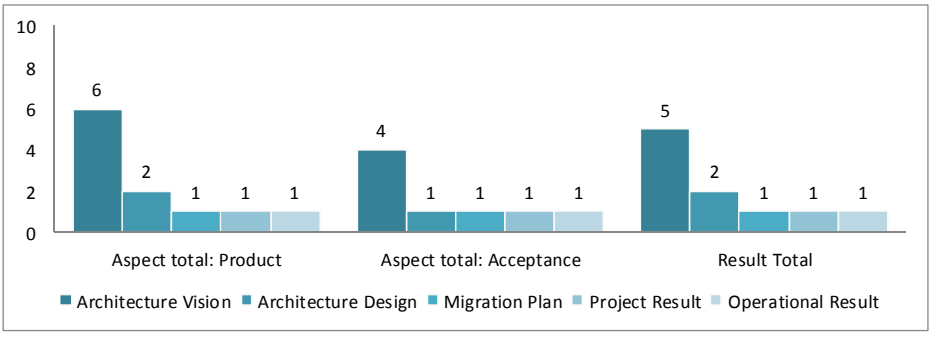

Fig. 7. Aspect totals and Result totals per EA activity result

The three aspect-scores per EA activity result were each constituted by the weighted average of the related indicator scores. As an illustration, Table 7 shows how the product score, acceptance score and scope score of the result #1 Architecture Vision are composed of the indicator scores. Per indicator, the indicator score (S), valued by the assessor on a scale of 1-10, is multiplied with the indicator's weight (W) to the indicator total (T).

Table 7. Aspect and indicator scores of result #1, Architecture Vision

Aspect	Id	Indicator	W	S	T
Product	1	The EA-goal is related to the business strategy and included in the vision.	0,2	10	2,0
	2	The EA-goal is SMART and (if needed) decomposed into high level stakeholder requirements.	0,2	6	1,2
	3	A high level solution direction is described and the solution direction to the goal is correct and realistic/realizable.	0,2	7	1,4
	4	The solution direction to the goal is integrated with the solution directions of the other goals (integrated vision).	0,3	8	2,4
	5	A comprehensive plan exist to realize the solution direction.	0,1	7	0,7
		Product score			**7,7**
Accep-tance	1	The architecture vision is well known by the stakeholder.	0,2	8	1,6
	2	The stakeholders understand the vision, the solution direction to the goal and its implication.	0,2	4	0,8
	3	The stakeholders agree with the solution direction to the goal and its implications.	0,3	5	1,5
	4	The stakeholders feel committed to (this part of) the vision.	0,3	4	1,2
		Acceptance score			**5,1**
Scope	1	The architecture vision covers the business, data, application and technology domains, related to the goal.	1	8	8,0
		Scope score			**8,0**

The indicator values were substantiated by means of arguments collected during the assessment. E.g., with regard to result #1 Architecture Vision, twenty five arguments were gathered, varying from two to seven arguments per indicator. Approximately 60% of these arguments originated from the study of architectural artifacts, while the remaining 40% did arise during the interviews. Table 8 shows examples of arguments. Arguments are described in case specific terms and may include references to the sources of the information. To ensure anonymity, table 8 contains the condensed arguments of only a few indicators.

Table 8. Arguments regarding two indicators of the product aspect of result #1

Aspect	Indicator	Contribution	Argument description
Product	1	+	The goal "Implement a corporate data warehouse" is based on the corporation's strategy and target operating model.
		+	Conformance is confirmed by several interviewees.
	2	-	The goal is not formulated explicitly, it is not SMART and no sub-goals were specified.
		+	Sub-goals can be derived from the architecture master plan.
		+	Stakeholder requirements are described in the master plan as business and ICT issues to be solved by the data warehouse.
		-	No objectives were set for the EA management function, when the function was initiated.

The assessment report describes the strengths and weaknesses of the realization process of the EA management function and recommendations for improvements. The strengths and weaknesses were based on the indicator scores and were described in case specific terms, in line with the corresponding arguments.

The recommendations were derived from the strength and weaknesses. The recommendations summarized the most important improvements to work on and included references to relevant literature. Some main lines from the recommendations of this case are:

- Identify explicit goals to the EA management function in collaboration with the stakeholders. Set realistic and SMART (sub) goals and work from these goals.
- Do not combine major goals and complex projects with a bottom-up strategy regarding the development of the EA management function and EA artifacts.
- Develop architectural artifacts to substantiate and verify the accuracy, impact and feasibility of the goals and solution directions. Do this for both the baseline and target situation and use these as a base for roadmaps.

5 Discussion

The EARS assessments, described above in the case studies, proceeded without problems and provided interesting analysis outcomes and recommendations to the organizations involved. The two described cases show great differences in the EA management's goals and approaches, and the assessments delivered very different outcomes. However, some similarities were identified as well. Both EA functions scored low on Architecture Design, especially the target architecture. This was partly compensated, by a shared effort to draw up solution architectures within the projects. Another similarity is that both EA functions failed to check on conformance during the implementation. These findings match with research on the maturity level of 56 EA management cases [25], where the focus areas 'Development of architecture' and 'Monitoring' scored respectively low and very low on the maturity scale.

The case studies were also focused on the evaluation of the EARS approach itself. During the interviews and meetings of the case studies, additional information was gathered to gain insight in the applicability, effectiveness and efficiency of the instrument.

The EARS approach appeared to be effective, since the scorecard, indicator values and assembled arguments proved to be an adequate base to identify the strengths and weaknesses of the realization process and to provide recommendations. Moreover, the responsible managers and key stakeholders approved the outcome of the assessments, and interviewees who were asked whether the main aspects of the architecture function were covered during the interview, responded positively. As additional revenue, a responsible manager observed that the assessment stimulated the internal discussion regarding the focus, method and effectiveness of the architecture function.

Some doubts in advance about the applicability of the EARS approach were answered. E.g., some findings in the case studies were:

- The EA goals were well identifiable and selecting representative goals did not cause problems.
- EA activities and the results were sufficiently distinctive and recognizable and could be found in practice.
- The aspects product, acceptance and scope were generally well identifiable for the results. However in some cases two aspects are closely linked. Such as in # 3 Migration Plan, where product and acceptance are not well distinguishable and thus are given the same value.
- The indicators were developed during the first case study and refined afterwards. During the following applications, they appeared to be useful and were not challenged.

The outcomes of the case studies give us reasons to believe that the EARS can be applied conveniently and is quite effective as an assessment instrument with awareness and improvement purposes.

However, there are some limitations to our research so far. Although three assessments in different types of organizations were conducted in the Netherlands, our research findings are not inevitably valid for other companies, sectors or countries. Furthermore, our study could not provide a valid conclusion regarding the efficiency of the assessment method, since it did not include a comparison with other assessment approaches. The EARS approach appeared to be quite efficient to the research team, because after five to six interviews, the image was sufficiently sharp and the results could be rated. Subsequent interviews did add little new knowledge to the assessment, but were useful to confirm findings.

6 Conclusions and Further Research

In this paper, we presented a novel instrument to assess and rate how well an EA management function is able to realize its goals, the Enterprise Architecture

Realization Scorecard (EARS). During the assessment of an EA goal, five types of results, delivered during the EA realization process, are analyzed and discussed in interviews with relevant stakeholders. Arguments are assembled and, by means of indicators, translated to scores. For each result, three aspects are scored: product, acceptance and scope. The scores are recorded at a scorecard and subsequently, totals at result level and goal level can be calculated. Finally, an assessment report is prepared, with a scorecard, strengths and weaknesses of the EA realization process (based on the scores in the scorecard, indicator scores and arguments), and recommendations.

We used two case studies to illustrate how the EARS instrument is used in practice. The application at a large governmental organization and a large financial organization delivered interesting outcomes: strengths and weaknesses were detected and substantiated and recommendations were given. Since the selected goal and EA management function itself were quite different from the first case, the outcome of the assessment and the recommendations differed significantly. The EARS approach appeared to be effective in these cases. The scorecard, indicator values and assembled arguments proved to be an adequate base to identify the strengths and weaknesses of the realization process and to provide recommendations. Furthermore, the assessment stimulated the internal discussion regarding the focus, method and effectiveness of the architecture function.

The EARS instrument contributes to the professional practice by adding an assessment instrument that can be used to evaluate the effectiveness of the EA management function's realization process. To connect to the professional practice, the instrument is based on two well-accepted open standards CobiT [12] and TOGAF [26].

The EARS instrument contributes to the research on architecture effectiveness by focusing on the EA realization process and its results.

Distinctive characteristics of the EARS approach are:

- the focus on goals specific to the organization;
- the focus on the realization process, its activities and results;
- aspects and indicators support the evaluation of the results;
- numerical values in a scorecard give an overview of and support reasoning about the strengths and weaknesses.

Interesting topics for future work emerged during this study. Research is needed to determine whether the assessment results of one or two representative goals can be generalized to general statements about the EA function. Furthermore, comparative research on EARS and other EA assessments approaches could be interesting. It could contribute to the further development of the set of indicators. In addition, it might reveal and explain correlations between focus areas of maturity models and high scores in the EARScorecard.

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