

# Experience Report: Assessing a Global Financial Services Company on its Enterprise Architecture Effectiveness using NAOMI

**Abstract**—Large organizations are increasingly recognizing the benefits of enterprise architecture, and heavily investing in it. However, many of those organizations struggle to be truly effective with architecture. In order to determine points of improvement, we have developed an approach for assessing an organization on its architecture effectiveness. Our approach differentiates from existing assessment models by considering multiple perspectives. It makes a distinction between the level of thinking about architecture, and the level of practicing it. It also gives insight in the (mis)alignment between IT and business oriented architecture functions. In this paper we describe the practical application of our assessment approach at a global financial services company.

## I. INTRODUCTION

Enterprise architecture, as a discipline, has received much acceptance within the business community. Almost every self-respecting organization of considerable size has at least one, but often various, architecture functions. These functions typically receive a structural budget, depending on their focus and scope (ranging from a single IT project architecture to an entire enterprise architecture). Also, the position of architect is often a formally acknowledged role within those organizations.

Although enterprise architecture has established itself as an accepted discipline, in practice many firms struggle with reaching the objectives they strive for with their architecture program. In practice there is quite a difference between architecture thinking and putting architecture into practice; between creating high quality architectures and actually reaching the TO-BE situation described by those architectures. Also, in practice, architecture functions with a different focus (either on business architecture or IT architecture) may not be aligned in their work [1].

In order to be truly effective with enterprise architecture, many firms need to improve their architecture functions. This involves establishing a high level of architecture awareness, creating and realizing high quality and practice-oriented architectures, which help in simplifying and aligning the business and IT situations. Such a learning process of improving the architecture activities may be accelerated through periodically performing architecture effectiveness assessments. This involves assessing the organization on its ability to reach the goals it strives for with enterprise architecture; its architecture effectiveness.

In general, two types of architecture assessment approaches exist, which focus either on (1) architecture maturity (e.g. [2], [3], [4] and [5]) or on (2) business and IT alignment (e.g., [6] and [7]). These architecture maturity or

architecture alignment assessment models provide a one-dimensional perspective on how effective an organization is with its enterprise architecture program. However, a multi-dimensional perspective is vital in properly assessing an architecture organization [8]. For example, making a distinction between creating architectures (architecture awareness) and actually putting them into practice (architecture maturity). Or the (mis)alignment in focus of several architecture functions within the same organization (architecture alignment). Furthermore, these existing models, in representing the assessment results, all assign a general, predefined level of maturity to an organization. Such general levels often do not fit an organization's specific situation well. Also, reaching the highest maturity level may become a goal on its own, which should never be the case, because an assessment model is by definition a means and not a goal.

Therefore, we are currently developing an approach for performing such assessments, named the Normalized Architecture Organization Maturity Index (NAOMI). Our approach assesses an organization on its architecture effectiveness from three essential perspectives: (1) architecture awareness, (2) architecture alignment, and (3) architecture maturity. This results in a multi-angle insight in an organization's architecture effectiveness, taking into account the difference between creating and improving architectures at a corporate level and putting them into practice at a project level. Also, NAOMI represents the assessment results using two visualization models, with which it does not assign a general level of maturity to an organization, but provides a customized assessment result.

In order to gain practical experience, and to improve and validate the approach, we conduct assessments at client organizations. Based on the lessons learned during those assessments we adjust our model, so that it becomes more practice-oriented. This paper provides an experience report of an assessment we conducted at a global financial services company. First, we give an overview of our assessment approach in Section II. In Section II.A we describe the variables we use while performing an assessment. Firstly we provide three specific perspectives on architecture effectiveness, and secondly six key intrinsic assessment variables of NAOMI. Following, in Section II.B, we describe how we construct the questionnaire we use to validate NAOMI, based on these variables. Section II.C describes the visualization models we use in NAOMI to represent the assessment results to the client. Section III describes the assessment we conducted within the IT function of a global financial services company. We start our assessment

description in Section III.A by providing a short company profile of the assessed organization. Next, in Section III.B, we give an overview of the data we gathered during the assessment. Finally, in Section III.C, we give the assessment conclusions and the recommendations we made, based on the assessment results. In Section IV we discuss the observations we made regarding the application of NAOMI in practice. Also, we present the lessons learned during this assessment, and the changes made in NAOMI based on those lessons. Finally, Section V concludes this paper.

## II. NAOMI

Our assessment approach determines an organization’s architecture effectiveness. It judges an organization on its ability to reach the goals it set with architecture.

### A. Assessment Variables

NAOMI provides three main assessment variables, which provide three different perspectives on architecture effectiveness:

1. architecture awareness
2. architecture maturity
3. architecture alignment.

Enterprise architecture isn’t suddenly there. It typically starts with an immature level of *architecture awareness*. The origin of architecture awareness might differ per organization. It might be the board members initializing an architecture program in order to cope with business complexity, or to guide a large business transformation. On the other hand, it might also be a few members of the IT department that introduce IT architecture in order to guide software development projects. From this initial, immature level an organization should improve its level of architecture awareness. Architecture awareness involves aspects of architecture thinking. For example, creating a clear vision and strategy with architecture. Also, having good ideas on how architecture should be applied – e.g., by writing down the architecture processes and work instructions.

When there is a certain level of architecture awareness, an organization should switch from merely thinking about architecture to actually performing it. *Architecture maturity* indicates how well the architecture function puts architecture into practice. For example, how well the overlaying enterprise architecture is translated into several specific domain architectures. And following, how well domain architects are able to supervise and guide project architects in creating project architectures that fit the relevant domain architecture. It therefore involves how advanced the application and realization of the architecture function’s ideas are. Compared to architecture awareness, this perspective focuses on how well architects succeed in the realization of architecture instead of how architecture is experienced in the minds of the architects. Architecture

maturity is about the actual observable behavior of the architecture function.

An organization may have several architecture functions, which their focus on different types of architecture – e.g., one function that is responsible for IT architectures and one for business architecture. In such case, it is key to align those IT and business architectures by ensuring the responsible architecture functions cooperate. Such collaboration indicates the level of *architecture alignment*. The extremes in architecture alignment are when an architecture function merely focuses on either IT or business architecture, without paying attention to the other type of architecture. Architecture functions that aim for alignment between their business and IT architectures focus on architecture alignment [1].

NAOMI evolved from [8]. In order to determine an organization’s levels of architecture awareness, maturity and alignment, NAOMI uses the six underlying intrinsic variables taken from [8]:

1. architecture **governance**
2. architecture **processes**
3. **communication** through and about architecture
4. organizational **support** for architecture
5. organizational **scope** of architecture
6. human and other architecture **resources**

Fig. 1 shows the structure of NAOMI, using notations taken from SEM [13], which is a framework for statistical analysis that also contains a variety of powerful analysis techniques. A single-headed arrow ( $\rightarrow$ ) in Fig. 1 indicates that the source variable explains the destination variable. A double-headed arrow ( $\leftrightarrow$ ) indicates that the two variables correlate.

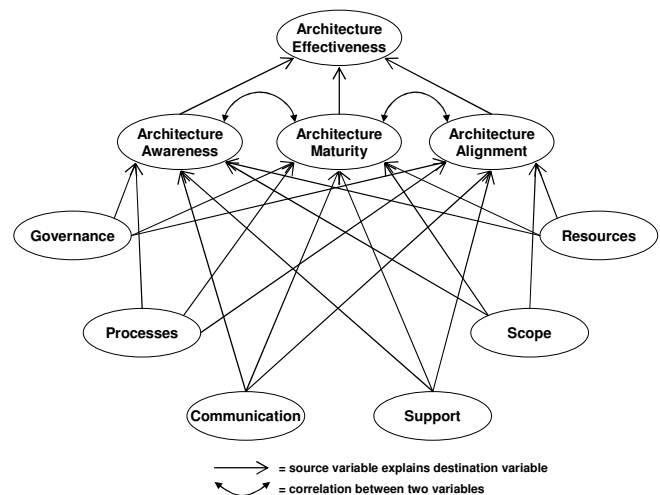


Fig. 1. The six underlying intrinsic variables explaining the three key variables that make out the architecture effectiveness of an organization

All six intrinsic variables explain each other, since they all depend on each other. Please note, however, that Fig. 1

shows only lines from the six intrinsic variables to the three key variables. We have omitted the single-headed arrows between the six intrinsic variables, since this would make Fig. 1 too complex. In [8] we show the structure of our model including the lines indicating dependencies between the six intrinsic variables.

The intrinsic variables in Fig. 1 each have a structure of explaining sub-variables, of which we give an overview in the rest of this section. In [9] we describe all these variables, including the other elements of NAOMI, in more detail. In [8] we describe the sub-variables of both governance and support.

#### 1) *Governance*

This represents the managerial and organizational aspects of enterprise architecture. An architecture function, like any other business unit or department, needs to create its own vision, mission and strategy. By doing this, the architecture function states its role and justification of its existence within the organization, its added value and strengths, its strategic objectives, and the direction in which it wants to reach those objectives. This allows the architecture function to have a clear focus, which should be aligned with the overall corporate (business and/or IT) strategy. Based on its strategic objectives, an architecture needs to create an internal organizational structure, and needs to plan its activities in order to reach those objectives [8].

#### 2) *Processes*

An architecture function should clearly describe its primary and secondary processes. Primary processes involve the development, maintenance, and implementation of architectures. Secondary processes entail architecture knowledge and quality management, which focus on improving the quality and efficiency of the primary architecture processes. Essential in describing the architecture processes is incorporating the linkage with other processes that reside outside the architecture function. For example, the link with the processes within the departments responsible for performing the IT projects that have to comply to the IT architecture the IT architecture function creates. Another example is the link between the business decision-making processes within business units or at corporate level, in which business strategy is devised, and the business architecture processes within the business architecture function, which is responsible for creating the business architecture that should guide the realization of the objectives within that business strategy.

#### 3) *Communication*

Architecture descriptions and models act as a means of communicating decisions to various stakeholders through specific viewpoints [10]. The level in which an architecture function is able to communicate with its stakeholders *through* architecture is essential in determining its ability to be effective.

However, another important issue is how an architecture function is able to communicate *about* the architectures it creates. Introducing an architecture within an organization inflicts changes. E.g., creating a TO-BE enterprise business architecture may result in a new organizational structure, affecting the entire company. Also, an IT architecture may result in software development departments having to change the way they execute their projects. They now have to create a project architecture that fits the involving domain IT architecture, before they are allowed to go ahead with building the concerning software application. Generally, such changes results in resistance. Explaining the importance of architecture and what it entails may help in raising architecture awareness within the rest of the organization. Also, measuring and communicating the added value of architecture may make the rest of the organization realize it is good for business. This might help in getting people to accept the architecture-driven changes.

#### 4) *Support*

Introducing and using architecture inflicts organizational changes. An architecture function can only successfully put the architectures it creates into practice with the support of the rest of the organization. Essential in determining the level of organizational support for the enterprise architecture program is the level of organizational acceptance of the architecture-driven changes. In order to increase this acceptance, the architecture function needs to specifically address this issue in its strategy. Except for clearly communicating the importance and added value of architecture (see previous section on communication), the change-initiators – e.g., architects, IT-managers, or senior management – should give the right example, by following the new way of working under architecture. Secondly, they should motivate organization members in adopting new behavior by creating expectations and making clear what the value of these changes may be to them personally. The flexibility of the organization in adjusting to its environment – which has greatly to do with the organizational culture – and the involvement of key organization members, such as senior management, in the enterprise architecture program are also essential in increasing organizational support [8].

#### 5) *Scope*

The organizational scope of architecture indicates which part of an organization (which departments, units, divisions) is involved in the enterprise architecture program. The percentage of all departments, business units, or divisions that work according to architecture indicates the broadness of the architecture program. The broader the architecture program, the higher the organizational impact will be. The type of departments – business or IT – where architecture is being used determines the organizational emphasis of the architecture program. Clearly, when architecture is primarily used in business departments, the accent will be on business

architecture, whereas architecture is mainly used in IT departments, the emphasis will be on IT architecture.

6) *Resources*

The resources an architecture function needs for developing, maintaining and realizing its architectures are twofold. Firstly, it needs human resources – e.g., IT architects, business architects, an architecture manager. Secondly, it also needs frameworks, methods, techniques and tools, which provide a standardized way of working. This involves both architecture specific, such as an architecture framework, techniques to analyze the architectural decisions made in various solution alternatives, etc. But also more general oriented, methods, techniques and tools are needed, such as for strategic decision-making, portfolio planning, and project management.

B. *Questionnaire*

We are currently constructing a self-administered Internet questionnaire, using a structured questionnaire method [11] in order to validate our assessment model. The questionnaire contains three scales – architecture awareness, architecture alignment and architecture maturity – holding Likert items [12] with a rating scale from 0 to 5 (‘completely disagree to ‘completely agree’). These Likert items are based on the six intrinsic assessment variables (see Section A) and their explaining sub-variables. These variables form the topics of the items for each scale in the questionnaire.

We will test the scales in the questionnaire on their psychometric quality by checking the convergent and discriminant validity of their items. In order to do this, we define indicative and contra-indicative items for each intrinsic assessment variable on which the items are based. Ultimately, we plan to use a combination of SEM analysis techniques (correlation, regression, factor analysis, path analysis, and model fit [13]) to validate NAOMI.

Here we give an example of indicative and contra-indicative items on ‘architecture processes’ for each of the three scales:

1) *Architecture Awareness*

**Indicative:**

Process descriptions of the architecture function’s primary process are clearly written down.

**Contra-indicative:**

Process descriptions of the architecture function’s primary process have not been written down.

2) *Architecture Maturity*

**Indicative:**

The architects within the architecture function work according to the written process while performing their tasks.

**Contra-indicative:**

The architects within the architecture function ignore the written process descriptions while performing their tasks.

3) *Architecture Alignment*

**Indicative:**

The process descriptions illustrate an attuned business and IT architecture development and maintenance processes.

**Contra-indicative:**

The process descriptions illustrate two separated business and IT architecture development and maintenance processes.

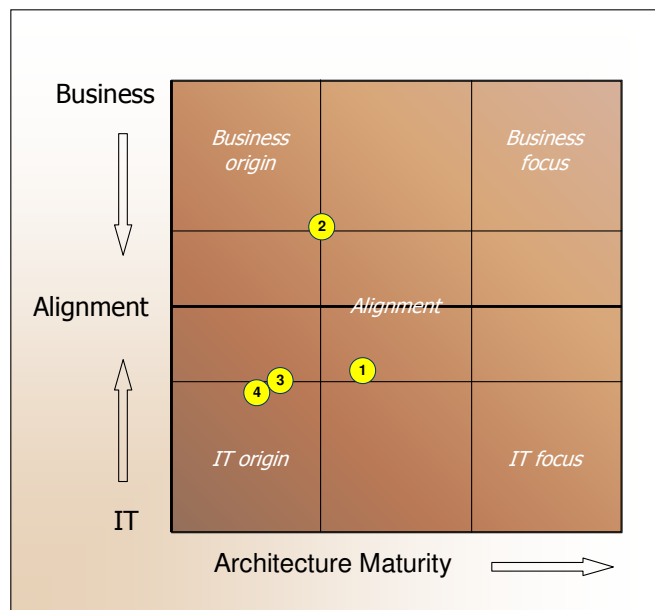


Fig. 2. Architecture alignment and architecture maturity

C. *Visualization Models*

In order to represent the data, which is gathered during an assessment, to the client, NAOMI provides two visualization models. The model shown in Fig. 2 relates architecture maturity on the horizontal axis with architecture alignment on the vertical axis. An architecture function may be focusing purely on business, purely on IT, or a combination of both where alignment between the two is the main goal. Only organizations with full alignment will appear on this middle ‘horizon’ of this model. Such companies focus evenly on the IT and business aspects of architecture, and in such a way that the business and IT cooperate effectively. Organizations that are positioned above this horizon, have a business focus with architecture, while those with an IT focus with architecture are positioned below the horizon [1]. Each organization may have a different optimum, depending on its architecture goals.

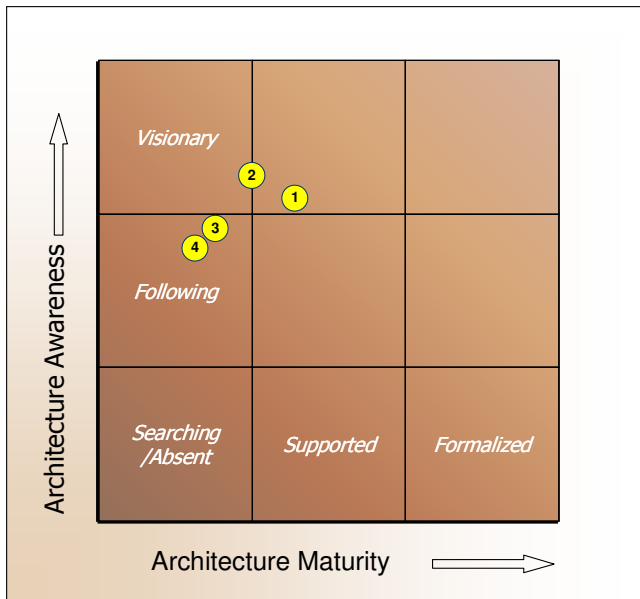


Fig. 3. Architecture awareness and architecture maturity

In order to determine architecture effectiveness, it is interesting to relate the level of architecture awareness with the level of architecture maturity of the client organization. The model in shown in Fig. 3 does just that.

The y-axis depicts architecture awareness. At the lowest levels of architecture awareness, an organization may be searching for awareness. From there, an organization may become following regarding its architecture vision; not creating their own vision, but using that of a competitor or a consulting firm. The highest level of architecture awareness is realized when an organization becomes visionary when it comes to architecture, creating its own vision.

The x-axis depicts architecture maturity, which is the same as the x-axis in Fig. 2. The lowest level of architecture maturity represents organizations where architecture as a discipline is absent. Organizations where architecture is supported make out the middle section. Finally, the highest level of architecture maturity is realized when an organization as formalized architectures a discipline.

The absolute optimum in this model is around the right top corner, where there is a high level of architecture awareness and a high level of architecture maturity. Note that the optimum might differ for each individual client organization depending on the goals they pursue.

We have not combined architecture alignment with architecture awareness within a visualization model. We felt this would not give any relevant insight like the two visualization models in Fig. 2 and Fig. 3.

In general, these two models are used in the same manner. Individual architecture functions (the subjects being assessed) are positioned within the two models. These individual architecture functions may be an individual architect, a team of architects active within a specific business unit, or a full architecture department. These architecture functions focus on a specific architecture type

(in general either IT or business architecture). Gaps between two or more architecture functions indicate points of improvement – e.g., there may be a misalignment between two architecture functions when it comes to the type of architectures they create (see Fig. 2). However, conclusions may also be drawn about one single architecture function – e.g., the visualization model in Fig. 3 may show there is quite a difference between an architecture function’s level of architecture thinking and its ability to put architecture into practice.

#### D. Assessment Process

A typical NAOMI assessment knows five phases (see Fig. 4). First, during the orientation phase, the assessor gathers general information about the subject organization from documents or other sources provided by the client. Also, the goal and scope of the assessment is determined and agreed upon with the client. The assessor, together with the client, selects the relevant members of the organization, and schedules and prepares the interviews with them. During the information gathering phase, the assessor gathers and studies more detailed documentation. Also, the assessor conducts the interviews. Following, in the analysis phase, the assessor analyzes the gathered information, and draws early conclusions. The assessor prepares the feedback workshop and communicates the early conclusions with the client. In case of any missing information, the assessor schedules and conducts follow-up interviews.

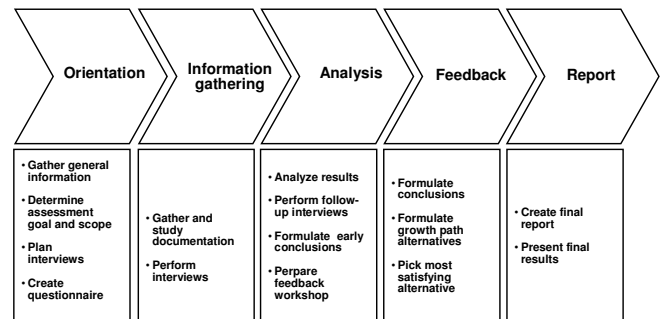


Fig. 4. The five phases of the NAOMI assessment process

In the feedback phase, the assessor presents the drawn conclusions to the involved members of the assessed organization in a group session. During this session alternative growth paths to improvement are discussed. The assessor and the client together determine which is the most satisfying alternative. In the report phase, the assessor produces the final report, which contains the assessment results and the recommendations for improvement, which is presented to the client. The duration of a typical assessment may vary from 2 to 6 weeks, depending on the assessment scope.

### III. THE ASSESSMENT

#### A. Company profile

Early 2006 we conducted an assessment at a global financial services company. This company provides a wide array of banking, insurance and asset management services in over 50 countries, employing more than 100,000 people. We conducted our assessment within the IT function, which is part of the division performing the supporting operational and IT activities for the wholesale and retail banking activities within the company. This division employs nearly 15,000 people. At the time of the assessment, two separate architecture functions, one business and one IT focused, were active within different parts of the IT function. Also, various project portfolio offices and change management functions were organizationally spread out over the IT function. A transformation project was set up in order to merge these spread out architecture, portfolio management and change management functions into one central CIO office. The assessment we conducted had to provide insight in the compatibility of the two architecture functions, and the gaps to be bridged in order to join these architecture functions effectively.

The two architecture functions that took part in the forming of the CIO office, and thus in the assessment, were:

1. **IT architecture function:** a staff function responsible for standardizing application interaction through infrastructure and application architecture.
2. **Business architecture function:** a staff function responsible for providing Business Process Management (BPM) services to projects (e.g., creating business process models for projects).

Also, two advanced development centers were involved in the assessment, which were to work according to the architectures created by the above two architecture functions:

3. **Payment channels:** a development department responsible for payment channels (e.g., ATM machines, e-Banking) for the retail banking division.
4. **Front office channels:** a development department responsible for front office channels (Web, phone, offices and Customer Relationship Management) for the retail banking division.

The objectives with enterprise architecture within the IT division is to reduce costs, and improve operational flexibility and customer service. Their enterprise architecture describes different business and application domains. Coherent business activities have been logically grouped into business domains. These business domains represent the requirements for software applications and IT infrastructure.

The applications aiming to satisfy the business requirements have been logically grouped into application domains, which are mapped onto specific infrastructure services. These business and application domains and infrastructure services lay down the enterprise architecture. This architecture aims to realize unified services, service centers, distribution channels, and product factories to all business divisions within Europe. For realizing this, the enterprise architecture provides principles for service-oriented application development and integration. To reach the objectives with enterprise architecture, all IT projects must be compliant with these service principles and service descriptions.

Both (payment and front office channels) development centers involved in this assessment execute IT projects, in which they are expected to comply to the principles and described business and application domains within the enterprise architecture. Both development centers have several project architects actively participating in projects.

The IT architecture function is responsible for creating, maintaining and realizing both business and application domain architectures, as well as describing the required infrastructure. Also, it is in charge of creating and maintaining the services principles for application development and integration. Finally, the IT architecture function is also responsible for supervising projects on their compliance with the principles and architectures they create.

The business architecture function is in charge of creating, maintaining, realizing, and advising about business process models for projects being performed within both the IT function and business departments outside the IT function. Accordingly, the business architecture function is responsible for supplying projects with knowledge on business process standardization and the supporting tools. Also, like the IT architecture function, it is responsible for supervising projects on their compliance with the architectures it creates.

#### B. Assessment Data

Since we have not finished creating a standard questionnaire, we used semi-structured interviews in order to gather the assessment data. However, we ensured the above six intrinsic variables were addressed during these interviews, from all three perspectives (see Section II.A). In this section we give a characterization of the four departments involved, based on the data gathered, in the order in which they have been introduced in Section A. Also, we positioned these four departments in our two visualization models in Fig. 2 and Fig. 3.

#### *IT Architecture Function*

On the topic of architecture awareness, this first department is quite visionary when it comes to application and infrastructure architecture. It has formed a clear vision on service-oriented architecture quite some years ago, being one of the early adapters of services-thinking. Also, its

enterprise and domain architectures are quite mature. However, ideas about how to improve organizational support for its architecture vision are less advanced.

In realizing the application and infrastructure architectures it has created, still much needs to be done. Therefore, this department does not have a very high level of architecture maturity. For example, the department has insufficiently cooperated – through communication and knowledge sharing – with other departments, architecture functions and development centers, that are to work according to their service principles and architectures.

This department focuses on application and infrastructure architecture, therefore emphasizing IT architecture aspects. Its enterprise architecture contains business domains, which are linked to application domains and infrastructure services, incorporating business and IT alignment elements. There is cooperation, although little, with the business architecture function. However, in creating its enterprise architecture, the IT architecture function has not consulted the business architecture function in order to create the business domains.

#### *Business Architecture Function*

The second department is quite visionary when it comes to business process architecture. The department is well organized and has clear architecture process descriptions. It is also very aware of the fact that they need to ‘sell’ their architecture knowledge by advising projects teams how to improve business processes, giving BPM trainings and sharing knowledge through their Intranet site.

When it comes to its ability to put its ideas into practice, this department experiences difficulties in ensuring project compliancy with the business process architectures it creates. Also, the architecture process descriptions available remain a paper exercise, since the architects within the business architecture function currently ignore them while performing their tasks.

This department mainly focuses on business process architecture, therefore emphasizing the business aspects of architecture. There is little cooperation, thus alignment, between the business architecture function and other architecture functions within the IT function.

#### *Development Center Payment Channels*

The third department partly follows the vision of the IT architecture function. The architecture vision, strategy and policy of this specific department have not been clearly and formally written down. This makes them freely interpretable, and it makes architecture a quite noncommittal activity within this department. The account and program managers within this department are well aware of the advantages of having well-experienced architects. However, the role and mandate of architects within this department is not clearly described.

The project architects within this department have a prominent role by contributing valuable knowledge and

experience during the intake phase of projects. However, during project execution, the project architects have difficulties enforcing that projects are performed according to the created project architecture and applying enterprise architecture and service principles. Mainly because performing projects according to the service principles provided by the IT architecture function slows projects down, resulting in increased costs, which the business owner has to pay. However, the number of projects that strives to be compliant with these architectures and principles increases slowly, since complexity becomes an increasing issue.

Since this department performs IT projects, its emphasis, when it comes to architecture, is on IT architecture. However, this department performs projects for the retail banking division, and thus has business clients. Therefore, this department does strive to satisfy the business requirements as much as possible, resulting in a business-oriented focus.

#### *Development Center Front Office Channels*

This last department also follows the vision of the IT architecture function. It has a good understanding of what architecture is. Nevertheless, it does not have a clear own vision on how architecture could help in improving IT project execution within the department. There is no clear description of the role and mandate of architects, and architecture processes have not been described. The attitude towards architecture varies per project. Occasionally the enterprise architecture and the services principles it prescribes are unjustly blamed for practical problems during IT projects.

In putting architecture into practice, this department faces many issues with making projects comply to the created project architecture, the applying enterprise architecture and the concerning service principles. Project architects and other team members have insufficient knowledge about how to apply the service principles provided by the IT architecture function. Also, the attitude towards enterprise architecture within this department is quite negative. Partly because the positive results created with architecture are not well communicated.

Similar to the other development center, this department performs IT projects for clients within the business division retail banking. It therefore has a similar focus.

#### *C. Assessment Conclusions and Recommendations*

Overall, the assessed organization has a good architecture vision, and is quite mature in creating high quality enterprise architectures. However, the two architecture functions assessed are struggling to put enterprise architecture into practice. They experience great difficulties with making sure that projects, performed within the development centers, create project architectures consistent with the enterprise architecture, and stick to that project architecture.

Architecture is not yet a mandatory activity within projects. This gap between a high level of architecture awareness and a medium to low architecture maturity is illustrated in Fig. 3.

As Fig. 2 portrays, the alignment between the different architecture disciplines (business and IT architecture) is not optimal. The business architecture function is quite isolated from the IT architecture function and the two development centers. For example, in creating its enterprise application and infrastructure architecture, the IT architecture function has not communicated with the business architecture function in order to seek alignment.

In order to be effective with enterprise architecture, we have provided some recommendations based on the performed assessment. There is not yet a positive attitude towards enterprise architecture within the development centers. This is partly because the business owners of the software development projects the development centers perform have to pay for the (initially) increased costs. In order to solve this a clear cost structure should be introduced, which divides the increased development costs over the business units that will eventually use the software application, and not only the business unit that initiates its development.

The level of acceptance of architecture should be improved, for example by measuring and communicating the added value of architecture (e.g., long term cost and complexity reduction). Architecture should become a mandatory activity within projects. Therefore, architecture, as a discipline, should be embedded into the existing organizational processes. For example, by creating clarity in architecture governance and processes, and introducing escalation procedures for solving (natural) conflicts between the architecture functions and development centers performing projects. This should improve the link between architecture policy making and operational project architectures. Also, architect should be given a clear function description, role and mandate so that they can operate more effectively. Furthermore, the prescribing (IT and business) architecture functions should improve their knowledge transfer and support of applying their architectures in projects to project teams. This includes a coaching structure, where enterprise architects support project architects in their work, by reviewing their work and providing constructive feedback.

#### IV. DISCUSSION

During the assessment we made some observations and learned some lessons regarding our approach, which we discuss in this section. Section A contains the observations we made about the benefits of NAOMI compared to existing assessment models. In Section B we describe the lessons we learned during the assessment and the remedies to those lessons, with which we will improve NAOMI.

##### A. Observations

**Observation A: Considering multiple perspectives is vital in properly conducting architecture effectiveness assessments.**

Existing architecture assessment models all focus either on business and IT alignment ([6] and [7]) or architecture maturity ([2], [3], [4] and [5]). However, from our experience with conducting architecture maturity assessments we have learned that clients very much appreciate getting insight into their architecture effectiveness from multiple perspectives. Providing them with assessment results from three different perspectives allows for creating a roadmap for improvement, which gives a clear direction. E.g., an organization might have a high level of architecture maturity, but might also have a slightly of course focus with architecture. The alignment between business and IT architecture functions might not there. With NAOMI, the assessment results would clearly visualize this. However, identifying and visualizing this gap between the business and IT architecture functions would not be possible with existing assessment models, since they only focus on one variable.

**Observation B: The distinction between architecture awareness and architecture maturity is essential in properly determining architecture effectiveness.**

In practice there appears to be quite a difference between architecture awareness and architecture maturity. It seems that, in general, members of an organization – whether there are part of senior business management or operate within a software development project – agree that creating an enterprise architecture is good for the organization. As long as the decisions made in the architecture are general of nature, and they involve long term decisions, all is good. However, as soon as the architecture is being put into practice so that the decisions made through architecture become more concrete and start to affect members of an organization personally, these members start to oppose. Stakeholders seem to judge goal relevance differently considering them from a business versus a personal viewpoint [14].

For example, a business owner of an IT project may notice that the project has a longer start-up phase because of the extra (architecture) activity that has to be performed. That same business owner was convinced the newly created IT architecture was a good thing a few months ago. However, now the business owner is personally affected by that architecture because it is threatening to result in a cost and time overrun of the project. So, as long as it involves general and long-term business goals, architecture is a good thing. But as soon as it becomes concrete and starts to affect individuals, resistance starts to increase.

NAOMI makes a clear distinction between the level of architecture thinking (awareness) and the maturity level of putting architecture into practice. By doing this, NAOMI has attention for a vital aspect of architecture effectiveness, which other existing architecture maturity models ([2], [3],

[4], [5], [6] and [7]) fail to address.

**Observation C: Representing the assessment results using visualization models, which provide a customized characterization of the architecture functions involved in the assessment, gives constructive insight in architecture effectiveness.**

All existing architecture assessment models ([2], [3], [4], [5], [6] and [7]) assign a general, predefined maturity or alignment level to the organization assessed, in the same manner as CMMI [15]. These levels each have a set of general characteristics, which do not necessarily reflect the specific organization being assessed. Therefore, representing the assessment results in such a way does not allow for creating a customized advice for improvement. Also, assigning a level of maturity or alignment may result in it becoming a goal to reach the highest level defined, which may not necessarily be the best level for that organization.

NAOMI provides a more flexible way of representing the assessment results. The models do not position architecture functions in a specific, predefined level of architecture awareness, architecture alignment, and architecture maturity. It positions the architecture functions in visualization models combining these various perspectives, based on a soundly validated assessment model, which also incorporates the dependencies between the various variables. From our experience, this results in a better customized assessment result, based on which a client-specific advice for improvement may be created.

### *B. Lessons*

**Lesson 1: There is a difference in determining the levels of architecture awareness, maturity and alignment of an architecture function and of the departments affected in their work by that architecture function.**

In positioning the involved architecture functions within the visualization model shown in Fig. 3, there was indistinctiveness about whether it involved the architecture function or that part of the rest of the organization that is affected by architecture. For example, with architecture awareness we clearly addressed the architecture function's awareness. However, when it involved architecture maturity, we implicitly positioned the architecture functions based on the level in which their architectures were being put into practice by the departments performing software development projects.

*Remedies.* We will make a more clear distinction between the architecture function and the affected organization in NAOMI. The architecture function is responsible for creating, maintaining and communicating architectures. The affected organization represents that part of the organization that should work according to the architectures created by the architecture function. This constitutes the external environment of the architecture function, which could be a specific business unit, an IT department, or an entire company. The architecture function should supervise and

provide guidance to those who are to work according to these architectures, the affected organization.

For example., in the assessment we describe in Section III, department 1 is an IT architecture function that creates an enterprise IT architecture, consisting of several domain IT architectures. Following, one or more specific domain IT architectures provides the overlaying structure and principles for the software development team within departments 3 and 4 performing IT projects. They depend on the enterprise and domain IT architectures in creating their project architecture. Therefore they are affected by department 1 through its architectural decisions and the new way of working (according to architecture) they demand.

We will use the same three key assessment variables to assess the affected organization. However, we will specify them to fit its deviating perspective on architecture, namely being the subject (or contents) of the architectures an architecture function creates.

**Lesson 2: The attitude towards enterprise architecture is a critical success factor in being effective with enterprise architecture.**

The acceptance of architecture is an important variable in determining the organizational support for architecture, which is addressed in NAOMI. However, the attitude towards architecture is a vital factor in realizing such acceptance. If this attitude is positive, the affected organization is more likely to accept architecture and to change their behavior (the way they perform their work) by complying to the architecture that is created by the architecture function. This topic is not properly addressed within NAOMI.

*Remedies.* We will include the attitude towards architecture as an explaining variable for architecture awareness of the affected organization in our assessment model. This variable is about the attitude of the affected organization towards the ideas and actions of the architecture function. This attitude of the affected organization depends on how the architecture function operates; how well the architecture function is able to positively influence the attitude of the affected organization. For example, by clearly communicating what architecture is, how it helps the organization improve and what results have been realized with architecture.

**Lesson 3: Aligning IT and business architectures should not always be an architecture function's target point.**

Whether an architecture function should strive for architecture alignment depends on the goal with enterprise architecture. For example, if an organization's objective with architecture is to reduce IT complexity, and has no desire to alter the business, then the focus should solely be on IT architecture. In that case the architecture maturity of the IT architecture function might be of a high level, without it focusing on architecture alignment. The visualization model, which relates architecture maturity and architecture

alignment, originally had a highlighted area which implied that, in order to become more mature, an organization needed to become more architecture aligned [1].

*Remedies.* We have removed the highlighted area in the visualization model (see Fig. 2). Also, we will change the perspective ‘architecture alignment’ into ‘architecture focus’. By taking these measures, NAOMI will not insinuate that every organization should strive for alignment. In our approach we will stress that the focus of the architecture function should correspond to the organization’s aim with enterprise architecture.

## V. CONCLUDING REMARKS

The feedback we, as assessors, received on this assessment from our client organization, the global financial services company, was very positive: “*This assessment gave us an instructive insight in our current situation, which is immediately applicable in the process of creating a central architecture function we are currently in.*”. The assessment results triggered a constructive discussion during our feedback session. However, we have also received some feedback about and discovered some issues with the approach. We solved these by adjusting and improving our approach (see Section IV). These adjustments were quite easily made, keeping the basic structure of NAOMI in tact.

Future work involves developing a standard questionnaire based on the improved NAOMI. We will validate whether this first version of the standard questionnaire measures the variables in our model properly using a small assessment data set. Following, we will adjust this first version questionnaire, if needed, after which we will validate NAOMI using an extensive data set. Finally, we will create a benchmark, so that client organizations may compare their practice with other comparable organizations (e.g., same market, same size, same country of origin, etc.).

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