Alignment and Maturity are Siblings in Architecture Assessment

Bas van der Raadt, Johan F. Hoorn, and Hans van Vliet

Vrije Universiteit
Faculty of Exact Science
Information Management and Software Engineering
1081 HV Amsterdam
The Netherlands
Fax +31 20 598 7718
{bvdraadt, jfhoorn, hans}@few.vu.nl

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Abstract. Current architecture assessment models focus on either architecture maturity or architecture alignment, considering the other as an explaining sub-variable. Based on an exploratory study, we conjecture that both alignment and maturity are equally important variables in properly assessing architecture organizations. Our hypothesis is that these variables conceptually differ, correlate, but do not explain one another. In this paper we describe our Multi-dimensional Assessment model for architecture Alignment and architecture Maturity (*MAAM*), which contains six main interrelated sub-variables that explain both alignment and maturity. We used existing models, literature from business and IS domains, and knowledge gained from previous research to identify the explaining variables. We constructed *MAAM* using structured modeling techniques. We are currently using a structured questionnaire method to construct an Internet survey with which we gather data to empirically validate our model. Our goal is to develop an architecture assessment process and supporting tool based on *MAAM*.

1 Introduction

Many large organizations suffer from the complexity of their business and IT structures and processes. This complexity makes it extremely difficult to keep an overview of the organization. Such overview, however, is needed to make important high-level strategic decisions about both business and IT priorities and activities. It also obstructs the identification of inconsistencies between business strategy and its supporting business and IT structures and processes, as well as possible bottle necks in those structures and processes. Furthermore, an organization needs a central point of reference to its business and IT situations in order to allow a meaningful communication about organizational decisions. Therefore these organizations are increasingly using architecture as a means of abstraction and communication, and as a management instrument to get a grip

on their often incomprehensible business and IT situations, and the fit between the two [27].

The introduction and use of architecture within organizations, however, often does not go without a struggle. Applying architecture as a means to solve problems often also creates new problems. Therefore, the need is growing within organizations to assess the current architecture program and organization in order to identify the constraints and problems that hinder their success, and to specify the points of focus and a roadmap for improvement. Several assessment models have been constructed to individually evaluate either business-IT alignment (e.g., [6], [19]), or architecture maturity (e.g., [2], [10], [12], [25]). Both types of models indicate that there is a relationship between alignment and maturity. Maturity models see alignment as a sub-variable that (partly) explains the level of maturity of an architecture organization. Alignment models see maturity as such an explaining sub-variable. That there is a relationship between alignment and maturity also becomes evident from the fact that the two types of models both generally use the same factors to assess either maturity or alignment – variables such as governance, process, communication, scope, and partnership/involvement.

Unlike these existing assessment models, we see alignment and maturity as two conceptually different variables that do not explain one another. However, we do have strong indications that they correlate – from an exploratory study we observed that when architecture maturity increases, alignment generally improves too [27]. Also, in our view, only assessing either the alignment or maturity of an architecture organization is not enough. They should be used in combination, as two equally important variables, in order to properly assess an architecture organization.

Trying to improve an architecture organization is like driving a car. While driving a car, both velocity and direction are important variables. Without one of these, the destination of the journey cannot be reached. These two variables are conceptually different, but can nevertheless be related or affect one another. For example, when the car makes a turn, the driver is likely to slow down. This is because he or she wants to stay on the road or does not want to run into another car. When driving on an oval racing circuit, the same driver probably would not slow down. Although the two variables direction and velocity may be correlated or may have an impact on one another, changing direction does not explain why a car slows down. However, the driver's carefulness does. Viewed this way, velocity partially mimics architecture maturity and direction might symbolize architecture alignment. A poorly aligned architecture organization translates to a car that only turns right; it will end up driving in circles. By focusing on both business and IT aspects, and applying them properly, an architecture organization, quite like a car driver, is able to set out a course for maturity improvement and change direction when needed.

In this paper we introduce our Multi-dimensional Assessment model for architecture Alignment and architecture Maturity (*MAAM*) that allows assessing an architecture organization on both architecture alignment and architecture ma-

turity. *MAAM* allows an assessor to better draw conclusions and identify points of improvement. We started constructing our model from the main variables that explain both alignment and maturity in existing maturity and alignment assessment models. We extended these rather high-level variables by adding sub-variables using general theories from business and IS literature, which we adopted to the enterprise architecture domain, inspired by, among others, Henderson et al. and Chan. For example, Henderson et al. adopted the business theory of external positioning and internal arrangement for maximizing economical performance to the IT domain [16]. Chan found that the informal organizational structure is essential to IT alignment [5]. We introduced additional variables based on the architecture aspects and critical success factors we identified during an exploratory study at architecture active organizations, which is described in [27]. We used Structural Equation Modeling (*SEM*) techniques [29] to construct our model. We hope to validate *MAAM* using data gathered from the field through a structured questionnaire. The goal of this research is to develop an assessment process and tool support based on *MAAM*.

This paper is structured as follows. In Section 2 we describe related work on business-IT alignment (Section 2.1) and architecture maturity (Section 2.2). In Section 3.1 we clarify how we measure both alignment and maturity of an architecture organization. We give a brief introduction to the six main variables in *MAAM* that explain both alignment and maturity in Section 3.2, and illustrate the depth of our model by describing in detail two of these variables, namely architecture governance, and organizational support for architecture activities. Section 3.3 shortly describes the practical application of the model. We end this paper with our conclusions in Section 4.

2 Related Work

2.1 Alignment

Since fundamental early work by Henderson and Venkatraman (e.g., [15], [16]), much is written about alignment in the literature. The notion and importance of alignment are well understood. Many definitions exist, but there is general consensus what alignment entails; the fit between business strategy, IT strategy, organizational structures and processes, and IT structures and processes (e.g., [5], [16], [18]). The goal of alignment is for IT activities to support those of the entire business [5].

Several alignment assessment models have been constructed. Luftman's strategic alignment assessment presents an approach for determining a firm's business-IT alignment based on six variables, namely communications, competency/value measurements, governance, partnership, skills, as well as scope and architecture [19]. This last variable is used to evaluate IT maturity, which indicates that Luftman sees the level of IT maturity as an explaining variable for the level of alignment. In [19], each of these six variables is assigned five levels of alignment. The model provides a short description of the aspects of each level. The level of alignment for each individual variable is determined by the answers to 6 or

7 questions. The model also describes the process of conducting an alignment assessment. Luftman created this alignment assessment model based on his extensive research and practical experience. The model has been used to assess numerous Fortune 500 firms in order to fine tune and validate the model, and allows for cross-organizational benchmarking. Luftman's model is quite pragmatic, but ignores the interrelations between the variables that explain business-IT alignment, which our model does address. It also focuses on the general issues of business-IT alignment, rather than architecture specific issues, although there is much resemblance.

The Chief Information Officer (CIO) Council, a consortium of US Federal executive agency CIO's, developed an architecture specific alignment and assessment guide [6]. This guide describes a process which consists of three phases, the select phase, control phase, and evaluate phase. First, the select phase entails assessing business alignment; whether and to what degree a proposed investment aligns with business strategy. Second, in the control phase the technical alignment is assessed on how well the technology of investments aligns with the infrastructure architecture. Finally, the third phase evaluates both the architectural products and the architecture development process itself. This architecture assessment does not describe any core variables, which disables the identification of specific points of improvement, as well as interrelations between these variables. Also this assessment is quite specific to federal agencies, where our model will be applicable in assessing different types of organizations.

2.2 Maturity

Not so much fundamental research is done on architecture maturity. There is no real definition or clear description of architecture maturity in the literature. However, we could derive such a definition from other maturity studies in the field of IT, such as the SEI Capability Maturity Model [26]. Architecture maturity involves an organization's ability to organization-wide manage the development, implementation and maintenance of architectures on various levels – e.g. business, information systems, technical infrastructure, etc. Please note that with architecture maturity we focus on the entire architecture organization responsible for architecture development, and not merely on the architecture products they create, such as descriptions and models.

Also assessment models have been constructed to evaluate a firm's architecture maturity. These models come from two types of organizations, consulting firms such as Gartner [12] and METAGroup [2], and federal agencies, such as the US Office of Management and Budget (OMB) [25] and the US department of commerce (DoC) [10]. These models generally all work the same, in a way comparable to Luftman's alignment assessment model. They use a number of variables, ranging from 4 to 12, to assess architecture maturity. Typical variables are process, governance, communication, technology, alignment (business linkage), etc. The latter indicates that these models perceive the fit between business and IT to be an explaining variable for architecture maturity. Each variable knows five maturity levels, which are provided with a description of

aspects. The individual level of maturity for each variable is based on answers to generally 1 to 4 questions. Also, the assessment processes of these models share many similarities with that described by Luftman [19].

Assigning assessed organizations a level of architecture maturity or architecture alignment contains an element of danger. Reaching the next level of maturity or alignment could become a goal, although an assessment is meant as a means for improvement. This obsession of reaching the next level draws the attention away from the real important issues. Our model does not assign a maturity or alignment level to an assessed organization. *MAAM* is able to give a more dynamic, multi-dimensional diagnosis that shows how the interrelations between variables influence and characterize the maturity and alignment of the architecture organization.

3 Assessing an Architecture Organization

In this section we explain how an architecture organization is assessed on its alignment and maturity using *MAAM*. We first define how these two variables are to be measured and in which way the sub-variables explain both architecture alignment and architecture maturity. In addition, we clarify why alignment and maturity covary.

3.1 Alignment and Maturity

Architecture is a multi-dimensional phenomenon with different aspects originating from different fields of study, such as management and organization, business psychology, software architecture and engineering, knowledge management, and quality assurance. Maturity – the ability of an architecture organization to company-wide manage the development, implementation and maintenance of architectures on various levels – depends on how many of these aspects an architecture organization has identified as important and is using in performing its activities. Companies using only few aspects of architecture have a low maturity, and companies using many aspects have a high level of maturity [27]. Therefore, we assess architecture maturity by measuring how many aspects are being used by the architecture organization.

Alignment as the fit between business and IT is about business management and IT personnel communicating with each other and understanding each other. Thus, alignment comes from two sides. For example, a company is properly IT to business aligned when its IT personnel have business knowledge and are able to understand the business goals as well as create technological solutions to reach those goals. When a firm's senior (business) management knows what IT might offer them and is able to express their needs to IT personnel it is well business to IT aligned [5]. Therefore, in assessing alignment we measure how much IT knowledge business management and employees have, and how much IT management and personnel know about business issues.

From the above descriptions of alignment and maturity, it becomes clear that both are conceptually different, independent variables that characterize an architecture organization. However, these two variables do correlate. For instance, some aspects of architecture specifically focus on business issues and others particularly on IT issues. When the number of architecture aspects that an architecture organization uses increases, an architecture organization becomes more mature. Another aspect of a mature architecture organization is the increasing exchange of architectural knowledge between different architecture functions, also between business-oriented and technical focused architecture functions, which makes them communicate and understand each other better. Therefore, with increasing maturity, business-IT alignment is likely to improve too.

Conversely, when alignment improves, the knowledge that senior (business) management have about IT increases, which makes them more aware of the opportunities IT offers them. The support of business executives boosts the priority of architecture-related projects. More money is invested in architecture, which results in more available architecture means – e.g., educating IT and business personnel, attracting experienced architects, acquiring or developing more architecture methods and techniques, etc. – and the presence of more architecture aspects. Therefore, alignment improvement results in an expected increasing maturity.

3.2 *MAAM*

Based on existing models ([2], [19]), existing theories from business and IS literature (e.g., [5], [16]), and findings from exploratory research ([27]) we identified six key variables that explain both the level of maturity and the level of alignment:

- architecture development process
- architecture governance
- organizational support for architecture activities
- communication through and about architecture
- organizational and logical scope of architecture
- human and other architecture resources

Fig. 1 shows the top-level variables of *MAAM*, how they are all interrelated, that they all explain both alignment and maturity, and that alignment and maturity correlate. In the figure, a single-headed arrow ($\rightarrow$) from one variable to the other shows that the source variable explains the destination variable. A double-headed arrow ($\leftrightarrow$) represents a correlation between two variables. These notations are taken from SEM, a framework for statistical analysis that also contains a variety of powerful analysis techniques we wish to use to validate our model.

In the remainder of this section we describe two variables in Fig. 1 into more detail, namely architecture governance and the organizational support for architecture activities. By describing these two variables in detail, we show the management and organization aspects and business psychological aspects of *MAAM*,

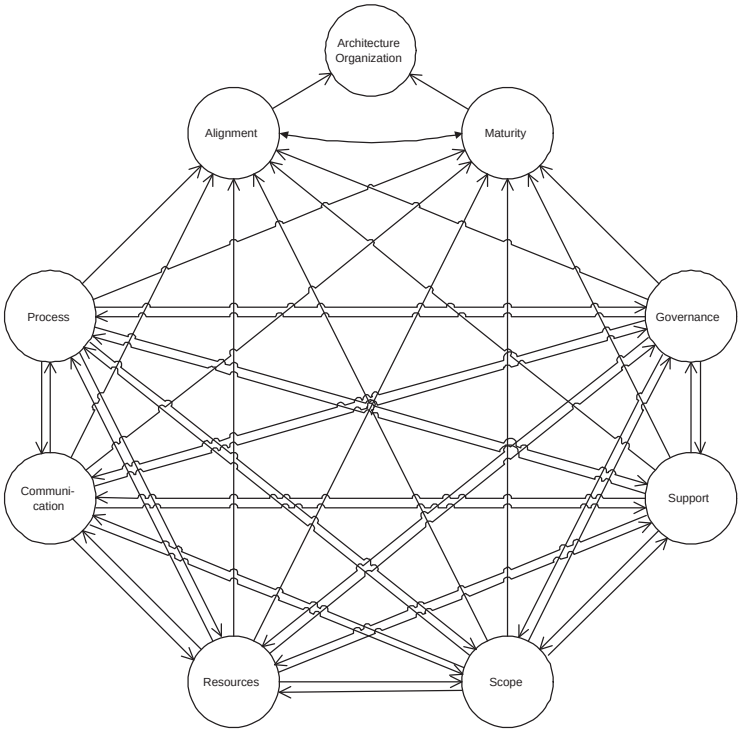

Fig. 1. The six main interrelated sub-variables that explain the two correlated variables alignment and maturity of an architecture organization

clarify how these variables explain each other, and we show the structure and depth of our model. The contributions of the lowel-level structures in Fig. 2 and Fig. 3 to the dependencies between these two top-level variables in Fig. 1 are included in the discussion in the following notation: (*Explaining variable* → *Explained variable*). An internal working paper [28] gives a full description of all six main variables of *MAAM* in a similar manner as in this section.

Governance represents the management and organizational aspects of architecture. Like any organization, an architecture organization has to create a policy that states its mission, vision and strategy concerning architecture. In order to reach its strategic goals it has to structure and plan the activities of its architecture program. Fig. 2 shows the interrelated sub-variables that further explain the top-level variable *governance* in Fig. 1, using the same notation. The three main explaining, interrelated sub-variables of governance are: (1) architecture policy, (2) structure of the architecture organization, and (3) planning of architecture activities.

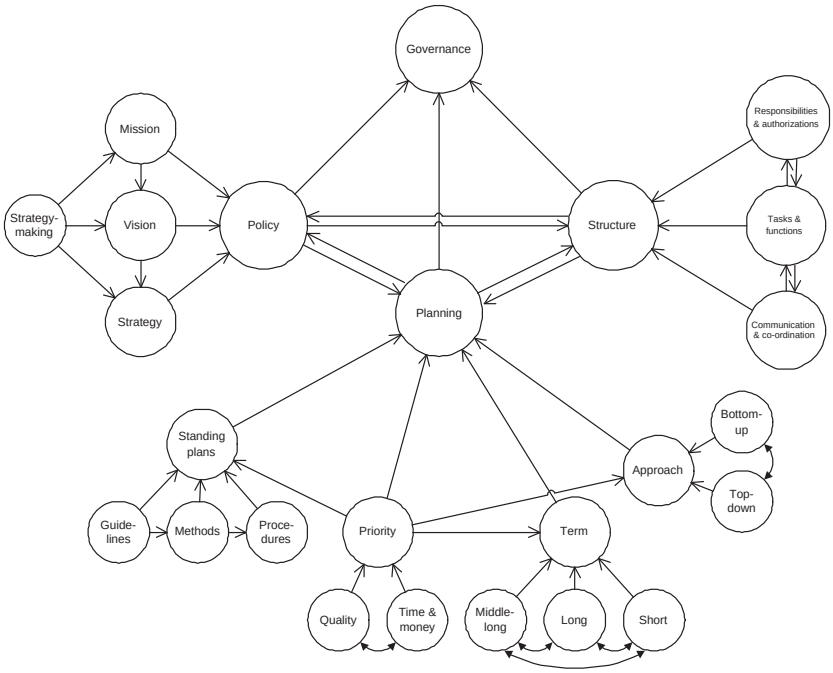

Fig. 2. The interrelated sub-variables that explain governance of the architecture organization.

Policy. An architecture organization needs to identify its environment (both internal and external to the company [16]), and clearly state its role, added value, and goals in a policy. An architecture policy consists of the mission, vision, and strategy concerning the architecture organization. The mission statement formulates the justification of the architecture organization's existence and its value to the business, its business partners, and the employees of the entire company. Further, the vision statement defines the goals and strengths of the architecture organization based on this mission statement. Finally, an architecture organization's strategy lays the plans for accomplishing architectural goals; it puts the vision in action and clarifies goals and tactics. All three parts of the policy are a result of the strategy-making process [21]. The architecture strategy should be aligned with the business strategy of the entire company. Communicating the architecture mission [3], together with the vision and strategy of architecture [27] to those stakeholders improves organizational commitment and support (*Governance policy* $\rightarrow$ *Support commitment*).

Structure. When one employee cannot perform all activities of a company's architecture organization, these activities need to be divided and structured. An organizational structure consists of three parts. Firstly, it shows the division of

work into functions such as architects, and IT-managers, and their tasks. Secondly, it assigns authorizations and responsibilities to functions so that they are able to carry out their tasks. Thirdly, the organizational structure defines the communication and coordination means – e.g., work feedback, discussion and reports of progress, and coordination committees – to glue the divided work together [22].

The assignment of responsibilities and authorizations, and the introduction of communication and coordination means depend on the way work is divided into tasks and functions. After a while, existing communication and coordination means, as well as responsibilities and authorizations can become part of the culture of an organization; 'the way work is done here' (*Governance structure* → *Support flexibility*).

The architecture organization's structure is part of the structure of the entire organization; it is typically a staff or line department. It should also be a reflection of the architecture policy and be aligned with the policy and structure of the entire firm. Ideally structure follows strategy [4], but in practice making a new policy requires paying attention to existing organization structures and operational processes [22]. In this the architecture organization is no exception.

Planning. An architecture organization needs to plan its activities. Planning is the process of information processing that results in decisions about and coordination of future acts so that these acts can be controlled. Decisions about future activities can be made on long, middle-long, and short term. An important short term goal is communicating the added value of architecture to senior and middle management [19]. Improving the quality and structure of information systems and infrastructure is typically a long-term goal [27]. The architecture organization's planning should serve the architecture strategy [23], but strategy also depends on the available planning means. When short-term goals are emphasized, middle-long and long term goals will be influenced negatively, hence the covariance between the three different variables.

Clearly assigning priority to either the quality of architecture products or the availability of resources, such as time and money, may prevent many problems. Architects prioritize quality because they are responsible for the quality of a design. Management, however, is more likely to prioritize the use of resources because they are responsible for finishing projects within time and budget. In practice this difference in responsibilities and prioritizing often results in tension between the two groups [27]. The choice of prioritizing quality has a negative correlation with the use of time and money, and vice versa.

The planning process knows two approaches. The first is a top-down approach that starts with senior management initiating the planning of architecture activities. This approach greatly depends on senior management's ability to get operational support. The second is a bottom-up approach where the planning of architecture activities starts within the departments or divisions; they seek senior management support (*Support involvement* → *Governance planning*). In

practice, the planning and execution of architecture activities often combines both approaches [27].

Standardization of the architecture processes is accomplished by making standing plans. Three kinds of standing plans exist: policy guidelines, standard methods, and standard procedures. Firstly, policy guidelines are general indicators of expected behavior or decisions in general situations. Secondly, standard methods are a refinement and specification of policy guidelines. They indicate how to deal with specific situations. Thirdly, standard procedures prescribe the range of connected tasks that form a unity with a precise rounded off outcome.

The planning of the architecture activities should reflect the architecture policy. Planning – a means of coordination of future activities – depends on the structure it has to coordinate, but the organizational structure also depends on the availability of means for planning those structured activities.

Support characterizes the psychological and social aspects of architecture. Introducing and using architecture inflicts organizational changes, which can only be successfully carried through with organizational support. Fig. 3 depicts the interrelated sub-variables that more specifically explain the key variable *support* in Fig. 1. Organizational support depends on three variables: (1) organizational acceptance of architecture-driven changes, (2) the flexibility of an organization in adjusting to its environment, and (3) organizational involvement in the architecture program.

Flexibility. Changing organizational behavior requires changing the organizational culture, which refers to the shared values and opinions, habits, and attitudes in an organization [9] and is typically difficult to change [17], [24]. A culture's compatibility with the intended changes influences the ability to make those changes.

In theory, changing the structure of an organization is quite simple, but in practice it often has unexpected repercussions because of the existing informal structure (*Support flexibility* → *Governance structure*). The informal structure is the behavior of organization members, which is not explicitly structured in advance. It consists of informal networks of personal contacts. Most companies see informal networks as a burden rather than an aid. Senior executives often work around them, or try to ignore them [7]. This hinders acceptance of decisions and slows change down. When it comes to realizing alignment, informal structures play a vital role [5].

Organizational commitment – the degree to which employees feel connected to the organization – is an important explaining variable of organizational flexibility. Personnel might completely internalize organizational values [24], which makes culture difficult to change. They may also conform to only typical behavior without the underlying values. This group works according to the rules, which are easy to change, and does not care about the shared values, which are hard to change. Finally, organization members could share the central values of an organization and at the same time criticize those values when needed. This

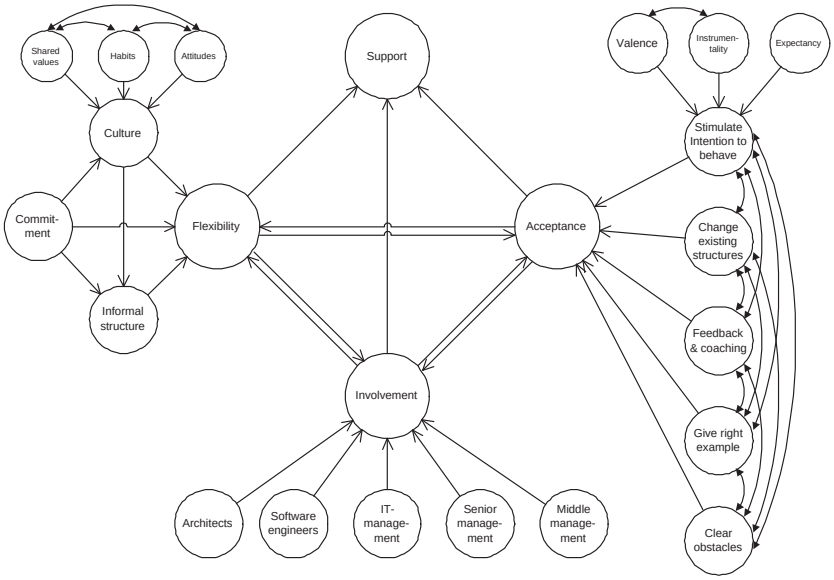

Fig. 3. The interrelated sub-variables that explain organizational support for architecture activities.

group is open for innovation and (architecture-driven) changes. It is important to involve these innovative employees in architecture activities.

Commitment could be a shared value and be part of an organization culture. If commitment is low, an organization member is more likely to go against the rules and use the informal structure to get work done. Working by the rules might also be a shared value – especially in hierarchical organizations – which disables the arise and use of an informal structure (*Governance structure* → *Support flexibility*).

Acceptance. In order to carry through architecture-driven changes, old organizational behavior needs to be transformed to new behavior. Many phase models for changing organizational behavior exist (e.g., [9], [17]). They show many similarities. First of all, the change-initiators – e.g., architects, IT-managers, or senior management – should give the right example of how things should be done in the future. Secondly, they should motivate organization members in adopting new behavior by creating expectations and making clear what value these changes can be to them. Expectancy-theory may be used to measure motivation and contains three variables: (1) the expectancy that certain behavior leads to a certain result, (2) the instrumentality that a certain result leads to a certain reward, and (3) the valence (subjective appreciation) of that reward [30]. Thirdly, change-initiators should give feedback about wrong, old behavior, and coach employees in new behavior. The fourth variable is clearing obstacles that thwart change,

like a manager on a key position who is unwilling to change, or the old reward system that stimulates old behavior. Therefore it is important to change these existing structures so that they stimulate new behavior and prevent old behavior (*Governance structure* → *Support acceptance*). All these above factors should be combined into one change program for the architecture program. Therefore they are likely to covary.

Acceptance greatly depends on whether the intended changes will alter the balance of power in the organizational structure. If so, people who will lose power because of the architecture-driven changes are unlikely to cooperate, and vice versa (*Governance structure* → *Support acceptance*).

Involvement. The involvement of key organization members – senior management [18], line management, IT-management, software engineers, and architects [2] – is critical to the architecture program's success. For example, senior management support for an architecture program would automatically create support by a large part of the organization, because of their leadership position.

Architecture might have its origin in different parts of an organization, either at the IT department, or at business management. If architecture has its origin at senior management, middle management is vital in passing on the architecture program to the operational level where the architecture should be implemented. If the architecture program is an initiative of the IT-department, IT-management and architects play an important role in selling architecture to senior management and the rest of the organization [27].

The involvement of software engineers is vital because they build the software systems architects design. The methods and techniques architects use and the quality of the architectures they produce play an important role in getting the software engineers to accept that architecture. If architects use practically oriented methods and techniques that result in comprehensible designs that fit the practice of implementing software systems, software engineers will be more likely to accept those designs [27].

Because all groups have such different interests, it is unlikely that their levels of involvement covary. For instance, a high level of involvement of software engineers – who are developing software according to the architecture – does not result in a higher senior management involvement. Every group has another reason to adopt or reject the architecture program, so they all need separate attention in raising their involvement.

3.3 Assessment Process

We are planning to gather data through a questionnaire (for an example, see Appendix), which allows us to validate *MAAM*. In our assessment process, the same questionnaire is used to gather data among employees within one department, a division, an entire firm, or even across enterprises, to assess the involved architecture organization(s). In order to visualize the results of each individual questionnaire in a supporting tool we use the Architecture Alignment Model (*AAM*), introduced in [27]. This model relates architecture maturity on the horizontal

axis with architecture alignment on the vertical axis. If clustering the results of the individual questionnaires shows groups with large differences when it comes to alignment, efforts to re-align these groups should receive high priority. Combining all results into an overall architecture assessment allows benchmarking an architecture organization with competitors, which might indicate the necessity to improve architecture maturity in order to keep up with them.

4 Conclusion

In this paper we indicate the importance of a multi-dimensional approach to assess an architecture organization. We introduce our Multi-dimensional Assessment model for architecture Alignment and architecture Maturity (*MAAM*) that is able to establish the current situation of a firm's architecture organization, identify the points of improvement, and construct a plan to address these points.

Existing architecture maturity assessment models assume that architecture alignment explains architecture maturity. On the other hand, architecture alignment assessments see architecture maturity as an explaining variable for architecture alignment. This indicates that there is an interrelation between the two. We view architecture alignment and architecture maturity as conceptually different. Also, in our view architecture alignment is not an explaining factor of architecture maturity, and vice versa. Our hypothesis is that they correlate. When architecture maturity increases, architecture alignment generally increases too, and vice versa.

To construct our model, we used variables of existing assessment models ([2], [19]), theories from literature from various research fields adopted to the IT domain (e.g., [5], [16]), and previous research on the aspects and critical success factors of architecture in practice [27]. Our model contains six main interrelated variables that all explain each other and both alignment and maturity. These six variables are again individually explained by other sub-variables.

We are currently constructing a self-administered Internet survey, using a structured questionnaire method [11], to internationally gather data at architecture active organizations of all types and sizes. Using these data, we hope to validate *MAAM* using SEM analysis techniques. This involves validating the hypothesis that alignment and maturity correlate and do not explain each other, and determining the strength of the relationships between the sub-variables that explain both alignment and maturity as well as how these two explain the architecture organization. An empirical study within the business-IT alignment domain with an approach related to ours is conducted by Croteau et al. [8].

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Appendix: Examples of Alignment and Maturity Scales

Below we give two example scales to measure alignment and maturity using Likert items with a rating scale from 0 to 5 ('completely disagree' to 'completely agree'). We plan to test these scales on their psychometric quality by checking the convergent and discriminant validity of their items. Ultimately, we plan to use a combination of *SEM* analysis techniques (correlation, regression, factor analysis, path analysis, and model fit [11]) to validate *MAAM*.

Architecture Alignment Scale:
indicative
item A_1: Business and IT strategy have the same priorities.
item A_2: Senior management is involved in developing both strategies.
item A_3: Business and IT strategy facilitate one another.
item A_4: Business and IT managers understand each other.

contra-indicative
item A_5: Business and IT strategy have different priorities.
item A_6: Senior management is involved in establishing only one strategy.
item A_7: Business and IT strategy constrain one another.
item A_8: Business and IT managers misunderstand each other.

Architecture Maturity Scale:
indicative
item M_1: Business architecture is well established.
item M_2: IT architecture is well developed.
item M_3: Business architecture is accepted.
item M_4: People approve of the IT architecture.

contra-indicative
item M_5: Business architecture is badly established.
item M_6: IT architecture is ill-developed.
item M_7: People reject the business architecture.
item M_8: People oppose to the IT architecture.
