Quality Enhancement in Creating Enterprise Architecture:

Relevance of Academic Models in Practice

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Abstract. This chapter presents an explicit approach, that is both theory and practice driven, to support evaluation and collaboration activities when creating enterprise architecture. The approach will be applicable in addressing evaluation and collaboration related aspects in two primary phases of the Architecture Development Method (ADM) of The Open Group Architecture Framework (TOGAF). The phases of interest are preliminary phase (defining architecture principles) and phase A (creating architecture vision). These two phases involve activities where evaluation of alternatives and collaboration among key stakeholders and enterprise architects, are paramount. Based on theoretical insights, a collaboration process to facilitate the steps in the formulated approach has been developed. Both the approach and the process design for its realisation, have been evaluated by exposing them to practitioners. This was done using structured walkthoughs. Insights from these walkthrough sessions with experienced enterprise architects, were used to enrich the theoretical models. Generally this chapter aims at demonstrating how theoretical models, enriched with experiences from industry, can fill the currently existing lack of profound analysis of success factors for enterprise architecting. Note that this lack exists in both academia and industry.

Key words: Enterprise Architecture, Design Alternatives, TOGAF, Collaboration Engineering, Practical Relevance.

1 Introduction

While making decisions regarding an enterprise transformation, stakeholders desire to understand the impact of the transformation on their concerns and the risks associated with current and future strategies of the enterprise [23]. Any changes in an organisation's strategy and business goals considerably affect all domains of the enterprise [15], and its corresponding partnerships or collaborations. An example of a rewarding enterprise transformation is enterprise architecture development. While the debate on the definition of (enterprise) architecture continues, discussions in this chapter concentrate on the definition

provided by The Open Group Architecture Framework (TOGAF). This is because TOGAF is freely available, neutral towards tools and technologies, and is a detailed approach for supporting architecture development [32]. Architecture is "*(1) a formal description of a system, or detailed plan of the system at component level to guide its implementation; (2) the structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time*" [32].

Since business essentials are more stable than specific solutions that are found (or sought) to address current (or emerging) problems, architecture assists in guarding business essentials while permitting maximum flexibility and adaptability [15]. Moreover, objects (such as an enterprise) designed under architecture offer improved performance regarding adaptability, integration, understandability, and agility among others [37]. The internal drive of an organisation to adopt enterprise architecture practice, is to effectively execute its strategy and optimise its operations [15]. However, this can be sufficiently achieved if, when creating enterprise architecture, possible design alternatives are generated, evaluated, and *appropriate* as well as *efficient* ones, are selected. Appropriate in this context refers to the suitability of the architecture to address its planned purpose and realise organisation objectives. Whereas efficiency is the ability of the architecture results to address stakeholders' concerns [23].

The endeavor of evaluating design alternatives will further yield better results if it is done in a collaborative context, involving enterprise architects and all organisation key stakeholders. In this chapter we hereby explore the practical relevance of formulating a two-fold approach that we refer to as Collaborative Evaluation of Enterprise Architecture Design Alternatives (CEEADA). The approach is two-fold in the sense that it addresses both collaboration and evaluation related aspects when creating enterprise architecture. CEEADA is a theory based approach that has recently been enriched by practice driven insights from practitioners. In this chapter we explain in detail the theoretical underpinnings of CEEADA, and discuss how insights from experienced enterprise architects were used to enrich CEEADA. These practice based insights were obtained through conducting structured walkthrough sessions with enterprise architects.

The chapter hence fills the gap, in both academia and industrial practice, of two significant needs in enterprise architecture development. First is the need for ensuring collaboration between architects and key stakeholders during enterprise architecture development. This need has been emphasized by several researchers and practitioners (e.g. in [1, 2, 14, 21, 23, 26, 27, 34]), but a sustainable, explicit, and consistent approach for sufficiently addressing this cause is absent in both academia and practice. Second is the need for evaluating enterprise architecture design alternatives and performing trade-off analysis when creating enterprise architecture. This need has also been emphasized by researchers and practitioners (e.g. in [23, 32]), but an explicit and consistent approach for sufficiently addressing this cause is absent as well, in both academia and practice.

The remainder of this chapter is organised as follows. Section 2 discusses efforts by researchers and practitioners towards evaluation of artifacts in the

domain of enterprise architecture. Section 3 presents theoretical underpinnings of CEEADA. Section 4 presents how Collaboration Engineering was used to design a collaboration process that can enable organisations to realise CEEADA in a sustainable way. Section 5 discusses the applicability of the approach within TOGAF's Architecture Development Method (ADM). Section 6 presents practice driven insights from enterprise architects into the approach, and illustrates modified CEEADA models. Section 7 concludes the chapter.

2 Evaluation Efforts in Enterprise Architecture Domain

This section discusses existing work on quality of artifacts in enterprise architecture practice. It also highlights aspects regarding quality achievement in the architecture creation process, that have been given insufficient attention.

A good (or high quality) enterprise architecture offers insights into balancing business requirements and transforming enterprise strategy into daily operations [15]. However, there are several interpretations of the correctness (in this context appropriateness) of an architecture [24]. The acceptability and appropriateness of an enterprise architecture vary across organisations, since they are relative to business requirements and stakeholders' concerns. Actually the kind of results expected from the architecture effort depends on the purpose of the architecture [23].

Existing work on evaluation of artifacts in enterprise architecture domain has mainly concentrated on measuring quality and benefits or return on investment of enterprise architecture. For example, in [28] a framework is presented, based on balanced scorecard approach, for enabling corporate management to identify and measure benefits of enterprise architecture. In [31], quantitative benefits of architecture are explored, and it is demonstrated how architecture may substantially reduce project risks and corresponding costs. In [33] an instrument is presented, based on Sogeti's DYnamic Architecture method, for measuring the quality of the process for enterprise architecture development. Moreover, in [35] an instrument is presented, based on DYnamic Architecture method, for determining the quality of (tangible) products delivered by enterprise architects.

A formal approach for verifying and validating the relevance and suitability of a developed enterprise model is also presented in [6]. However, since enterprise architecture addresses company-wide integration [20], evaluation and validation of its model(s) could be complex especially if, when creating these models, insufficient quality assessment was done on its individual (tangible and intangible) components. Therefore, although it is significant to do a quality check on enterprise architecture products before they are deployed [35], evaluation of possible design alternatives during the creation of these products is equally significant. Actually in the context of TOGAF, it is recommended that there should be frequent validation of results for the entire ADM cycle, and for a particular completed phase of the ADM [32]. Enterprise architecture benefits can better be reaped if, when creating architecture, the quality of decisions behind its com-

ponents are also put into consideration. Such a reflection has been given little attention so far.

Additionally, it is reported that the quality of enterprise architecture products can be improved based on expectations of organisation stakeholders [34]. Such expectations can be obtained and comprehended through effective collaboration between enterprise architects and stakeholders during the architecting process. Literature hardly reveals efforts towards how these aspects can be handled to improve the quality of the process for creating enterprise architecture. Therefore, our research scheme generally focuses on achieving a method that can be used within an enterprise architecture framework (particularly TOGAF ADM), to address collaboration related aspects and evaluation of design alternatives, when creating enterprise architecture. Such a method will be significant towards filling the gap, which is reported in [23], of the lack of scientific research on success factors for enterprise architecting.

3 CEEADA in Creating Enterprise Architecture

This section presents theoretical underpinnings of CEEADA, quality related variables in the process of creating enterprise architecture, and an explicit approach for balancing such variables in order to realise CEEADA.

Creating enterprise architecture generally involves understanding the purpose of the architecture effort, determining deliverables, monitoring planned architecture context, creating shared conceptualisation among stakeholders, designing the architecture creation process, determining impacts, and communicating the architecture [23]. Several enterprise architecture frameworks are in place to guide the architecture creation process. Yet some enterprise architecture projects may fail to deliver as planned, due to a number of challenges.

Challenges that enterprise architects and organisations face during enterprise architecture development originate from political, project management, and organisational problems and weaknesses, rather than technical aspects [16]. Such challenges can be steadily addressed by gradually building consensus among stakeholders through effective collaboration, and encouraging informed evaluation of possible design alternatives when creating enterprise architecture. These aspects are significant during the high level definition of the architecture. This is because if they are not intensively addressed at that point, it will negatively affect the quality of any intended evaluation of alternatives and collaborative work in the subsequent architecture activities. However, as discussed in section 2, literature hardly reveals an explicit and consistent approach for addressing these two aspects in the enterprise architecture domain.

We therefore offer theoretical insights (guided by design science) into improving the process of creating enterprise. In this paragraph, we briefly describe design science based on [11, 12, 13, 30]. Design science is a paradigm for problem-solving that was pioneered by Simon in 1969. It is concerned with the creation and evaluation of IT artifacts (i.e. constructs, models, methods, and instantiations) for solving identified organisational problems. It also enables formulation

of new artifacts that offer opportunities for improving practice prior to practitioners recognising any problem with the existent way of working. Creation of these artifacts is supported by pre-existing theories, frameworks, instruments, constructs, models, methods, and instantiations.

Thus, in devising an approach for CEEADA, we first draw upon the causality analysis theory to perform a cause-effect analysis of key variables for improving the architecture creation process. This is because explaining an event usually involves explaining its cause, and an analysis of the relation between cause and effect of events is essential to several formations of theory (i.e. conjectures, models, frameworks, or body of knowledge) [10]. Causality analysis will thus help in the formulation of models to realise CEEADA.

3.1 Cause-Effect Review in Creating Enterprise Architecture

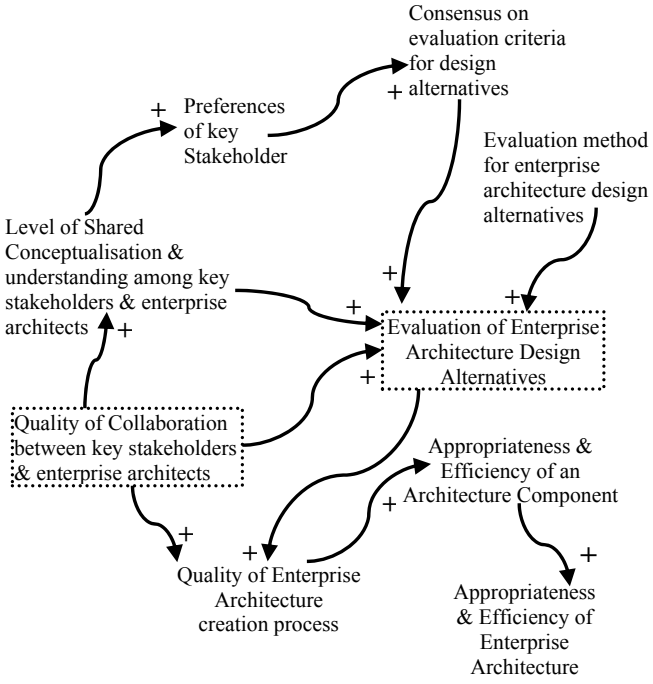

Fig. 1. Cause-Effect Analysis in Creating Enterprise Architecture

From [1, 2, 14, 19, 21, 23, 26, 27, 32, 34], we identify variables that are key to quality enhancement in creating enterprise architecture. As figure 1 shows, these variables include: the quality (appropriateness and efficiency) of an enterprise architecture, the quality (appropriateness and efficiency) of an enterprise architecture component, the quality of the evaluation process of architecture design alternatives, the quality of collaboration among key stakeholders, the quality

of enterprise architecture creation process, the level of consensus on evaluation criteria for enterprise architecture design alternatives, the evaluation method for enterprise architecture design alternatives, and the level of shared conceptualisation and understanding of organisation problem and solution aspects among key stakeholders.

In the following explanations for figure 1, we concur with Gregor that *"various arguments for causality are not mutually exclusive and at different times and in different circumstances we will rely on different reasons for ascribing causality"* [10].

The quality of the process of creating enterprise architecture can be improved by evaluating enterprise architecture design alternatives, and by encouraging effective collaboration among key stakeholders and enterprise architects. The reason for evaluating (design) alternatives is to search for optimal or satisfactory solutions [29, 30]. Such solutions can be viewed as high level solutions or low level unit components of the high level solution. In this context, architecture components include principles, models, and views [23]. In our view, there are design alternatives regarding each of these components during the architecture creation process. Therefore, evaluating them and selecting satisfactory and optimal ones, will add value to the architecture creation process.

Better still, evaluating such alternatives in a collaborative context leads to better decisions. This is because successful problem solving and decision making in organisations often requires joint expertise [19]. Moreover, maximum effectiveness of the architecture function is only attainable if stakeholders efficiently collaborate towards a shared goal [34]. Therefore, effective collaboration adds value to the process of evaluating enterprise architecture design alternatives.

In [31], it is demonstrated how the quality of (enterpise) architecture is one of the key inputs for high customer satisfaction in a given project. Logically, if the quality of architecture affects customer satisfaction, then the quality of the process of creating architecture indirectly affects customer satisfaction. Our definitions of appropriateness and efficiency of enterprise architecture (see section 1), are closely related to customer satisfaction. Therefore, as shown in the lowest part of figure 1, an improvement in the quality of the architecture creation process leads to selection of appropriate and efficient architecture components, which ultimately results into creation of an appropriate and efficient enterprise architecture.

Additionally, evaluation of design alternatives can be improved by: (1) a high level of shared conceptualisation and understanding of enterprise aspects among stakeholders, (2) a high level of consensus on evaluation criteria for design alternatives, and (3) the evaluation method for design alternatives. Full commitment of stakeholders in an initiative is often guaranteed if a shared goal has been acquired [19]. This implies that achieving a shared goal directly improves the priorities of stakeholders. This in turn results into an increased level of consensus on evaluation criteria for design alternatives. For example, results obtained after ranking of alternatives some evaluation criteria, are often consistent with a stakeholder's objectives and preferences [9]. Ultimately, the evaluation of design

alternatives is directly and indirectly improved by an increased level of shared conceptualisation and understanding of aspects among stakeholders.

Furthermore, the level of shared conceptualisation and understanding can be increased by effective and efficient collaboration between stakeholders and enterprise architects. This is because collaboration is a joint effort of stakeholders towards achieving a goal, and the probability of acquiring shared and supported goals is higher when stakeholders make this joint effort [19]. On the other hand, mutual understanding is a requirement for architects and stakeholders to improve their collaboration and make the architecture function effective [34]. This hence reveals a recursive relation between shared understanding and collaboration.

The causal relations explained above cannot be sufficiently measured in isolation, but a hypothesis can be drawn, and a synthesis formulated from such relations, such that they are measured in an integrated and meaningful manner. This is possible because the knowledge of causal relations enables predictions to be made from theory [10]. Therefore from figure 1, and the underlying reasons for its factors, the following predictions are made with the focus of improving the quality of the process of creating enterprise architecture.

Since key stakeholders have diverse concerns and views, they could first acquire a shared conceptualisation and understanding of enterprise aspects. A shared conceptualisation and understanding is a basis for evolution of an enterprise [23]. A shared understanding will consequently guide the determination of common and explicit criteria for evaluating enterprise architecture design alternatives, the identification and validation of possible design alternatives, the evaluation of such alternatives, and the selection of appropriate and efficient ones. This approach for enabling CEEADA is illustrated in figure 2, decomposed and characterised in figure 3, and explained thereafter.

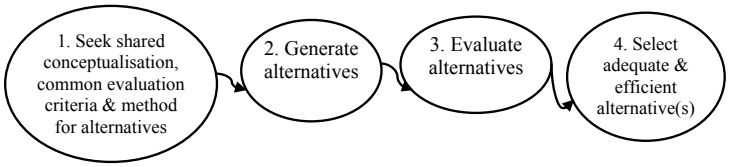

Fig. 2. Collaborative Evaluation of Enterprise Architecture Design Alternatives

In the middle part of figure 3 we see the pattern for CEEADA consisting of four steps shown by dashed boxes. Above the dashed boxes we see the decomposition of tasks for the four steps, and sub activities involved in each step are shown. Below the dashed boxes we show the characterisation of CEEADA according to Simon's generic decision making process. The pattern for CEEADA has its roots in the generic decision making paradigm introduced by Simon in 1960 in [29]. Simon structured all decision making tasks to comprise of three phases, i.e. intelligence, design, and choice. Intelligence is concerned with investigating an environment for circumstances that call for decision or intervention. Design is concerned with devising possible courses of action or possible decision

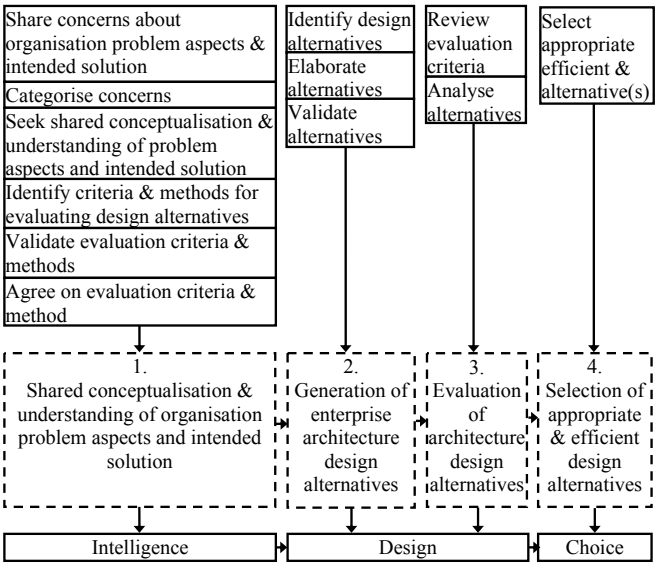

Fig. 3. CEEADA Pattern Decomposition and Characterisation

alternatives to solve the problem or to improve the environment. Choice is concerned with choosing a particular course of action or decision alternative from those available. As figure 3 shows, step 1 of the pattern for CEEADA is characterised as Simon's intelligence phase, steps 2 and 3 are characterised as design, and step 4 is characterised as choice. The following sections describe these steps in detail.

3.2 Shared Conceptualisation, Common Evaluation Criteria

Agility as a key requirement in several business lines is often hindered by organisation stakeholders being uninformed about their own products, services, and capabilities; and lacking a common understanding and governance of data resources [23]. Stakeholders should understand aspects related to data and control flow, as well as decisions that will affect the organisation's overall performance [16]. Although several companies still lack an integrated view of their enterprise, the architecture process helps to raise stakeholders' awareness of business objectives and information flow [15]. However, stakeholders' awareness of these key aspects, during the architecting effort, is not an automatic achievement.

Thus, the architecting process should be '*open*' in the sense that participation of stakeholders is encouraged [1, 2]. This openness calls for collaboration between architects and organisation stakeholders. Moreover, although collaboration between architects and stakeholders is problematic, it can be effective if also architects acquire a good understanding of the goals of the stakeholders [34]. Figure 1 shows that effective collaboration between stakeholders and ar-

chitects during enterprise architecting enhances a shared conceptualisation and understanding of all key aspects.

The enterprise architecting process requires all involved actors to speak a common and identical technical language, and to have a shared understanding of what the architecture is supposed to do [1]. Shared understanding involves: sharing knowledge, sharing meaning about the knowledge, mutual learning (people learning from each other to advance their knowledge and the group knowledge), and understanding of mutual differences or conflicts [17]. It is essential for stakeholders to acquire a shared conceptualisation and understanding about 'the *as-is* situation'; 'the *to-be* situation'; and any constraints that should be met by the architecture [23]. Open modeling, sharing models, and frequent communication with stakeholders can enable the architect to steadily eliminate the different implicit views that individual stakeholders have regarding the intended system [21].

Additionally, literature hardly reveals explicit criteria for evaluating enterprise architecture design alternatives during the architecting process. Evaluation criteria for design alternatives often vary across organisations depending on the organisation's mission and vision. This therefore calls for stakeholders and enterprise architects to identify, evaluate, and agree on explicit criteria and a method for evaluating enterprise architecture design alternatives. This is possible if a shared conceptualisation and understanding of organisational problem aspects has been attained.

3.3 Generation of Design Alternatives

Designing a system (in this context, enterprise architecture) consists of determining its requirements and devising feasible specifications that satisfy the agreed on requirements [37]. In the endeavor to optimally fulfill these requirements and specifications, design alternatives arise. Enterprise architecture comprises of four major types of architectures, i.e., business, data, applications and technology [32]. Logically enterprise architecture design alternatives arise from these architectures types, and from the phase of defining framework and principles (TOGAF's preliminary phase), and creating architecture vision (TOGAF's phase A). Section 5 expounds this. Enterprise architecture design alternatives can be generated at different phases of architecture development, depending on the enterprise architecture framework that has been adapted.

We give two reasons for collaborating with key stakeholders even at this step. First, is the creativity that collaboration offers during problem solving [7]. Creativity is a key input to generating design alternatives of a solution. Logically generation of design alternatives can be more fruitful if key stakeholders and enterprise architects have acquired a shared conceptualisation and understanding of problem and solution aspects. Second, involvement of key stakeholders at this step gradually builds commitment and consensus among them. This is because during the intelligence and design phases of decision making, commitment of actors to a new course of action can gradually evolve [29].

Generation of alternatives involves identifying, elaborating, and validating possible architecture design alternatives. Elaboration of design alternatives involves adding relevant detail to an alternative, preparing it to be evaluated. Vague concepts in an enterprise architecture should be translated to a detailed level such that the architecture is understandable and agreed on by all stakeholders [14]. Detail does not need to be restricted to only the overall enterprise architecture but can be carried over to its constituent components and their respective design alternatives. Detailed alternatives enable informed evaluation of alternatives to be performed.

Validation of design alternatives involves investigating an alternative for its feasibility. Validation of alternatives is most likely to be affected by the information available for each design alternative. The lack of knowledge and misunderstanding of particular features and information from a system (say an enterprise) or its environment consequently limits the verification and validation of (enterprise) model(s) [6]. This further explains why stakeholders and enterprise architects should effectively collaborate in the generation of design alternatives, and above all, have a shared conceptualisation and understanding of enterprise aspects.

3.4 Evaluation of Design Alternatives

Evaluation involves assessing the appropriateness and efficiency of each validated design alternative, with respect to predefined common evaluation criteria, using a common evaluation method. Often the predefined evaluation criteria may require revision, hence the need for consensus on any amendments. In decision making some decisions may be too complex for an individual to understand all implications [19] regarding each decision alternative. Hence the need for collaboration among enterprise architects and stakeholders during the evaluation of design alternatives. Stakeholders' involvement in the evaluation of design alternatives gradually increases consensus among them.

Before evaluating design alternatives, the type of evaluation problem must be understood because it determines the evaluation methods to be used. According to [8], evaluation problems are categorised into three: (1) Choice problems, involve *"selecting of a subset of actions, as small as possible, in such a way that a single action may be finally chosen"*, (2) Ranking problems, involve *"ranking of all the actions belonging to a given set of actions from the best to the worst"*, (3) Sorting problems, involve first defining a set of categories depending on some typical features, and then *"assigning each action to one of the pre-defined categories"*.

From these problem types, the idea of collaboratively evaluating enterprise architecture design alternatives is a "Sorting-Ranking-Choice" problem. This is because in order to realise CEEADA, at least one of the three problems must be encountered at different instances when creating enterprise architecture. For example when defining architecture principles, a ranking problem could be encountered; yet when defining architecture vision, both sorting and choice prob-

lems could be encountered. Therefore, a "Sorting-Ranking-Choice" problem in CEEADA would generally appear as follows.

1. In a sorting problem context, categories of design alternatives at a given phase of architecture development would be defined. For example using TOGAF ADM, categories of design alternatives at phase A (architecture vision) would include aspects regarding scope, constraints, baseline architecture, and target architecture. Then each action (in this case design decision alternative), would be assigned to a category where it can be further assessed.
2. In a ranking problem context, all possible enterprise architecture design alternatives are ranked from best to worst. Where ranks are based on stakeholders' priorities and quality value judgements.
3. In a choice problem context, a subset of architecture design alternatives can be selected, based on stakeholders' value judgements and priorities, from which a single alternative will be finally chosen.

3.5 Selection of Appropriate and Efficient Design Alternatives

The focus at this step is to select design alternatives that will collectively result in optimal business operations and an appropriate and efficient enterprise architecture. Although it is difficult to satisfy all stakeholders [34], a solution embraceable by key stakeholders can be sought.

Two situations may arise at this step, depending on the phase of architecture development and the type of evaluation problem encountered in that phase. (1) Only one alternative may be required, for example the alternative with the highest score or rank, making the selection step to be trivial; or (2) more than one alternative may be required. In case 2, the remaining alternatives may be assessed using additional evaluation criteria.

4 Collaboration Engineering

Literature [4, 25] reveals sustainable approaches (i.e. collaboration engineering and group model building scripts) that can be used to enable execution of steps in CEEADA. This section therefore presents an attempt of applying collaboration engineering to this cause.

Collaboration engineering is an approach used for designing re-usable collaboration processes that yield predictable success for recurring mission-critical tasks, and the deployment of such processes for execution by practitioners rather than skilled facilitators [5, 18, 36]. Relevant facilitation skills, knowledge of group support systems, and group dynamics can be transferred to practitioners using this approach, since skilled facilitators are an additional cost to organisations [4, 18]. In a collaboration process, participants undergo a reasoning process that comprises of a series of activities referred to as basic patterns of collaboration or thinking [4]. Six general patterns of collaboration are defined in [5] as follows.

1. *Generate*, moving from having fewer concepts to more concepts as shared by the group.
2. *Reduce*, moving from having many concepts to a focus on fewer concepts that the group considers worthy of further attention.
3. *Clarify*, moving from having less to more shared understanding of concepts and phrases used to express them.
4. *Organise*, moving from less to more understanding of the relationships among concepts the group is considering.
5. *Evaluate*, moving from less to more understanding of the relative value of the concepts under consideration.
6. *Build consensus*, moving from having fewer to more group members willing to commit to a proposal.

Each pattern of collaboration is created by a unit known as a ThinkLet, which defines the group support system to use; how to configure it; and a clear sequence of events and instructions for the group to follow [4]. Therefore, thinkLets are building blocks for designing collaboration processes [17, 18].

To formulate a collaboration process for CEEADA, the following design approach as described in [17, 36] was used.

1. *Task diagnosis*, determining the goal and deliverables of a collaboration process.
2. *Task decomposition*, determining the basic activities for realising the process goal.
3. *ThinkLet choice*, matching each basic activity with a thinkLet using some criteria.
4. *Agenda building*, preparing all relevant information for validating the process and graphically representing it in a Facilitation Process Model (FPM). The FPM shows "*the logic of the flow of the collaboration process from activity to activity*" [17].
5. *Design validation and evaluation*, using walkthroughs, pilot testing, simulation, and expert evaluation.
6. *Documentation.*

Under task diagnosis, the goal of our collaboration process is to realise CEEADA when creating enterprise architecture. Our results for task decomposition, thinkLet choice, and agenda building, in CEEADA, are summarised in table 1. The FPM for CEEADA is illustrated in figure 4. The building patterns used in table 1 and fig. 4 are described in [36]. Initial versions of table 1 and figure 4 are presented in [22].

5 Relevance of CEEADA in Practice

This section discusses how quality of output from the first two phases of TOGAF ADM can be improved by applying CEEADA. In sections 5.1, 5.2, and 5.3, a brief report is first given on the steps involved in each phase, as presented in [3, 32], then the applicability of our approach in that particular phase is discussed.

Table 1. Key Activities, Patterns of Collaboration, and ThinkLets

#	Activity Description	Deliverable	Pattern of Collaboration	ThinkLet
0	Prepare for architecture development sessions	Architecture Development information & sensitization	-	-
SESSION ONE – Shared Conceptualisation & Common Evaluation Criteria				
1A	Introduction/Briefing	Guiding information	-	-
1B	Share concerns	Concerns	Generate	LeafHopper
1C	Categorize concerns	Categories of concerns	Reduce & Clarify	FastFocus
1D	Discuss concerns while seeking shared conceptualization & understanding of enterprise aspects	Shared understanding of aspects & a common view of the enterprise	Build Consensus	CrowBar
1E	Identify criteria & methods for evaluating design alternatives	Evaluation criteria & methods	Generate	Free Brainstorm
1F	Categorize criteria & methods	Categories of criteria & methods	Reduce & Clarify	FastFocus
1G	Evaluate criteria & methods	Evaluated criteria & methods	Evaluate	StrawPoll
1H	Agree on evaluation criteria & method	Common evaluation criteria & evaluation method	Build Consensus	MoodRing
SESSION TWO – Generation of Enterprise Architecture Design Alternatives				
2A	Identify design alternatives	Design alternatives	Generate	Comparative Brainstorm
2B	Elaborate alternatives	Elaborated alternatives	Generate	TheLobbyist
2C	Validate alternatives	Validated alternatives	Evaluate	StrawPoll
SESSION THREE – Evaluation and Selection of Design Alternatives				
3A	Evaluate alternatives	Evaluated alternatives	Evaluate	MultiCriteria
4A	Select appropriate & efficient alternative(s)	Appropriate & efficient design	Build Consensus	MoodRing

5.1 Defining Framework and Principles

This TOGAF phase generally involves: (1) defining the framework to be used (i.e. adapting the ADM); (2) reviewing (pre-existing) business principles, goals, and strategic drivers to ensure that they are current and unambiguous, restating/cross referring to them; (3) defining architecture principles; and (4) seeking commitment (among stakeholders) to the success of the architecture effort.

Based on (1)-(4), CEEADA approach can enable key stakeholders and the architect team to effectively collaborate when reviewing pre-existing business principles, goals, and strategic drivers. This will lead to a shared conceptualisation and understanding of significant enterprise aspects such as the enterprise mission, strategic plans, and external constraints among others. According to TOGAF, these are the key aspects for developing good architecture principles. A shared understanding will enable the determination of common criteria that will be used to evaluate architecture principles. Furthermore, a shared understanding will be a basis for defining architecture principles (i.e. identifying, elaborating, and validating elements of each architecture principle). Generated architecture principles can then be evaluated, such that adequate ones that echo business goals and strategic drivers are selected. Moreover, since gaining consensus on architecture principles is vital for the success of the architecture effort [32, 24], CEEADA approach is useful because it focuses on gradually building consensus on various aspects when creating enterprise architecture.

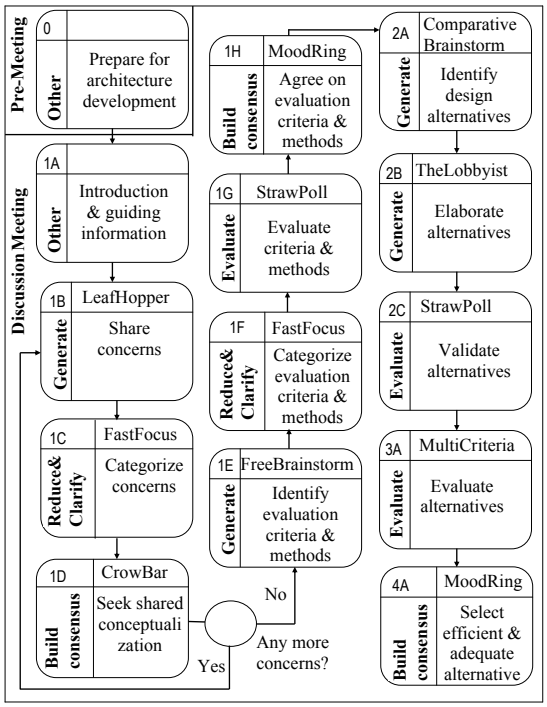

Fig. 4. Facilitation Process Model for CEEADA

5.2 Creating Architecture Vision

This TOGAF phase generally involves the following activities. (1) Seeking and gaining approval of the architecture project from corporate management, and commitment to its success from line management, (2) Identifying business goals and strategic drivers, or ensuring that their definitions (if pre-existing) are current and unambiguous, (3) Reviewing architecture and business principles, that will influence the development of the baseline architecture, ensuring that their definitions are current and unambiguous, (4) Defining the scope, and identifying and prioritizing the components of the baseline architecture. However, decisions regarding architecture scope should be made after practically evaluating the organisation's resources and competence, as well as the value that could be reaped if a given scope of the architecture work is chosen, (5) Defining enterprise-wide and project-specific constraints that the architecture must address, (6) Defining relevant stakeholders and their concerns, defining business requirements, and defining the high level description of the baseline and target environments that will address the requirements, within the defined scope and constraints, while conforming to business and architecture principles, and addressing stakeholders' concerns, and (7) Critically evaluating baseline environment, and documenting architecture vision in a statement of architecture work and seeking its approval.

Based on (1)-(7), CEEADA approach can enable key stakeholders and the architect team to effectively collaborate when reviewing and validating business goals, strategic drivers, business principles, and architecture principles. This will enable key stakeholders to acquire a shared conceptualisation and understanding of enterprise aspects significant for creating architecture vision. Moreover, evaluation criteria for possible solution alternatives in this phase can be determined. This is then followed by identifying, elaborating, and validating solution alternatives, i.e., architecture scope decisions, constraints, stakeholders' concerns, business requirements, components of the baseline and target (business, technology, data, and applications) architecture environments. Possible components of the baseline and target environments can then be evaluated, such that realistic and efficient ones are selected and consolidated into the statement of architecture work. According to TOGAF, consensus on the statement of architecture work determines the acceptability of the final architecture. Gaining consensus on the statement of architecture work is not a hassle if CEEADA approach is applied within this phase, because it will enable architects to gradually build consensus among stakeholders, when creating the architecture vision.

5.3 Business Scenarios: Business Requirements in the ADM

A business scenario "*is a description of a business problem in both business and architectural terms, which enables individual requirements to be viewed in relation to one another, in the context of the overall problem*" [3, 32]. According to TOGAF, developing a business scenario involves Gathering, Analyzing, and Reviewing information on the following aspects. (1) The problem motivating the architecture effort, (2) the business and technical environments affected by the problem, (3) SMART (Specific, Measurable, Actionable, Realistic, Time-Sensitive) objectives to solve the problem, (4) human actors, and their places in the business model, (5) computer actors and computing elements, and their places in the technology model, and (6) responsibilities, success measures, and desired outcome for every actor.

Based on (1)-(6), CEEADA approach can enable key stakeholders and the architect team to effectively collaborate during the gathering phase. This will lead to an exhaustive gathering of business information on the aspects above, and enhance a shared conceptualisation and understanding of the such aspects. It will also enable architects to secure commitment from stakeholders. Furthermore, in the analysing phase where gathered information is filtered and translated into models, collaboration can be encouraged among key stakeholders. The idea of collaboration here is to enable identification and validation of possible alternatives regarding business requirements in order to address the problem. TOGAF literature highlights that in the reviewing phase, results of the analyzing phase are returned to stakeholders to seek a shared understanding of the problem scope and the possible depth of the technical impact. However, shared understanding can be steadily acquired if stakeholders are collaboratively involved in the early stages of developing business scenarios. Stakeholders should be involved in the

filtering of gathered information on business requirements. This continuous involvement enables them to understand the reason(s) behind particular inferences in the business scenarios. The review phase could then be enriched by collaboratively evaluating the created business scenarios and selecting efficient ones.

6 Practice - Driven Insights into CEEADA

Constructed artifacts in design science are evaluated (using methods such as case study, action research, field study, and simulation among others) and the feedback obtained is used to refine the artifact further [11, 12, 13]. However, these artifacts must be tested in laboratory and experimental settings before field testing is undertaken [13]. In this research, before an experimental exploration of the performance of CEEADA models could be done, theoretical concepts in CEEADA had to first be validated by enterprise architects. Structured walkthrough sessions were used to expose these models to architects.

A walkthrough involves a step by step review and discussion, with practitioner(s), of activities that make up a process to reveal errors that are likely to hinder the effectiveness and efficiency of the process in realising its intended plan [17, 19]. In addition to validating CEEADA models, walkthrough sessions were used to obtain industrial or practice-driven insights into our models. Three bi-lateral walkthrough sessions were conducted at Capgemini Netherlands, with three experienced enterprise architects. Architects who participated in the walkthroughs acknowledged the relevance of this approach in practice, and accordingly provided insights to improve the models.

Inputs to each session were figure 2 (CEEADA approach), and table 1 (task decomposition for CEEADA). Output from each session was feedback to improve the models. The following three sections detail the analysis of feedback from the walkthroughs, and tables 2 and 3 summarise the output from all sessions.

6.1 Walkthrough Session One

The positive impact of collaboration between stakeholders and architects, and evaluation of enterprise architecture design alternatives depends on the type of stakeholders invited to the task. Stakeholders to participate in each collaboration session need to be carefully selected such that the right information is obtained and delays in making decisions, regarding deliverables of a session, are avoided. Moreover, the right stakeholders will be able to effectively and efficiently evaluate alternatives, and select appropriate and efficient design alternatives. It is therefore vital to indicate the type of stakeholders to be involved at each step of the proposed approach. For example key decision makers of the organisation units of interest should be involved in all steps of the proposed approach.

The type of stakeholders to be involved depends on the scope of the organisation's problem. The wider the scope, the higher you go up the rank of leaders; and the narrower the scope, the lower you go down the rank of leaders. Therefore, prior to step 1 in the proposed approach, a preliminary activity involving

collaboration with senior management is vital. The idea for such an activity is to initially define the organisation's problem scope, and to select stakeholders who should participate in the subsequent collaboration efforts.

An initial definition of the organisation's problem scope, initiates the determination of the initial purpose of the architecture effort, as well as initial preparation of stakeholders' concerns. Thereafter seeking a common understanding among stakeholders, of both the organisation's problem scope and objective of the architecture effort, is indeed significant.

Table 2. Summary of Insights from Walkthrough Sessions

#	CEEADA Aspects	Walkthrough 1	Walkthrough 2	Walkthrough 3
1	Prepare for architecture development sessions	– should not be a trivial activity – type of stakeholders involved affect the value of collaboration & evaluation of alternatives – The type of stakeholders to involve depends on scope of the organisation's problem – should include initial definition of organisation problem, & selection of stakeholders to involve in collaboration sessions – initial definition of problem scope initiates determining initial purpose of architecture effort, & preparation of stakeholders' concerns – all collaboration sessions should involve key decision makers of organisation units	– Architect team reveals calendar of events – Architect team briefs stakeholders on what they should expect from the architects, & what architects expect from stakeholders – Architects gain the trust of stakeholders – distribute agenda of a particular collaboration session prior to the session – all collaboration sessions should include key decision makers of organisation units	– determine the type of stakeholders to involve in every collaboration session
2	Introduction/ Briefing		– communicate purpose of the session & kind of information being sought for – get feedback on the agenda of a session	
3	Share concerns	– is successful if concerns were prepared by stakeholders prior to the session	– make explicit the type of concerns that stakeholders should share	
4	Categorize concerns			– clarify how to categorize concerns
5	Discuss concerns, seek shared conceptualisation & understanding of enterprise aspects	– Should seek for common understanding of organisation's problem scope, & initial purpose of the architecture effort, among other aspects		– Should also validate stakeholders' concerns against principles – valid concerns are vital for defining criteria & method for evaluating alternatives
6	Identify evaluation criteria & methods for alternatives	– is driven by the business goals to solve the organisation's problem		
7	Categorize criteria & methods	– instead validate criteria to be SMART		

When defining common evaluation criteria and evaluation method for alternatives, architects should indeed collaborate with stakeholders. This is because business stakeholders have the expertise in evaluating and measuring quality of aspects in their business domain. Therefore, they should identify the possible evaluation methods, evaluate the identified methods, and then select a suitable one. The enterprise architect basically facilitates this activity and documents the aspects therein.

In practice, generation of design alternatives is driven by criteria balance. Therefore, it is vital to have explicit and valid evaluation criteria before generating design alternatives. Defining evaluation criteria for alternatives is driven

Table 3. Summary of Insights from Walkthrough Sessions - Continued

#	CEEADA Aspects	Walkthrough 1	Walkthrough 2	Walkthrough 3
8	Identify design or solution alternatives	– is driven by criteria balance – Should include stakeholders like business analysts, innovation department	– Architects may identify alternatives prior to session – Is hard to achieve in the case of principles. Architects compiles them – invite stakeholders to brainstorm on business requirements	– For the case of principles, architect compiles the list
9	Elaborate alternatives		– Indicate against each alternative, consequences (-ves & +ves) of choosing it. – In the case of business requirements, stakeholders should categorize them	– stakeholders help in the elaboration of principles
10	Validate alternatives	– effective & efficient if evaluation criteria are SMART – seeking for feasibility of alternatives	– seeking for feasibility of alternatives – stakeholders need to validate principles	– stakeholders need to validate principles
11	Evaluate alternatives	– Ranking, in the case of principles	– seeking quality of alternatives – In case of principles, stakeholders prioritize them – In case of architecture scope & constraints, negotiation dominates – In case of business requirements, stakeholders prioritize them	– for principles, stakeholders prioritize principles – Architect performs cross tabulation of principles against solution alternatives – architects consider relevance of opinion of @ stakeholder by assigning weights to them
12	Select efficient & adequate alternative	– may need to investigate candidate solution alternatives for more detail, before a final selection is done	– seek consensus on selected alternative(s)	– architecture board takes the decision (in the case of TOGAF ADM)

by the organisation's problem scope and therefore business goals (e.g. swift cost reduction, swift volume growth, etcetera) to address the problem. Generation of alternatives is not the area of architects, so they should indeed collaborate with the stakeholders. Stakeholders that should be present may include business analysts, and process innovation department among others. In step 1 and 4 of the proposed approach, architects should facilitate the progress of the activities therein, while in steps 2 and 3, they should be actively involved as well as facilitate the associated activities.

Validation of alternatives for feasibility can be effective and efficient if the pre-defined evaluation criteria are SMART (Specific, Measurable, Actionable, Realistic, Time-sensitive). Additionally, depending on the phase of architecture development in which the approach is applied, investigating candidate solution alternatives for more detail before a final selection is done, could be vital. However, this may not apply in the case of architecture principles because the associated nature of evaluation is ranking of the principles.

6.2 Walkthrough Session Two

Stakeholders' concerns can be serious issues that could block the progress of the architecture work if not sufficiently addressed. Therefore, it is significant, to carefully address them when creating enterprise architecture. However, the term

concerns as used in the proposed approach is ambiguous. In order to gather concerns exhaustively, there is need to specify the type of concerns that stakeholders should share during the collaboration sessions. Prior to the sessions, the architect team should draw a calender of events and organise an informal meeting with key stakeholders. In such a meeting, the team briefs stakeholders on what they should expect from them (the architects), and what the architects expect from the stakeholders, throughout the architecture creation process. This step is usually ignored by several architects yet it is crucial, because through such a gathering and clarification of events, it is very possible to gain the trust of the stakeholders.

The proposed approach can be useful during the high level specification of the architecture. However, during the collaboration sessions, it is essential to manage stakeholders' expectations, for example stakeholders know the agenda of a session before it begins. This enables them to make the necessary preparations for it. Moreover, before a collaboration session begin, its purpose, as well as the kind of information being sought for in that particular session, should be communicated. It is quite rewarding if architects identify some alternatives before the collaboration session of generating solution alternatives. This rules out the possibility of any associated difficulties amidst the session, and it helps to build confidence. Moreover, during the elaboration of identified alternatives, the consequences of choosing a particular alternative should be highlighted if possible. This fastens the validation and evaluation of the solution alternatives.

Depending on the phase of architecture development, architects often do the evaluation of alternatives and trade-off analysis without stakeholders. This affects the acceptability of the ultimate solution alternative. Yet seeking consensus on a chosen alternative is indeed significant. In every collaboration session, it is important to have key decision makers of the client organisation. For example if a decision is made in the absence of a CIO, this implies that in the next session when the CIO is present, if he does not agree with previously made decision; then activities must be repeated in order to make decisions in his support.

In practice it is difficult for architects to collaboratively generate architecture principles with the stakeholders. Architects commonly develop principles as follows. (1) They conduct interviews with senior management, (2) Findings from interviews are documented, and a list of architecture principles is compiled by the architects, (3) Principles are then presented to stakeholders for validation and prioritisation. Prioritising principles involves having stakeholders assign weights to them. It is easier having stakeholders prioritise principles, than generate them collaboratively with architects. Yet for the case of business requirements, stakeholders should be invited to brainstorm, categorise, and prioritise the requirements. Moreover, when defining architecture scope and constraints, negotiation is vital, rather than evaluation of design alternatives. The aspect of evaluating alternatives may arise during the negotiations.

6.3 Walkthrough Session Three

The categorisation of concerns in the process design should be clarified. For example since the approach is focusing on addressing collaboration related aspects in TOGAF ADM, categories of concerns should be specific to aspects in a particular TOGAF phase. This is because concerns are always related to objectives of a particular project. Stakeholders' concerns need to be validated before considering them in decision making. During the validation of a concern, the question of whether it matches principles should be answered. Valid concerns are useful for defining evaluation criteria, and choosing an evaluation method for alternatives. Since principles are always existent within the organisation but not written down, the architect collects information regarding the principles, and compiles it into a consistent set of about 10 to 15. The role of stakeholders then, is to validate and prioritise the principles.

In practice, when evaluating alternatives, the architect often performs a cross tabulation of principles against available alternatives. Each principle takes up a column in the table depending on its priority, while each alternative takes up a row. The performance of each alternative in fulfilling a given principle is assessed, and scores given. Moreover, during the prioritisation of principles and analysis of alternatives, architects must consider the relevance of opinion of each stakeholder. This is done by assigning weights to stakeholders. Documentation to justify judgements made on alternatives is also significant. To select alternatives, the architecture board (in the case of TOGAF) makes the final decision.

6.4 Revised CEEADA Models

Insights from the three walkthrough sessions were used to refine CEEADA models, i.e. the cause-effect analysis model (shown in figure 5), the pattern for CEEADA (shown in figure 6), and the collaboration process design for CEEADA (shown in table 4 and figure 8).

From the walkthroughs, other causal relations associated with quality improvement of the architecture creation process were obtained and amended (see shaded variables in figure 5). Explanations of these causal relations are given in section 6.

Figure 6 depicts an amendment of step 0 to the pattern for CEEADA. The relevance of step 0 is to enable enterprise architects with senior management to define the problem scope, identify external constraints from regulatory authorities, and define the purpose of the architecture effort. Key stakeholders to participate in the subsequent collaboration required in the architecture creation process, are also selected at step 0. These amendments arose from the walkthrough sessions (see section 6). Accordingly, in step 1 a shared conceptualisation and understanding of output from step 0 (i.e. problem scope, external constraints, purpose of the architecture effort, and solution specification) among other stakeholders is then appropriate. Iterativeness can also be identified within the pattern, in the sense that conflicts and errors that may arise in steps 2, 3, and 4, will be a result of ineffectiveness and inefficiency from steps 0 and 1.

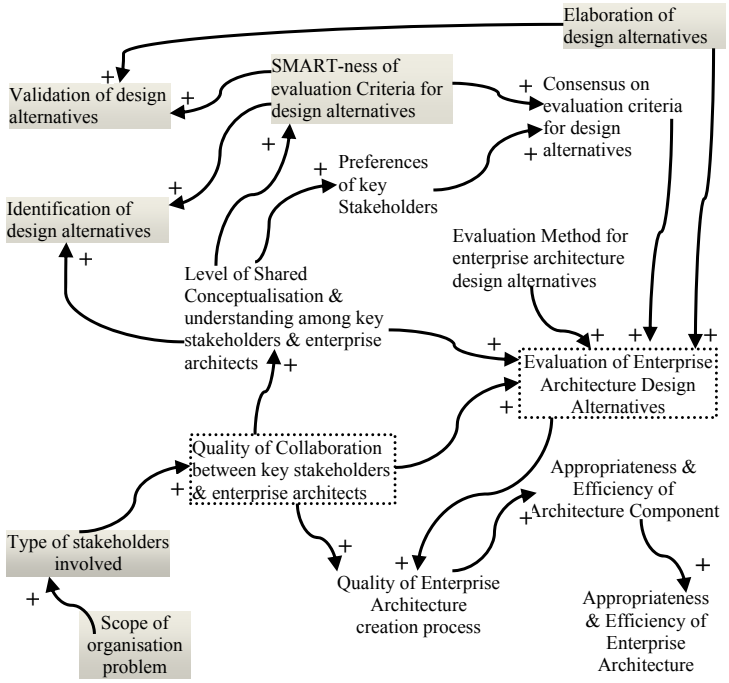

Fig. 5. Modified Cause-Effect Analysis in Creating Enterprise Architecture

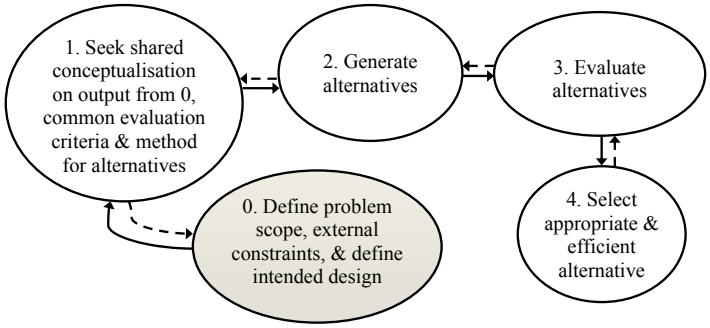

Fig. 6. Modified CEEADA Approach

Furthermore, figure 7 depicts modifications in the decoposition and characterisation of tasks in CEEADA. In the left part of figure 7, step 0 is decomposed into six tasks and characterised as part of Simon's intelligence phase. For the reason of making the underlying concepts of CEEADA more explicit and understandable, characterisation of CEEADA tasks has been further detailed (see bottom layers of figure 7). Step 0 is characterised as defining project context, steps 1-3 are characterised as tasks that involve negotiation, and step 4 is still characterised as choice.

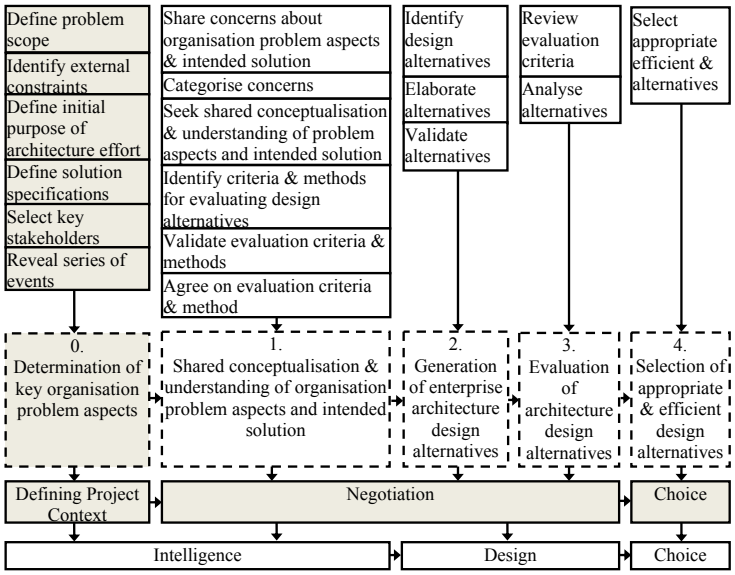

Fig. 7. Modified CEEADA Pattern Decomposition and Characterisation

Table 4. Modified Key Activities, Patterns of Collaboration, and ThinkLets

#	Activity Description	Deliverable	Stakeholders involved	Pattern of Collaboration, ThinkLet
0.1	Define initial organisation problem scope	Initial problem scope	Senior management	-
0.2	Identify external constraints	Nonnegotiable constraints		
0.3	Define initial purpose of the architecture effort	purpose of the architecture effort		
0.4	Select key stakeholders to participate in subsequent collaboration sessions	Key stakeholders to collaborate with architects		
0.5	Reveal calendar of events for architecture effort & expectations of architect team & key stakeholders	Calendar of events & expectations	All selected stakeholders	
SESSION ONE – Seeking Shared Conceptualisation & Defining Common Evaluation Criteria				
1.1	Introduce purpose of session, kind of information required, organisation problem scope, & initial purpose of architecture effort	Guiding information	Decision makers of different organisation units	-
1.2	Stakeholder share concerns about initial purpose of the architecture effort & other aspects on organisation problem scope	Concerns		Generate, LeafHopper
1.3	Categorise concerns by type & organisation domains	Categories of concerns		Reduce & Clarify, FastFocus
1.4	Discuss concerns while seeking shared conceptualisation & understanding of problem aspects and initial purpose of architecture effort	Shared conceptualisation & understanding of problem aspects & architecture purpose		Build Consensus, CrowBar
1.5	Validate stakeholders' concerns	Valid concerns		Evaluate, StrawPoll
1.6	Agree on amendments to problem and solution aspects	Amendments to problem scope, and architecture purpose		Build Consensus, MoodRing
1.7	Identify criteria & methods for evaluating design alternatives	Evaluation criteria & methods		Generate, FreeBrainstorm
1.8	Validate criteria & methods	Valid criteria		Evaluate, StrawPoll
1.9	Agree on evaluation criteria & method for design alternatives	Common evaluation criteria & evaluation method		Build Consensus, MoodRing
SESSION TWO – Generation of Enterprise Architecture Design Alternatives				
2.1	Introduction/Briefing	Guiding information	Business analysts, process innovations unit, IT architects, etc	-
2.2	Identify design alternatives	Design alternatives		Generate, ComparativeBrainstorm
2.3	Elaborate design alternatives	Elaborated design alternatives		Generate, TheLobbyist
2.4	Validate design alternatives	Validated design alternatives		Evaluate, StrawPoll
SESSION THREE – Evaluation and Selection of Design Alternatives				
3.1	Introduction/Briefing	Guiding information	Decision makers of organisation units	-
3.2	Evaluate valid design alternatives	Evaluated design alternatives		Evaluate, MultiCriteria
4	Select appropriate & efficient design alternative	architecture design component		Build Consensus, MoodRing

As a result of modifications in figures 5, 6, and 7, the agenda plan for validating the collaboration process for CEEADA and its associated FPM, were modified as depicted in table 4 and figure 8 respectively.

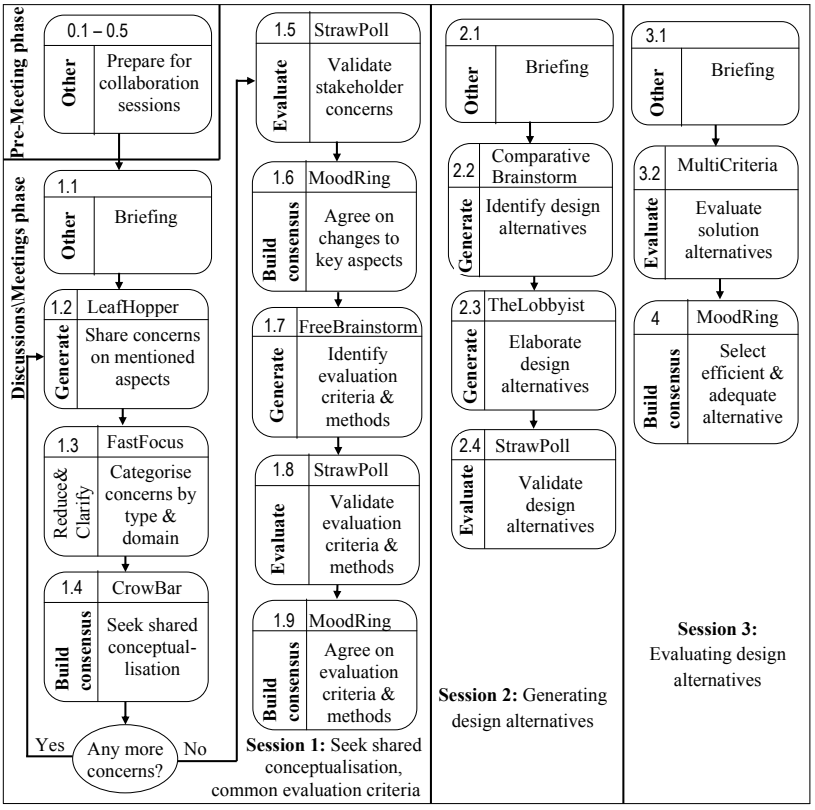

Fig. 8. Modified Facilitation Process Model for CEEADA

7 Conclusions

In this chapter we presented theoretical underpinnings of CEEADA, an approach focusing on quality enhancement in creating enterprise architecture. The relevance of the approach in two phases of TOGAF ADM was discussed. In these phases, results of collaboration, negotiation and evaluation of design alternatives highly affect subsequent activities in the architecting effort. CEEADA models have been validated and enriched through structured walkthrough sessions with experienced enterprise architects. This resulted in modified models that represent both theoretical and practical insights into quality improvement of the ar-

chitecture creation process. This chapter therefore contributes to efforts towards filling the gap (reported in [23]) of insufficient reflections on success factors for enterprise architecting.

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References

1. Armour, F.J., Kaisler, S.H., Liu, S.Y.: A big Picture Look at Enterprise Architectures. IT Professional, IEEE, 1(1), 35–42 (1999a)
2. Armour, F.J., Kaisler, S.H., Liu, S.Y.: Building an Enterprise Architectures Step by Step. IT Professional, IEEE 1(4) 31–39 (1999b)
3. Blevins, T., Spencer, J., The Open Group Architecture Forum: Manager's Guide to Business Scenarios. The Open Group (2002)
4. Briggs, R.O., de Vreede, G.J., Nunamaker, Jr., F.: Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems. Journal of Management Information Systems. 19, 31–64 (2003)
5. Briggs, R.O., Kolfschoten, G.L., Vreede, G.J. de, Dean, D.L.: Defining Key Concepts for Collaboration Engineering. Proceedings of the Twelfth Americas Conference on Information Systems, Acapulco, Mexico (2006)
6. Chapurlat, V., Kamsu-Foguem, B., Prunet, F.: Enterprise Model Verification and Validation: an Approach. Annual Reviews in Control. 27, 185–197 (2003)
7. Conklin, J.: Dialog Mapping: Building Shared Understanding of Wicked Problems. Wiley & Sons Limited, England (2006)
8. Figueira, J., Mousseau, V., Roy, B.: ELECTRE Methods. In Figueira, J., Greco, S., Ehrgott, M. (eds) Multiple Criteria Decision Analysis - State of the Art Survey, Springer (2005)
9. Findeisen, W., Iastrebov, A., Lande, R., Lindsay, J., Pearson, M., Quade, E.S.: A Sample Glossary of Systems Analysis - Handbook of Applied Systems Analysis - IIASA. Web Dictionary of Cybernetics and Systems, `http://pespmc1.vub.ac.be/ASC/ASCGloss.html` (accessed on Feb 16th 2009)
10. Gregor, S.: The Nature of Theory in Information Systems. MIS Quaterly, 30(3), 611–642 (2006)
11. Hevner, A.R., March, S.T., Park, J. and Ram, S.: Design Science in Information Systems Research. MIS Quarterly, 28(1), 75–105 (2004)
12. Hevner, A.R.: A Three Cycle View of Design Science Research. Scandinavian Journal of Information Systems, 19(2), 87–92 (2007)
13. Iivari, J.: A Paradigmatic Analysis of Information Systems as a Design Science. Scandinavian Journal of Information Systems, 19(2), 39–64 (2007)
14. Janssen, M., Cresswell, A.: The Development of a Reference Architecture for Local Government, In: HICSS IEEE Press (2005)
15. Jonkers, H., Lankhorst, M. M., Doest, H.W. ter, Arbab, F., Bosma, H., Wieringa, R. J.: Enterprise architecture: Management tool and blueprint for the organisation. Information Systems Frontiers 8(2) 63–66, (2006)
16. Kaisler, S.H., Armour, F., Valivullah, M.: Enterprise Architecting: Critical Problems. In: HICSS IEEE Press (2005)

17. Kolfschoten, G.L., Vreede, G.J. de: The Collaboration Engineering Approach for Designing Collaboration Processes. In: Haake, J.M., Ochoa, S.F., Cechich A. (eds.) CRIWG 2007. LNCS, vol. 4715, pp. 95–110. Springer, Heidelberg (2007)
18. Kolfschoten, G.L., Briggs, R.O., Appelman, J.H., Vreede, G.J. de: ThinkLets as Building Blocks for Collaboration Processes: A Further Conceptualization, In: de Vreede, G.J., Querrero, L.A., Raventos, G.M. (eds.) CRIWG 2004. LNCS, vol. 3198, pp. 137-152. Springer, Heidelberg. (2004),
19. Kolfschoten, G.L.: Theoretical Foundations for Collaboration Engineering. Delft University of Technology, The Netherlands (2007)
20. Lankhorst, M., van Drunen, H.: Enterprise Architecture Development and Modelling, http://www.via-nova-architectura.org
21. Muller, G. How to relate design decisions to stakeholder satisfaction: Bridging the broad stakeholder universe and the detailed technology world, http://www.via-nova-architetura.org (2007)
22. Nakakawa, A.: Collaboration Engineering Approach to Enterprise Architecture Design Evaluation and Selection. In Proceedings of 15th CAiSE-DC (Doctoral Consortium) held in conjunction with CAiSE'08, CEUR-WS vol. 343, pp. 85–94, Montpellier, France (2008)
23. Op 't Land, M., Proper, H.A. (Erik), Waage, M., Cloo, J., Steghuis, C.: Enterprise Architecture - Creating Value by Informed Governance. Springer, Berlin, Germany, EU, (2008)
24. Richardson, G. L., Jackson, B.M., Dickson G.W.: A Principles-Based Enterprise Architecture: Lessons from Texaco and Star enterprises. MIS Quarterly 14(4) 385–403 (1990)
25. Rouwette, E.A.J.A., Vennix, J.A.M.: System Dynamcis and Organisational Interventions. Systems Research and Behavioral Science. 23, pp. 451–466 (2006).
26. Schekkerman, J.: The Economic Benefits of Enterprise Architecture, How to quantify and Manage the economic Value of Enterprise Architecture. Trafford Publishing, Canada (2005)
27. Schekkerman, J.: How to survive in the jungle of Enterprise Architecture Frameworks, Creating or Choosing an Enterprise Architecture Framework. Trafford Publishing, Canada (2004)
28. Schelp, J., Stutz, M.: A Balanced Scorecard Approach to Measure the Value of Enterprise Architecture, http://www.via-nova-architectura.org (2007)
29. Simon, H.A.: The New Science of Management Decision. Harper and Row, New York (1960)
30. Simon, H.A.: The Sciences of Artificial, Third Edition, The MIT Press, Cambridge, MA (1996)
31. Slot, R.: What is the ROI of Architecture? Reporting on the added value of architecture. Landelijk Architectuur Congrees, http://www.lac2004.nl/docs/fvbg2hdsb83/Sponsors/Capgemini.pdf (2004)
32. TOGAF - The Open Group Architecture Framework Version 8.1.1 Enterprise Edition, http://www.togaf.org (2007)
33. van den Bent, B.: A Quality Instrument for Enterprise Architecture Development Process. Master's Thesis Business Informatics, Utrecht University (2006)
34. Van der Raadt, B., Schouten, S., Van Vliet, H.: Stakeholder Perspective of Enterprise Architecture. In: Morrison, R., Balasubramaniam, D., and Falkner, K. (eds.) ECSA 2008. LNCS, vol. 5292, pp. 19–34. Springer, Heidelberg (2008)
35. Veltman-van, R.E.:Determining the Quality of Enterprise Architecture Products. Master's Thesis Business Informatics, Utrecht University (2006)

36. Vreede, G.J. de, Briggs, R.O.: Collaboration Engineering: Designing Repeatable Processes for High-Value Collaborative Tasks. In: HICSS, IEEE Press, Waikoloa (2005)
37. Extensible Architecture Framework version 1.1 (format edition), report of the NAF working group, `http://www.naf.nl/content/bestanden/xaf-1.1-fe.pdf` (2003)