Best practices for business and systems analysis in projects conforming to enterprise architecture

Ralph Foorthuis and Sjaak Brinkkemper

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Explanation of symbols

.	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
–	= nil or less than half of unit concerned
–	= (between two figures) inclusive
0 (0,0)	= less than half of unit concerned
blank	= not applicable
2005-2006	= 2005 to 2006 inclusive
2005/2006	= average of 2005 up to and including 2006
2005/’06	= crop year, financial year, school year etc. beginning in 2005 and ending in 2006
2003/’04–2005/’06	= crop year, financial year, etc. 2003/’04 to 2005/’06 inclusive

Due to rounding, some totals may not correspond with the sum of the separate figures.

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Telephone .. +31 88 570 70 70
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Best practices for business and systems analysis in projects conforming to enterprise architecture

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Summary: This paper aims to identify best practices for performing business and systems analysis in projects that are required to comply with Enterprise Architecture. We apply two qualitative research methods to study real-life projects conforming to architecture at Statistics Netherlands. First, a Canonical Action Research approach is applied to participate in two business process redesign projects. Second, we use Focus Group interviews to elicit knowledge about carrying out projects conforming to architecture. Based on this empirical research we present seven observations and ten best practices. The best practices point to the fact that project conformance is not only the responsibility of project members, but also of enterprise architects. Considering four levels of best practices (good idea, good practice, local best practice, industry best practice), we argue that our guidelines are located at the second (good practice) level. More research is required to prove or falsify them in other settings.

Keywords: enterprise architecture, project compliance, conformance, project architecture

1. Introduction

Enterprise Architecture (EA) provides the organization with high-level solution directions, constraints and overall views. EA therefore focuses on the relatively stable essentials of the enterprise as a whole [Lank05, OpPr07, WBLS05]. This should lead to various benefits [BFKW06, TOGR03, Lank05, PuHi05, WBLS05, Kozi06]. Perhaps most important, EA enables management to pursue a coherent strategy that is optimal for the entire company, instead of local optimizations. This should enable the organization to align business and IT and let its business processes and IT systems contribute to the enterprise's core business objectives in an agile fashion. Furthermore, EA should be able to facilitate the reduction of complexity, and the integration, undoubling and outsourcing of processes and systems. In order for the EA's high-level solutions and constraints to provide these benefits, business processes and IT systems should be consistent with the organization's Enterprise Architecture. Specific, local projects that design and implement these processes and systems should therefore also conform to the EA [GoBR99, TOGR03, WBLS05, FoBr07].

In addition to the above mentioned benefits for the organization as a whole, EA is claimed to provide the projects themselves with value in a number of ways. Working with EA is said to improve project success, to reduce project risk, duration and complexity, to speed up the initialization of a project and to reduce project costs [BFKW06, WBLS05, Capg07, Pulk06].

Several governmental and commercial organizations have developed approaches for stimulating projects conform to EA [Line07, FDoT06, USDA07, CaAm07]. Important recurring elements here are *architectural trainings* and *formal reviews* to assess whether proposals and project artifacts (i.e. work products or deliverables) conform to the EA. Such a review may include a dedicated "project consistency checklist" containing requirements that projects should conform to [see FDoT06]. Formal reviews are also mentioned in TOGAF as a measure to ensure compliance with EA [TOGR03]. The topic of conformance is discussed in more detail in [WBLS05], where the concept of the Project Start Architecture (PSA), which we will discuss in section 2, is introduced.

1.1 Research question and goals

The above demonstrates that practitioners have acknowledged the need for developing ways for projects to comply with EA. However, very few scientific publications seem to discuss the topic, and those that we found only scratch the surface [see e.g. GoBR99, PuHi05, Pulk06]. This is remarkable, as an EA cannot provide the benefits mentioned above if its high-level solutions and constraints are not being applied in the projects developing and implementing the business processes and IT systems. Alignment with strategic goals, integration and avoiding duplicate processes cannot be expected to happen automatically. Not surprisingly, therefore, the question of how projects can conform to an overall architecture has been recently identified as an important research area [BICS07, FoBr07]. Therefore, the research question in this paper is:

> *What best practices can be identified for eliciting business and IT requirements in local projects that have to comply with Enterprise Architecture?*

The goal of our research is to contribute to knowledge on how enterprises can deal practically with project conformance to EA, mainly from a business and systems analysis perspective. Since not much research has been done on this topic, we consider our study to be explorative by nature. Therefore, in this paper, we shall formulate hypotheses (best practices) on the basis of empirical research. As this research is part of a larger research project, the results of this study will provide input for a theoretical model for projects conforming to EA.

The focus in this paper is on projects that are not part of the enterprise-wide EA itself, but instead have a local scope (i.e. the 'regular' projects). These projects typically affect only part of an enterprise, for example delivering a software solution for a specific department. Unless specified otherwise, the "projects" mentioned in the remainder of this paper are specific, local projects that have to conform to EA. Typically, these projects comprise both a business (re)design component and an IT component.

The remainder of section 1 will define central terms. Section 2 will present the theoretical framework that we will use to carry out and present our empirical research. Section 3 will state our research approach. Section 4 will present the research results: observations and best practices. Finally, section 5 contains the conclusion and suggestions for further research.

1.2 Best practices

Although by no means as pretentious as the much used concept of “critical success factors”, the term “best” practices can be said to imply too grandiose a claim (see also the conclusion section). We will use it here, however, because of its institutionalized character. We base our definition of best practices on that of Chevron, as stated in [ODGr98]. Consequently, a *best practice* is: any habit, knowledge, know-how or experience that has proven to be valuable or effective within one organization, and may have applicability to other organizations. As [WaSG06] state, the term best practice is widely used in the discourse of business and Information Systems (IS) professionals. At the same time, however, they find that neither the proposal nor the analysis of such guidelines are a very common topic in IS literature. Nonetheless, more scientific research seems to be warranted, since benchmarking best practices might provide significant gains in time and money, whereas identifying and transferring them can be quite complicated [ODGr98]. Furthermore, there are indications that the best practices put forward by commercial vendors may not be the result of a thorough, investigative process, but may have been created by a relatively small, powerful interest group [WaSG06].

We acknowledge four levels of best practices, based on the levels defined by Chevron [ODGr98]. These levels will be used to characterize the best practices that we identified in our research.

- *Good idea*: unproven practice, making a lot of sense intuitively and thus a potential candidate.
- *Good practice*: a candidate practice which has been tested in one or more projects. Further substantiation is needed. There is little or no comparative data from other organizations.
- *Local best practice*: a good practice that has been determined to be the best approach for all or part of an organization. This is based on an analysis of performance data, including some review of similar practices outside the organization where the best practice originated. Note that “local” here has a potentially broader scope than for the “local projects” mentioned above.
- *Industry best practice*: a practice that has been determined to be the best approach for all or most of the organizations in an industry. This is based on benchmarking inside and outside the original organization (including organizations outside its industry), and includes analysis of performance data. Note that the “industry” in this paper comprises organizations applying EA.

1.3 Business and systems analysis

Inspired by [IIBA06], we define *business analysis* as the set of tasks, knowledge and techniques required to describe the current or future problems, goals, needs, products, stakeholders, processes, organizational structure and/or other relevant aspects that add value to the business. The focus of business analysis is broad but abstract. Defining detailed solutions will be done by specialists (e.g. accountants or systems analysts).

We define *systems analysis* as the set of tasks, knowledge, and techniques required to describe an existing or desired information system in terms of its context, boundaries, constraints and functionality. This kind of analysis is therefore not concerned with technical design, but instead with specifying the requirements of the software and possibly hardware. Systems analysis takes as its input the artifacts that are the result of a business analysis.

2. EA and projects

Inspired by [WBLS05, BrWi05, IEEE00] we define *Enterprise Architecture* as the high-level set of views and prescriptions that guide the coherent design and implementation of processes, organizational structures, information provision and technology within an organization or other socio-technical system. The views can depict both as-is and to-be architecture, and typically provide insight into the fundamental organization of a system, its components and their relationships. *Prescriptions* focus solely on to-be architecture and thus provide generic constraints and direction for both high-level, enterprise-wide services and more detailed local initiatives. As such, they are the means by which the EA guides the local projects central to this paper. Prescriptions may take various forms. For example, they can be text-based *principles* that state a generic requirement, e.g. “Every business process has to generate audit trails that conform to the standard.” Prescriptions can also be graphical *models* that depict a generic process or structure which can be detailed by the projects which take them as a starting point. For example, a graphical overview of the organization’s security zones and related user roles.

A framework is often used in creating an EA. This is a conceptual structure to analyze an enterprise and to structure both an EA and its design process.

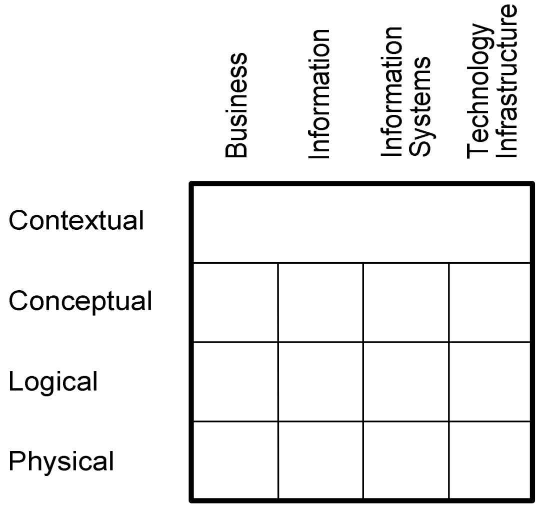

Figure 1: The IAF framework for EA

Such a framework often takes the shape of a two-dimensional matrix [GrKV06]. The cells in the matrix describe the content elements of the EA and their relationships. This provides an overview and helps to identify required analysis or design artifacts, such as information models or documents containing principles. Several architecture frameworks exist [GrKV06]. Figure 1 shows a simplified variant of the Integrated Architecture Framework, or IAF, which can also be used on project level [GoBR99, Capg07, FoBr07]. IAF uses a categorization of aspect areas that is widely accepted [Pulk06, GrKV06, TOGR03]:

- *Business*: business objectives and strategy, products and services, organizational structure, people, key business processes and governance.
- *Information*: the creation, processing, exchange, storage and use of information and knowledge.
- *Information Systems*: the information systems that offer communication and information services to the business and information areas.
- *Technology Infrastructure*: the (network of) hardware devices, operating systems and middleware on which the information systems run.

On the vertical dimension, four abstraction levels are used to detail issues identified at higher levels. As we will refer mainly to the aspect areas in this paper, the reader is referred to the mentioned literature for more information about this dimension.

2.1 The project conformance framework

When working with Enterprise Architecture, one can distinguish between different kinds of architectures. The first architecture is the EA itself, which is the architecture residing at the level of the enterprise. Second, one or more *Domain Architectures* (DAs) may be created, if needed. These are architectures defined on the basis of one specific group of products, services, processes or functions. A domain can be acknowledged at the level of the enterprise, for example when considering enterprise-wide security. However, a DA can also reside below enterprise-level, for instance when creating guidelines for one specific product group. Third, at the project level, *Project Architectures* can be distinguished. To state the relationships between the different architectures, we use the theoretical framework for Project Architecture in the context of EA which is presented in [FoBr07]. This framework is shown in Figure 2, condensed into one diagram. The original framework is mostly concerned with the *structure* and *relationships* of the various architectures. However, this study focuses on the *process* of carrying out business and systems analysis, which is the reason we have included feedback loops.

The Project Architecture consists of two parts. The *Project Start Architecture* (PSA) is the collection of prescriptions from an EA and/or DA that is relevant for the current project, and the early translation of these prescriptions to the specific situation (see also [WBLS05]). As a result, the PSA specifies the project's direction and boundaries at the start of that project. Therefore, the fundamental analysis and design artifacts (deliverables), that describe the specific solution that will be created in the project, will have to be compliant with the prescriptions in the PSA. This collection of fundamental artifacts is called the *Project Exclusive Design* (PED). The PED can contain artifacts such as those found in the Rational Unified Process [Kruc03], such as the Vision document, Use Cases, Domain Model and Software Architecture Document. See [FoBr07] for an overview. During or after the creation of the Project Architecture, the project members can provide the Enterprise and Domain architects with feedback on the EA and DAs. With these comments the EA and DAs can be further modified and refined.

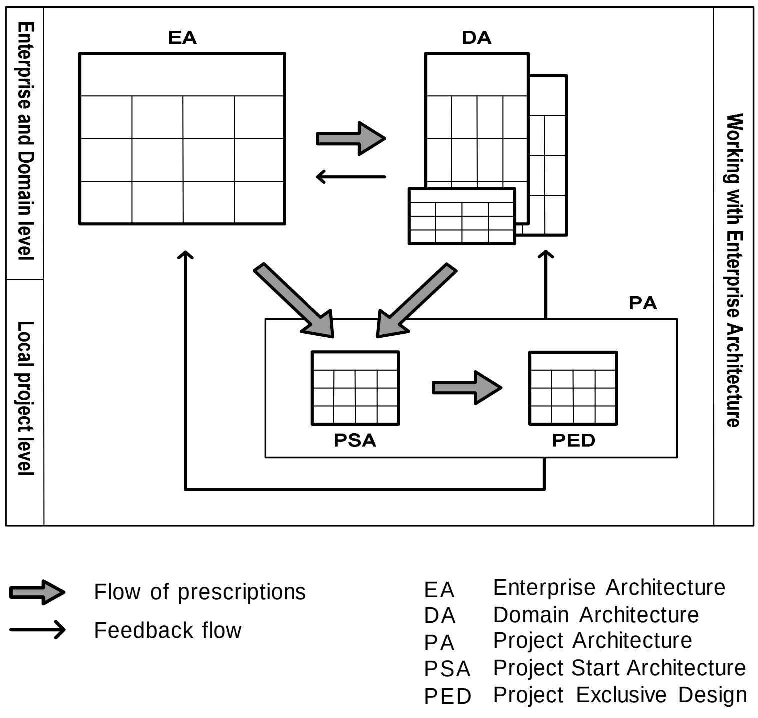

Figure 2: The PA and higher-level architectures

For the reader's convenience, when we mention "Enterprise Architecture" or "EA" in the remainder of this paper, this actually refers to "Enterprise and/or Domain Architecture".

3. Research Approach

Because not much research has been done on the topic of projects conforming to EA, we consider our study to be explorative by nature. We shall develop hypotheses on the basis of empirical research. A qualitative approach is a highly relevant research strategy in this stage of scientific study [MiHu94]. We use a multi-method approach for discovering and experimenting with relevant best practices. The methods used are Canonical Action Research (CAR) and focus groups (FG).

3.1 Research setting

Both the action research and the focus group interviews were carried out within Statistics Netherlands (SN), a large governmental organization located in two cities in the Netherlands (Voorburg and Heerlen), employing over 2000 people. Its mission is to produce and publish undisputed, consistent and relevant statistical information. The organization is information-intensive by nature, as both its input and output consist of information. Six months prior to the start of our research project (late 2006), the EA of the organization had been officially approved by its top management, which meant that working with EA, DAs and PSAs was relatively new to the organization.

The EA, created using IAF, aimed to provide a complete architecture, although some parts were to be implemented by Domain Architectures. At the time of research, the architecture consisted of five central documents (258 pages), containing the prescriptions, plus some supporting material. The EA included 247 text-based principles, 75 graphical models (e.g. generic processes and security zones), and a substantive amount of descriptive text for explaining the principles and models.

3.2 Canonical Action Research

In action research, the researcher participates in a real-world situation to help solve an immediate problem situation while carefully informing theory [Bask99, Vrie07]. Canonical Action Research has been developed to ensure maximum relevance and scientific rigor by formalizing the approach using five principles [DaMK04]. Participating in a project allowed us not only to discover best practices, but also to experiment with them. This was done in two business process redesign projects with an IT component: the Consumer Price Index (CPI) and the energy statistics. The CPI, arguably Statistics Netherlands' most important product, calculates the average price change of consumer goods and services purchased by Dutch households, and as such influences salaries, pensions and rent levels. The energy statistics provide information about physical energy flows in relation to energy commodities (e.g. oil and electricity) and energy producers and consumers. In both projects, the principal researcher participated as a business and systems analyst. In these projects the business processes, statistical methods and supporting IT-systems were being redesigned. Research data were collected by keeping a daily research diary, recording audio, taking minutes of discussions, and analyzing documents (e.g. EA artifacts and presentations). Below, we will describe how we applied the five principles of CAR as described by [DaMK04].

- *Principle of the Researcher-Client Agreement (RCA)*: To build trust and guarantee behavior, an RCA was drawn up for each CAR project, containing twelve (mostly behavioral) statements, a description of the research question and its goals, information about the CAR method and a preliminary version of the framework presented in section 2. This was discussed with the project members, after which both project boards approved the RCA.
- *Principle of Theory*: Before participating, an early version of the framework of section 2.2 was discussed with the project members. No best practices were formulated before the research, since it was our intention to discover and develop them during the empirical study.
- *Principle of the Cyclical Process Model*: CAR uses a cyclical process model in order to ensure systematic rigor. Since the research focused on carrying out business and systems analysis, the action involved creating several analysis and design artifacts. As a consequence, the research featured a large number of small cycles, as every artifact needed several iterations. A standard cycle would consist of creating a new version of the artifact, distributing it to the relevant stakeholders, organizing and holding a review session, and analyzing the shortcomings of the current version. If the artifact was not yet of satisfactory quality, another run of the cycle would begin.
- *Principle of Change through Action*: Actions are a central part of CAR, as they can be used for experimenting and have to be taken in order to achieve more satisfying conditions for the stakeholders. Actions here were e.g. creating a new version of an artifact and holding a review.
- *Principle of Learning through Reflection*: Reflection and learning are needed to formulate implications for both practice and the advancement of scientific knowledge. Reflection and learning took place at several levels: the review sessions in which the artifacts were discussed, the focus group sessions (in which we presented our CAR findings), keeping the diary and refining the best practices during the projects. Learning for the organization was also specified in feedback to the EA architects and a best practices document. For more on reflection, see the data analysis paragraph in section 3.3.

To improve validity, both CAR projects reviewed this paper after it had been completed. In addition, a formal peer review of this article was conducted (the peers being two business analysts).

3.3 Focus groups

According to [Morg96], focus groups are “a research technique that collects data through group interaction on a topic determined by the researcher.” The interaction in focus groups lets participants both query each other and explain themselves, thus providing articulations on normally unarticulated assumptions. Therefore, according to [BFTR01], focus groups can yield data on the meanings that lie behind group assessments and the group processes that lead to these assessments.

FG interviews, when adjunctive to other methods, can be used in valuable ways [BFTR01]. First, as an extension to CAR, focus groups help us gain insights that were missed by the first method. Second, by discussing best practices in focus groups we have an opportunity to deepen our existing knowledge, for example by obtaining practitioner feedback on our explicitly presented CAR findings. In short, our goal of the focus groups is to extend (obtain new data) and enrich (get feedback on) our CAR findings. The following description of our research is based on the design issues (see italics) mentioned by [Morg96].

Starting with *sampling* and *group size*, all participants were employees of SN. We used three focus groups, depending on the role that participants had in projects in SN. Group 1 (n=6) consisted of business analysts and enterprise architects from both office locations. Group 2 (n=4) comprised systems analysts from the Voorburg location. Finally, group 3 (n=6) included statistical methodologists, also from Voorburg. The meetings were held in the office building during working hours. So-called *focusing exercises* [BFTR01] were used to concentrate the group’s attention and interaction on the study’s topic. This means that participants were asked a week in advance to prepare a short presentation about their own best practices when doing analyses in projects. During the focus group meetings, each presentation was followed by a discussion about the practices presented. At the end of the session, another, more general discussion was held. The end of the FG session was also used by the principal researcher to present the CAR fieldwork findings and to obtain feedback on them. The *level of moderator involvement* was relatively low. Discussions were structured only to make sure the participants could present their contributions and that there was ample time for discussion. Finally, several aspects concerning *data gathering and analysis* deserve attention. In order to utilize the richness of the data and to avoid selective and superficial analysis, the discussions in the focus groups were audio recorded and transcribed verbatim. This was done using the notation given by [BFTR01]. The transcribed recordings were coded (indexed) and further analyzed using QSR NVivo, a tool for organizing and analyzing unstructured data. Hypotheses (best practices) were formulated early on in the CAR projects and, akin to Znaniecki’s method of *analytic induction* (see e.g. [Patt02]), refined and made dependent on conditions as more FG and CAR data were collected.

4. Research Results

4.1 Observations

This section presents the opportunities and problems we observed using CAR and FG, and that have led to the formulation of best practices.

1. Ambiguity of prescriptions: Because of the inherently abstract and generic nature of architectural prescriptions, the EA (and consequently the PSAs of projects) might contain quite a number of principles and models that are difficult to grasp. As a result, prescriptions might not be interpreted as originally intended by the architects. This holds true at different levels. First, the prescription content that is present may simply be ambiguous. Second, on several occasions we found that information about the level at which to apply them was missing. This means that it was not immediately clear whether these EA prescriptions described elements of the EA-level itself (e.g. enterprise-wide services that need to be delivered and which every project can then use) or were prescriptions that projects should adhere to (e.g. "Every information object has exactly one owner, who is accountable for its quality").

In our CAR projects, for example, one EA principle stated that there should be regular archiving functionality for statistical datasets. At the start of the CPI project, we interpreted this principle as a requirement for our project (i.e. our project should deliver archiving functionality to ensure that the CPI data are stored safely for reproducibility purposes). However, during the project, our interpretation shifted towards it being a requirement for a future enterprise-wide archiving service that an EA-related program was going to deliver, and which projects were expected to utilize.

2. Additional project complexity: Demanding that a project conforms to EA prescriptions may introduce considerable complexity to the project. In our study, we observed several reasons for this. First, the high-level architecture defined an ideal solution, without considering practical problems. This led to a large number of requirements for projects to conform to. Second, project members had to learn and understand the EA that had to be adhered to. Third, the ideal and generic EA prescriptions had to be translated to the specific project situation. All of the above took time and effort. For example, the EA in our empirical study demanded that business rules be separated from the software. This should lead to more flexible systems, whose business rules can be changed quickly by the user department without requiring IT specialists. However, during the energy statistics project it became clear that this would require quite some additional IT expertise in the user department (mainly specifying requirements, programming rules and testing). This required the project to determine a governance strategy for how the user department could deal with changing its systems itself in a way that minimized risk.

3. Projects are test cases: Both in the PSA and the PED, projects have to make important decisions concerning the application of prescriptions. One reason for this is the fact that generic prescriptions are often ambiguous; another is that a project has to translate such prescriptions to its specific situation. As a consequence, early projects can be seen as important test cases for applying EA prescriptions.

4. High-level EA models: An EA might feature high-level models in order to make generic structures, processes or locations explicit. At Statistics Netherlands, for example, a distinction is made between four stage-dependent storage bases. These are the Inputbase for collected raw microdata, the Microbase for corrected microdata, the Statbase for aggregated data and the Outputbase for published data. In both our CAR projects this concept helped us to critically reflect on our own situation and provided us with the high-level design for our storage architecture in which we could fill in our project-specific data sets. See Figures 5 and 6 in section 4.2.4 for an example from one CAR project.

5. PSA similarity: PSAs of several projects were very similar in terms of the content of the architectural prescriptions that were included. The reason for this was the fact that the PSA collected the prescriptions from the EA that were relevant for projects. As might be expected, the abstract and generic nature of these prescriptions made them relevant for most statistical redesign projects. This was demonstrated in our CAR projects, of which the PSAs were created by the participating researcher shortly after each other. The second PSA, that of the energy project, could be created far more quickly, as the selection of prescriptions and commenting on them proved to be quite similar to that of the CPI project. To a certain extent this is not surprising, as we have seen that the EA should focus on the enterprise's relatively stable essentials. For SN, one example of these essentials is the set of four stage-dependent storage bases, which can be identified in nearly every statistical process.

6. Awareness stimulating role of the PSA: The research findings seem to indicate that the PSA was mainly read at the start of the project, but was not used as a 'holy book' or rigid set of instructions during the project. These results can be explained by the fact that a PSA is created at the start of a project. Therefore, especially in complex projects, a PSA might not be sufficient to satisfactory stimulate project conformance to architectural prescriptions. After all, the PSA is not updated during the project because other, more suitable artifacts are used (e.g. the Vision and Software Architecture Document). Furthermore, albeit cited as one of the functions of a PSA [WBLS05], it proved to be difficult or impossible to make definite fundamental choices at the start of our CAR projects. This was a consequence of the fact that at the beginning of these complex projects not much was known in terms of requirements and domain knowledge, which severely hampered the translation of generic prescriptions to the project situation. However, we found that creating and reviewing the PSA in our CAR-projects did stimulate positive discussions about the EA and the fundamental elements of the project. This led to a richer and more tangible understanding of the EA and the possible consequences for the project.

7. Aspect area orientation: In principle, business analysis and systems analysis each have their own architectural prescriptions. *Business analysis* focuses mainly on the prescriptions in the Business and Information (B&I) aspect areas. For example, during our CAR projects, Statistics Netherlands was developing a domain architecture for storing (meta)data. One important principle in this context was "Statistical products will be described according to the metadata model". This prescription was input for the business analysts, as they had to describe statistical datasets in a pre-defined way. *Systems analysis* focuses mainly on the Information Systems aspect area and, to a lesser extent, the Technology Infrastructure (IS&TI). The IS area included the principle "Every information system supports the storage bases", referencing the bases of observation 4. In our CAR projects, this was input for the systems analyst, as he had to functionally design an information system compatible with these bases.

When reflecting on these 7 observations it can be argued that they refer to the different levels mentioned in the framework in section 2.2. For example, the observation that prescriptions may be ambiguous refers mainly to the EA level, as this implies that the prescriptions will have to be formulated more sharply by the enterprise architects. In contrast, the observation that prescriptions have to be translated to the specific project situation refers to work done at the project level. The above would imply that problems and other observations might need best practices at both the project level and the EA level. The next section will demonstrate this explicitly, as a set of these practices is presented for both *project members* and *enterprise architects*.

4.2 Best practices

This section presents the best practices according to two core dimensions of the framework presented in section 2.2. First, the level at which they are located (the EA level versus the project level). Second, the project content category (the PSA versus the PED).

	PSA	**PED**
EA level	Section 4.2.1	Section 4.2.2
Project level	Section 4.2.3	Section 4.2.4

Figure 3: Presentation of best practices

For every best practice one or more *supporting observations* will be referenced. These are the observed opportunities and problems providing empirical support for this guideline's relevance and validity.

4.2.1 The EA level – PSA

This section contains the best practices for enterprise architects creating EA prescriptions.

1. State the level of application: For every prescription in the EA, state explicitly whether it applies to an EA-level solution or service that has to be delivered, or to projects that have to adhere to it.

Comment: This makes it clear whether projects should adhere to the prescription. A local project should not implement a prescription that describes a solution or service that an EA- or DA-related initiative will implement (e.g. an enterprise-wide storage system). This practice will also make the selection of prescriptions for the PSA easier, since only the prescriptions that apply to projects are relevant (see also best practice 2).

Supporting observation: (1) Prescription ambiguity.

2. Supply PSA-template with default content: If the PSAs of various completed projects prove to contain more or less the same prescriptions, then create an enterprise-wide PSA template with a standard initial filling of prescriptions.

Comment: This will save the members of future projects considerable time, as they do not have to select the relevant principles from the large pool of EA prescriptions themselves. Drafting the PSA in a specific project then consists mainly of tailoring it to the project circumstances (e.g. giving domain-specific translations, explanations and project-level examples of the application of the prescriptions). It is possible to create several pre-filled templates, depending on the type of project. At SN, for example, two types of these PSA templates are relevant. The template for non-statistical (re)design projects (e.g. implementing a CRM system) features all the prescriptions. A future template for statistical (re)design projects will contain only prescriptions that are relevant specifically for this project type.

Supporting observation: (5) PSA similarity.

3. Counterpart prescriptions: IT prescriptions with implications for the business should lead to counterpart prescriptions in the Business and Information areas. Analogous, Business or Information prescriptions with IT implications should lead to counterpart prescriptions in the Information Systems and Technology Infrastructure areas.

Comment: The EA should align the business and IT prescriptions, at least at a high level. Therefore, avoid that prescriptions with IT implications are present only in the B&I areas. In addition, avoid that prescriptions with business implications are present only in the IS&TI areas. There are several reasons for this. First, alignment implies tight integration between business and IT. For example, high-level design choices in the IS&TI aspect areas may impose restrictions for doing business analysis: an IT principle stating that off-the-shelf packages or data warehouse technology should be used is very likely to have an impact on (the freedom in) the design of the business process and the subsequent elicitation of IT-requirements. Therefore, IS&TI prescriptions that have an impact on the business should have related prescriptions in the Business and/or Information areas. Second, it helps to reduce complexity when creating the PSA and applying EA prescriptions in projects at a later stage. While some knowledge of prescriptions in other areas might be helpful, the business analysts should not spend their time understanding irrelevant IT prescriptions. Conversely, systems analysts should not spend their time understanding irrelevant business prescriptions. For example, in SN the IS aspect area featured the principle "Authorization is dependent on the user's role." Therefore, when we carried out the business analysis in the CAR projects, we defined roles and related them to the processes. We only did this because we had also studied the IS principles. The risk that business analysts do not adhere to this principle can be minimized if the Business aspect area had featured a counterpart prescription, e.g. "Descriptions of business processes should be related to the relevant business actors."

Supporting observation: (7) Aspect area orientation.

4. Example prescriptions: Every prescription in the EA that applies to projects should feature a comments section containing a clear *explanation* (explicating the rationale and implications) and *illustration* (giving a simple example of implementation in a specific project).

Comment: [TOGR03] suggests adding the rationale and implication for principles. In addition, we suggest giving examples in order to reduce the margin for interpretation. This should help in making important elements of the architecture clear. In the FG discussions, for example, it became clear that members of different projects had a fundamentally different interpretation of the four stage-dependent storage bases mentioned in observation 4, even though they are a core element of the EA. In the CPI project we could reach a shared understanding of these bases by not only stating their properties but also illustrating them with specific datasets that were familiar to the domain's stakeholders.

Supporting observation: (1) Prescription ambiguity.

4.2.2 The EA level – PED

This section contains the best practices for enterprise architects regarding the PED.

5. Conformance through templates: Make enterprise-wide document templates available to projects in order to stimulate substantive project adherence to EA prescriptions.

Comment: The pre-defined template can thus give concrete specifications both for *what* content should be included in local analyses and *how* it should be filled in (i.e. specifying formats and giving the project members instructions). This way, a template is not merely a style sheet ensuring the same visual style across projects, but an effective way to influence the what and how of project content.

At Statistics Netherlands, an enterprise-wide template was created for designing logical information models in projects, describing the metadata of statistical datasets. This template forced authors to think about which of the four storage bases a specific dataset belongs to and requires the datasets to be described using a pre-specified format. Helpful comments for the future author were provided using blue text between brackets (e.g. *[Describe the object types and populations. See principle CBI03 for more information.]*). The comments can direct the author to relevant EA prescriptions or additional background information. Alternatively, they can provide guidance themselves and present the author with examples of applying the prescriptions.

Supporting observation: (6) Role of the PSA.

6. Architect involvement: An enterprise architect should either participate in projects or be available to be consulted.

Comment: This helps to stimulate conformance and to avoid deviant project interpretations of prescriptions. In our CAR projects we found that access to enterprise architects helped us to understand what was meant by certain prescriptions. Furthermore, several focus group participants indicated that they missed architect involvement in their own projects. Architect involvement is also mentioned in TOGAF as a way of ensuring compliance [TOGR03].

Supporting observation: (1) Prescription ambiguity.

4.2.3 The project level – PSA

This section contains the best practices for project members creating the PSA.

7. Phase dependent PSA: Make the creation of the PSA artifact dependent on the project phase.

Comment: Especially if the project is complex – and thus starts with a comprehensive business analysis phase – it is recommended that two versions of the PSA be used. This helps reduce unnecessary complexity. The widely accepted distinction of the four aspect areas offers a natural way to implement this practice. The first PSA should cover only the Business and Information areas. The business analysis and design, then, should adhere to this relatively small version of the PSA. Initially focusing solely on the B&I areas keeps the PSA relatively simple, and makes it easier and more accessible for project members to read and understand this artifact. As soon as the project starts specifying IT requirements and buying or creating software, a second version of the PSA can also cover the Information Systems and Technology Infrastructure areas. This IT project phase should conform to this second version of the PSA. In our CAR projects we chose to split the PSA in two versions, as there were many prescriptions and this allowed us to speed up the initiation of the (business) project.

Supporting observations: (2) Additional project complexity; (7) Aspect area orientation.

8. Stimulate architectural awareness and knowledge: Use the PSA at the start of a project for increasing architectural awareness and knowledge. Subsequently, use templates for actually stimulating a project to conform to EA prescriptions when creating the PED.

Comment: Especially in a complex project, the PSA might be less suitable to stimulate EA adherence when creating the PED. However, at the start of the project – which is when the PSA is drawn up – creating the PSA and reviewing it with stakeholders can stimulate discussion about the EA and the fundamental elements of the project. This creates awareness and knowledge of the architecture among project members, managers and users.

Supporting observation: (6) Role of the PSA.

4.2.4 The project level – PED

This section contains the best practices for project members creating the PED.

9. Project instantiation: Use the project instantiation technique to provide a mapping between the general EA and the project.

Comment: In the project, the EA model can be 'copied' and filled-in in detail for the specific project situation. Thus, the EA offers the project a design framework onto which lower-level concepts can be projected, resulting in a project-specific instantiation. In our CAR projects, for example, we used the framework of the four generic storage bases (Figure 4) to structure our own storage bases (see Figure 5 for a simplified example from the CPI project). Project instantiation has several advantages. The explicit mapping stimulates the project architecture to conform to the EA. Also, the project instantiation diagram can act as a powerful means of communication to the enterprise architects and other stakeholders, to indicate that the project conforms to the EA.

Supporting observation: (4) High-level models.

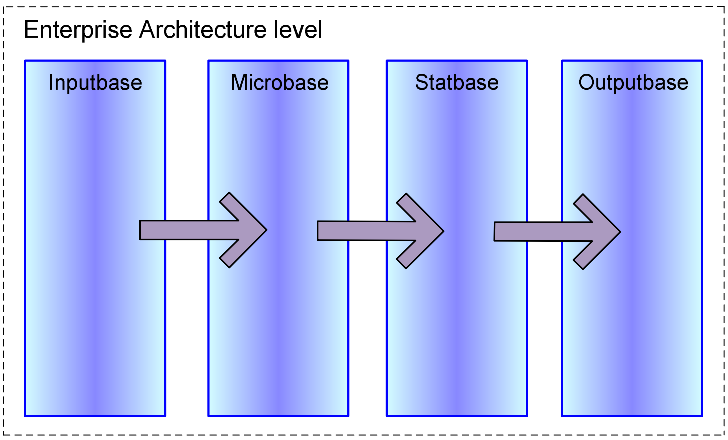

Figure 4: The generic EA model of the four bases

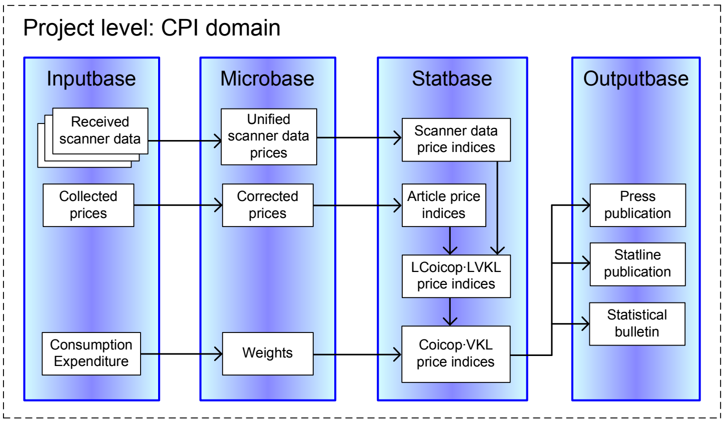

Figure 5: The project instantiation for the CPI

10. Provide feedback: Provide the enterprise architects with feedback about applying the architectural principles.

Comment: Feedback should be used to improve the quality of the EA, which is especially important if these architectures are relatively new. Looking back at the PSA, which was created at the start of the project, may provide valuable information. Prescriptions in the PSA which are labeled ADD (added), ALT (altered), AMB (ambiguous) or ABD (abandoned) might be candidates for additions, changes and deletions of prescriptions in the EA. (See [FoBr07] for a more detailed description of the PSA labels.) Furthermore, when creating the PED, project interpretations of, deviations from and suggestions for improving the generic prescriptions should all be noted. Once the project is completed, these notes can be sent to the enterprise architects, who might be able to use this feedback for a revision of the EA. Based upon the experiences in the CAR projects, the participating researcher indicated several times that there were too many prescriptions to conform to. This was used by the enterprise architects to reduce the number of prescriptions down significantly. The notion of feedback is also mentioned by [Pulk06], flowing from the systems level to the domain and enterprise level. However, it is not stated explicitly here if this concerns systems actually conforming to EA, or a generic systems architecture for projects to be adhered to.

Supporting observation: (3) Projects as test cases.

In Statistics Netherlands, several of these best practices are either implemented or are in the process of being implemented for the entire organization (2, 3, 5, 6, 7, 8, 9). The other best practices are included as proposals in a document that the researcher created specifically for carrying out statistical (re)design projects that have to conform to the higher-level architectures of SN.

4.3 Discussion of best practices

Looking at the 10 best practices listed above, we see several themes emerging. As could be expected, several practices aim to directly *stimulate project compliance* with higher-level architectures (5, 6, 9). Another theme is to *reduce the complexity* that is added to the project by demanding conformance to EA (2, 3, 7). Our observation of increased project complexity is interesting, as it contradicts the claim of EA as an instrument for managing and reducing complexity [WiFi07, Capg07, Kozi06]. Justification for this claim usually lies in the fact that EA frameworks facilitate breaking down complexity using aspect areas, abstraction levels and views. An interesting hypothesis is that this might actually *cause* (project) complexity to increase. Modeling at the EA level provides a relatively simple overview, detecting processes and systems that should be undoubled or integrated. Consequently, a result may be quite ambitious and complex projects that cannot focus solely on their own relatively simple silo anymore. Instead, they now need to take into account a larger environment and additional requirements (i.e. EA prescriptions). Further research is required to test whether this hypothesis can be supported by empirical evidence.

As a third theme, we observe that several practices are meant to *avoid project level interpretations* of prescriptions that deviate from what was intended by the original enterprise architects (1, 4, 6). Related to this theme, ambiguous principles are already a research topic that has been studied recently. In this context, several publications have focused on criteria for the formulation of less ambiguous or even formalized principle statements [see e.g. TOGR03, BHPW06, Lind06, OpPr07]. The formalization of principles still has to prove its value, however, as several problems might surface. First, formal principles might be unambiguous for automated compilers, but difficult to read for humans (who actually have to work with them). Second, even formal EA principles cannot be very specific, as they are inherently generic. Because of these reasons, we have chosen in our research to experiment with *examples* of prescriptions (best practice 4).

An interesting aspect is that best practices for project conformance are not only found on the level of the project, but also on the EA level. Therefore, project conformance is not only the responsibility of *project members*. It is also desirable that the *enterprise architects* themselves take action to assist projects to comply with EA. According to the best practices, active tuning between the two levels is advised, for example by providing feedback and involving enterprise architects in projects.

In this context it is interesting to consider tool support, as tools might assist in aligning the EA and project level. Enterprise architects could initially use the tool to create prescriptions, mark them (ir)relevant for projects, and store them in a central repository. Subsequently, projects could use the same tool to select the relevant prescriptions from this repository and tailor them to generate the PSA artifact. The tool could also be part of a larger integrated environment, facilitating more types of communication between EA and projects (e.g. news, FAQs, new templates, new example prescriptions).

5. Conclusion

We set out to identify best practices for performing business and systems analysis in projects that have to conform to EA. We presented seven observations and ten best practices based on CAR experimenting and focus group interviews. Not all best practices we found are guidelines for project members. Several of these are practices for enterprise architects, as they can play a role in stimulating project conformance and avoiding deviating project level interpretations of prescriptions. In other words, EA architects have an indirect but important role to play in business and systems analysis in projects conforming to EA. It would be too simplistic to consider it solely a responsibility for project members.

In terms of the four levels of best practices mentioned in section 1.1, the best practices we identified are at the second level, i.e. the *good practice* level. As we based our explorative research on an in-depth qualitative study of only one enterprise, some modesty is in order. Additional research should be done in other settings, where different and entirely new best practices might be found. Furthermore, we concur with [Gree01] that best practice research should not only be concerned with internal validity, but also with external validity, i.e. the extent to which the findings can be generalized to other settings and populations. We view our research results as being grounded hypotheses (i.e. based on empirical study) which require further research to test and refine them with other (perhaps more positivist) methods. Being practices on the *good practice* level, more research is also needed to validate them in alternative settings in real-life projects before they may possibly be hoisted to the *local* and *industry best practice* levels.

At the same time, however, the difference between the levels – and their value in practical situations – should not be overestimated. In our opinion even the practices at the highest level, which have been tested in many different situations, cannot be adopted blindly by an organization, but should merely be seen as guidelines or behavioral patterns. We agree with [Gree01] that, when facing social and behavioral aspects, best practices are contingent upon the specific situation. Consequently, best practices will never be a “silver bullet”. In our view, therefore, even industry best practices should always be checked for validity in a specific situation, and possibly be tailored to its idiosyncratic needs. This also means that the best practices presented here could already be applied in practice, although a more critical evaluation of their validity in the situation might be justified than for industry best practices.

Another recommendation for future research would be to study how applying the guidelines presented in this paper affects project risks and costs. Finally, perhaps the most important next step will be to take these relatively independent best practices as a basis for a coherent model for projects conforming to EA. Such a model would have to take into explicit account both the EA level and the project level.

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Ralph Marcel Foorthuis

Statistics Netherlands
Henri Faasdreef 312
2492 JP The Hague
The Netherlands
R.Foorthuis@cbs.nl

Sjaak Brinkkemper
Utrecht University, Information and Computing Sciences
Padualaan 14
3584 CH Utrecht
The Netherlands
S.Brinkkemper@cs.uu.nl

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