Quality Evaluation of Architectural Documentation and Models

AISA Project Report

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Summary

Architecture documents have more and more central role in the company management, IT governance and system development. For example, enterprise architecture core diagrams are suggested be used in the company management. Architecture documents are used especially to support communication. Examples of use situations of architectural documentation are business planning for transition from a legacy business or ICT structure to a new structure and communication between acquirers and developers as a part of contract negotiations.

The quality of architectural documents is crucial for the value of documents: how useful those are for the company's business and ICT development work. This study contributes to the quality assessment of architectural documentation by identifying and defining a group of questions, criteria and metrics that can be used in the quality assessment of architectural documentation and models. Questions, criteria and metrics relate to the stakeholder and purpose –orientation and the quality of content and visualization as well as to the architecture documentation management. These evaluation factors were validated by practitioners. The results of this study aim to help enterprise and software architects to produce architectural descriptions and models of good quality.

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APPENDIX 1. Query Results

1 Introduction

Currently, companies commonly utilize architectural documents and models in their management, business and ICT development work. These documents and models relate to enterprise and software architectures. Lankhorst et. al represents that describing architectures is all about communication [1]. If an architecture description is not used as a means of communication in some shape or form, this description should not have been created in the first place.

The models are essential elements of architectural descriptions [2]. Models act as a medium for communication, helping to explain thinking to others. Models reduce the amount of information the reader needs to understand, and their structure guides the reader through the information [2]. In addition, models help to understand the situations it is modelling and to analyze situations by allowing the isolating key elements and understanding their relationships. Models also help to organize processes, teams, and deliverables as a result of the structures they reveal in the situation being modelled [2].

Use situations for architecture descriptions are described for example by the IEEE 1471 standard [3]. These are, for example, business planning for transition from a legacy architecture to a new architecture; communications between acquirers and developers as a part of contract negotiations and preparation of acquisition documents; planning and budget support; communications among organisations involved in the development, production, fielding, operation, and maintenance of a system as well as expression of the system and its (potential) evolution and analysis of alternative architectures.

Quality problems relating models are, for example, crowded diagrams, inconsistent notation, over emphasis of one aspect and the overlooking of individual stakeholder concern [4]. In addition model can be irrelevant, too complex, not sufficiently complete and contain superfluous elements [1]. These problems may affect the communication about topics presented in the model. The communication may thus be funnelled to the discussion about visualisation issues, neither than discussion about the questions to be solved.

The documentation is not the main aim of architecture development. However, the quality of documents and models affect on how well architectural documents and models are understood and used. The quality of them may thus affect on the value and usefulness of this documentation.

So for the assuring that architecture document can be understood and used correctly, architects should have practices to evaluate the quality of documents. However, it is not clear how to carry out the quality evaluation of architecture documentation. It seems that quality evaluation criteria and metrics for architectural documentation are thus not yet identified and analyzed yet enough.

Previous studies have studied and considered the quality evaluation of conceptual models [5, 6] [7] and technical documentation [8] [9]. Quality dimensions for conceptual models (syntactic, semantic and pragmatic quality) [5, 6] and for

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technical information (easy to use, to understand and to find) [9] are defined. In addition, quality properties for conceptual models [6] and for technical information [9] are also defined.

Some studies, books and guidelines relating to documentation of architectures are also published. These are presented, for example, relating enterprise architecture descriptions (e.g.[10], [1], [11], [12], [13]) and relating software architecture descriptions (e.g. [2], [14], [15], [16], [17]). Qualities of an effective architectural description (e.g. correctness, sufficiency, conciseness, clarity, currency and precision) is also introduced, for example, by Rozanski and Woods [2].

This study contributes the quality assessment of architectural documentation by presenting a group of quality evaluation questions, criteria and metrics for architectural documentation. These evaluation factors are validated by a group of practitioners.

This study consists of the following sections. Firstly, architecture documentation related concepts are considered in chapters 1. Secondly, research method used in this study is introduced in chapter 2. Evaluation questions and criteria identified by this study for architectural documentations are presented in chapter 3. Finally, identified metrics and the practitioners' validation results of them are discussed and analysed.

2 Architecture Documentation

2.1 Enterprise and Software Architecture Definitions

Enterprise architecture is typically used as an instrument in managing a company's daily operations and future development [1]. It can be seen both as a strategic tool for company management and as a tool for the IT governance. According to Lankhorst [1] management areas relevant to EA are strategic management, strategy execution, quality management, IT governance, IT delivery and support and IT implementation.

Enterprise architecture and enterprise models are usually produced and used at the organisation level. The enterprise architecture is defined for example by Kaisler et al. [18] that enterprise architecture is " *the main components of the organization, its information systems, the ways in which these components work together in order to achieve defined business objectives, and the way in which the information systems support the business processes of the organization*". These components include staff, business processes, technology, information, financial and other resources, etc.

Other definition for EA is presented in [1]: *enterprise architecture is a coherent whole of principles, methods and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure.*

Software architecture descriptions are usually produced in the projects in their system or software development work. A definition of software architecture is provided by Bass et. al [19]: "*The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them.*"

2.2 Architecture documentation standards

The concept of an architectural description / documentation is formalized and standardized in IEEE 1471 Standard: *Recommended Practice for Architectural Description* [3]. In addition standards for architecture descriptions are also developed and defined by companies. For example, IBM has presented architecture description standards ([20], [21]).

Main architecture documentation concepts defined by IEEE 1471 Standard [3] are especially the followings:

- *Stakeholder*: An individual, group or organization that has at least one concern relating system.

- *Architectural description*: A set of views (which consist of architectural models) and additional architectural information.

- *View*: A set of model representing enterprise or system from the perspective of a related set of concerns.

- *Model*: A particular diagram and description constructed following the method defined in a viewpoint.

- *Viewpoint*: The conventions for creating, depicting and analyzing a view.

Relationships between these concepts are presented in figure 1.
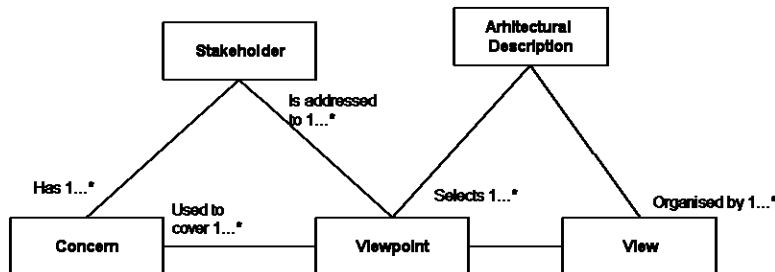

Figure 1. Architectural description related concepts (IEEE 1471 [3]).

2.3 Architecture document and model types

Various documents may relate to architecture documentation. Different document types are needed because use purposes and users of architecture documents vary a lot. A categorisation of enterprise architecture models is the following [10]:

- Ad hoc models: models that serve basic goals of communication and documentation and that are usually developed using simple drawing or presentation tools
- Standardized models: models adopting a standard or framework-based approach and using case tools
- Formal models: models that are based on reference architectures
- Federated models: models that aggregate across diverse sources and using EA tools interoperating with diverse repositories of information
- Executable models: active knowledge models that can be consulted by applications as well as humans.

Rozanski and Woods classify software architecture models to formal qualitative or quantitative models or informal qualitative models (sketches) [2]. These are defined as follows:

- *Qualitative models* illustrate the key structural or behavioral elements, features, or attributes of the architecture being modelled.

- *Quantitative models* make statements about the measurable properties of an architecture, such as performance, resilience, and capacity.

- A *sketch* is a deliberately informal graphical model, created in order to communicate the most important aspects of an architecture to non-technical audience. It may combine elements of a number of modeling notations as well as pictures and icons.

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2.4   Architecture Frameworks

Architectural frameworks have a central role in architectural documentation. These frameworks provide structure to the architectural descriptions by identifying and sometimes relating different architectural domains and the modelling techniques associated with them [22]. They typically define a number of conceptual domains or aspects to be described [22].

Enterprise architecture frameworks are for example Zachman's Framework for Enterprise Architecture [23], The Open Group Architecture Framework (TOGAF) [24], Archimate framework, ISO Reference Model of Open Distributed Processing (RM-ODP) [25]. Software architecture frameworks are for example Kruchten "4+1" View Model [26], Software Engineering Institute (SEI) set of views [14], Siemens Four View Model [27] and Rational Architecture Description Specification (ADS).

As discovered by May [4], viewpoints defined for example by different SA frameworks do not completely correspond to each other. The similar situation seems to be relating to EA framewoks. It is thus currently no commonly accepted set of architectural viewpoints [4, 28]. As Smolander [28] bring out architectural viewpoints chosen by companies are rather agreements between people depending on the organizational and project environment. In the practice, the selection of architectural viewpoints is thus based on the prevalent situation and characteristics in a company and in the project at hand.

2.5   Core Architecture Documents

Many different kind of documents may relate in architecture documentation. EA core artifacts are identified, for example, by Winter and Fischer [29]. EA core artifacts are mentioned especially to include documents relating to:

- Strategy specification

- Organisation/process specification

- Application specification

- Software specification

- Technical infrastructure specification

- Specification of dependencies between different layers.

2.6   Architecture documentation practices

Company's architecture documentation practices are affected by architects' own practices as well as by company level practices.

Organisation level aspect

A maturity model for enterprise architecture representations and capabilities is introduced by Polikoff and Coyne [10]. This maturity model consists of the following levels:

Level 1 Ad hoc: No common reference framework, possible use of case tools, little commonality between descriptions produced by different people or groups.

Level 2 Standardized: Established methodology for describing architectures, use of industry standard/custom framework, methodology not fully supported and enforced by tools.

Level 3 Formal: Methodology enforced by tools; Reference architectures; Multiple tools in use but from different vendors with low level of interoperability; Reference framework and architectural models cannot be readily queried.

Level 4 Federated: Connections between different systems and tools established.

Level 5 Executable: Models are consultable by applications at run time. Knowledge about enterprise activities, systems and capabilities becomes a real time resource.

Architect-aspect

In addition, architect's decisions and choices affect on architecture documentation. Architect decides what to describe in architecture documentation. Given a specific goal and focus, an architect decides which aspects of an enterprise or a system are relevant and should be represented in the model [1]. Examples of aspects that are frequently included in enterprise architecture models are: products, business processes, applications and IT-infrastructure elements, as well as their relations [1].

2.7 Challenges and Questions Relating to Architecture Documentation

Several discussions between AISA project researchers and company practitioners have been carried out before this study. In these discussions came up frequently following architecture documentation related challenges and questions:

- *Architectural documents do not exist in company.*

- *What documents and models should be produced? Framework and viewpoints that should be chosen?*

- *Many kinds of stakeholders and use purposes for architecture documentation exist. What kind of architecture documents should be produced in company?*

Different purposes and different target audiences may thus require fundamentally different models: while an IT manager may wish to have an overview of the system software, the devices it runs on, and the communication paths between these devices, the manager of a company may wish to have an overview of the products the company produces and the services they depend on [1]. The need for the fundamentally different kind of models is one key challenge in architecture documentation work.

3 Research method

In order to define, categorize and validate quality criteria and metrics for architectural descriptions and models, a series of the following research phases was carried out in this study.

3.1 Sources for the evaluation questions, criteria and metrics

Specific quality dimensions of documents can be measured by asking probing questions [8]. The evaluation questions provide thus the direction and foundation for

the evaluation. Such as presented in [30] a several sources can be used for the identification and construction evaluation questions, criteria and metrics. The sources selected to be used in the identification and construction criteria and metrics for architecture documentation in this study were:

- o Models, findings, or salient issues raised in the literature in the enterprise and software architecture field
- o Questions, concerns, and values of practitioners
- o General evaluation and quality models for documentation (e.g. technical documentation)
- o Views and knowledge of expert consultants: Consultants comments and recommendations in articles published in internet.
- o The researcher's own professional judgment

The first version of the list of the quality metrics, criteria and questions was produced on based these sources.

3.2   Validation of results

A semi-structured group interview with a focus group of practitioners from five ICT user and service provider organisations was organised for the validation of the results. Practitioners were managers and specialists of the management of enterprise and software architectures in their organisations. The companies and interviewees are described in the next table.

Table 1. Interviewees in the focus group interview

Companies	Number of personnel (year 2005)	Number of interviewees	Viewpoints of interviewees
Architecture consultation company	10	2	business consultation and software architecture consultation
Banking, finance and insurance company	11 974	1	enterprise architecture
Telecommunication company	4989	1	enterprise architecture
Business & IT consulting and development organization	a part of a large international company having 329 373 employees in total	2	enterprise architecture, software architecture, marketing, business
Retail and service company	28 092	1	IT governance, enterprise architecture

The participants from these companies were interviewed as one group in order for group members to influence each other by responding to ideas and comments of others [31]. This group influence came up and new aspects were brought out.

However, some aspects may not have been brought out by interviewees due to confidentiality reasons.

Metrics, evaluation criteria and their definitions presented in the following chapter paper were presented to the participants. Based on practitioners' own practical experiences, practitioners were asked to evaluate value and usefulness of these evaluation criteria and metrics. The interview was tape-recorded. Notes were written during the interview session. In addition, the query for evaluation of usefulness of evaluation criteria and metrics was organised. Workshop participants answered to this query. The question form and results of this query are presented in the appendix 1.

4 Quality Evaluation of Architecture Documentation

On based literature, it was identified that the quality of architectural descriptions can be evaluated from the following aspects:

1) stakeholder and purpose orientation: evaluation of how well documents are focused on purpose and on the stakeholder that use these documents..

2) content quality: evaluation of quality of information included in the models

3) presentation/visualisation quality: evaluation how well information is presented in documents.

Quality of Architectural Description

Stakeholder and Purpose orientation　　**Quality of Content**　　**Quality of Presentation / visualisation**

Figure 2. Aspects on quality of architecture description.

A group of evaluation criteria and questions to be used for the evaluation of each of these aspects was identified. In addition, it was identified a group of evaluation factors for the management of architecture documentation.

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4.1 Stakeholder and Purpose Orientation

Stakeholder and purpose orientation evaluation questions are presented in the table below.

Table 2. Evaluation questions and metrics for the content quality of architectural description.

Criteria	Questions/metrics	Sources
Stakeholders	Are the stakeholders of a model / AD defined and who are them?	[1]
Purpose	Is it the purpose of a model / AD in relation to these stakeholders defined and what it is?	[1]
Model's/ AD's suitability for the stakeholders	- Does model provide the stakeholder with the desired knowledge? - Do model answer/correspond to the objective of stakeholder? - Do model relate to problem? - Is a practical reason for the information evident? - Is the information presented from the stakeholders' point of view?	[1]
The use of AD/models – value of AD/model (degree the AD or model is being read, understood, and effectively used)	- Frequency of Use: This characteristic describes how frequently the documentation is used or referenced. - Number of Users: This characteristic describes the approximate number of personnel who will likely want or need to use this documentation. - Variety of Users: This characteristic describes the variety of different functional areas or skill levels of personnel who will likely use this documentation. - Impact of Nonuse: This characteristic describes the level of adverse impact that is likely to occur if the documentation is not used properly.	[32]

4.2 Quality of Content

Aspects for the AD's content quality of evaluation are presented in the figure below and evaluation questions relating to these aspects are presented in next table.
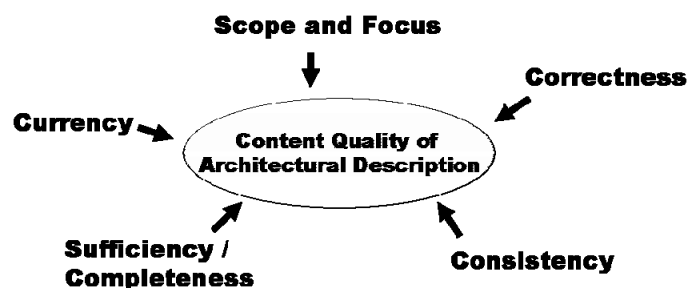

Figure 3. Aspects on the architecture description's content quality.

Table 3. Evaluation questions and metrics for the content quality of architectural description.

Criteria	Questions/metrics	Source
Scope and focus	– Scope: Is it defined what part of reality will be described in the model/AD (e.g. only primary processes)? – Aspects: Is it defined what aspects will be described? – The level of detail: Is it defined what level of detail will be described?	[1]

Currency of EA description	– Does information reflect the current enterprise?
	
	   – degree with which the current version of the documentation is up to date (Percents, subjective evaluation)
	
	   – Number of architectural effects having projects carried out after EA description has been produced
	
	   – Number of architecture changes made after EA description has been produced.
	
	– Frequency with which AD is kept current
	
	   – Number of updates / year
		[32]
		own contribution

Currency of SA description	Does information reflect a system? – Frequency with which AD is kept current – *Number of updates / project*	[9], own contribution
Correctness	Verification of information: – Is the information included in an AD/model verified? – Is there any incorrect arguments, or in-accurate or untrue reasoning?	[9], [1]
Correctness of EA	The number of "subtantive" errors / deficiences found after EA has been released: *the number and type of change request applied to EA principles*	[33]

Correctness of SA	– Correctness for stakeholders:
	
	   – Does model/AD present correctly needs and concerns of stakeholders?
	
	– Correctness of solution:
	
	   – Does model define correctly architecture that will meet stakeholder's needs?
		[2]

EA Completeness	EA's coverage of business areas – The degree to which EA addresses needs of each business area (e.g. subjective evaluation score 1-10)	[33]

Sufficiency / Completeness	AD's coverage of required viewpoints – The degree to which AD addresses each required architectural viewpoint (e.g. subjective evaluation score 1-10) Sufficient amount of information: – Is the all required information included in the model? Are all topics relating stakeholder's objectives and concerns covered, and only those topics? – Is information repeated only when needed? – Do model contain irrelevant or superfluous elements? Sufficient level of detail: – Has each topic has just the detail that stakeholder needs?	[33],[9], [1]
Consistency	Are models presenting different viewpoints consistent with each other?	[2]

4.3 Quality of Presentation/Visualization

Quality aspects for the AD's presentation/visualization are presented in the figure below.
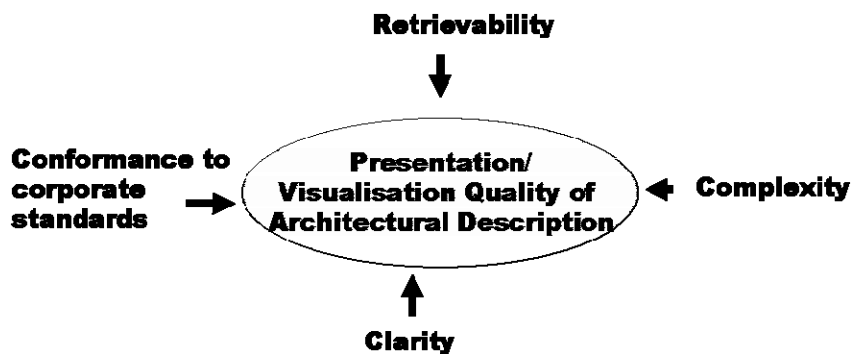

Figure 4. Aspects on the presentation/visualization quality of architecture description.

Evaluation questions and metrics for these criteria are presented in next table.

Table 4. Evaluation questions and metrics for presentation/visualisation quality of architectural description.

Criteria	Questions/metrics	Source
Conformance to corporate standards	Does the presentation of the AD/model conform to the corporate standards (if any) for such documents?	[2]
Retrievability: Presentation way familiar to stakeholder	– Does model have intuitive structure for the stakeholder? – What is the intuitive structure of stakeholder? – Do model correspond to it? Are used structures to which the receiver is used to?	[1]
Retrievability: Notation and structures	– Do model use a defined notation? – Is the notation/structure of model explained ? – Is stakeholder familiar with notation?	[1]
Clarity: Vocabularity and concepts	– Is the vocabularity and concepts stakeholders' concepts? Are the terms and concepts used known by stakeholder? – Are the terms used defined? Are the (new) concepts defined and explained? – Are the names of elements descriptive? Are the all of model's elements defined so that their meanings, roles, and mapping to the real world are all clear and not open to different interpretations?	[1] [2]
Complexity Information amount	Is there too much information included in the model? - The number of elements in the model (Humans are only good at working with models that do not include more than 30 elements) - The number of types of elements in the model - The number of relations depicted in the model - The number and types of concepts - The number of architectural viewpoints (Viewpoints reduce complexity)	[1]
Complexity Visual complexity	– Proximity: Are the related objects placed near to each other in a model? – Continuity: Is there any right angles positioned next to each other? (Right angles should not be positioned next to each other in a model.) – Closure: Are objects symmetry and regular? (This increases readability of models and reduces the perceived complexity.) – Similarity: Are similar objects presented in the similar way? – Common fate: Are similar object presented to move or function a similar manner? (People have a tendency to perceive different objects that move or function in a similar manner as a unit.)	Gestald principles, referred in [1]

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4.4 Architecture documentation management

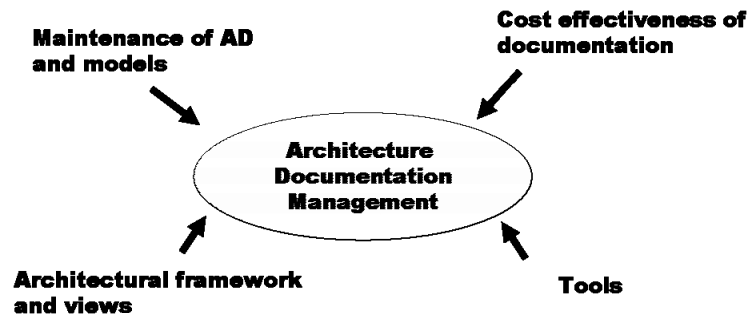Criteria for the architecture documentation management evaluation are presented in the figure below.

Figure 5. Criteria for the architecture document management evaluation.

Table 5. Evaluation criteria for architecture documentation management.

Criteria	Questions / metrics	Sources
Maintenance of AD and models	Ownership: Is staff responsible for AD clearly identified and supported? Maintenance practice: - Is it know how the AD will be maintained once it has been accepted? – Frequency of updates: *Number of updates / year or project* – Needs for updates: *Number of architecture changes made (in a year, in projects) that require documentation update* Maintainability of models – Ease of update: the relative ease or difficulty with which the documentation can be updated, including revision dates and distribution of new versions and the relative ease or difficulty with which the consistency between descriptions can be checked.	[32], [2]
Cost effectiveness of EA documentation	– Costs: Time and resources needed to produce or update EA descriptions or models: *Man-days needed* – Amount of documentation: *Number of documents/models* – Frequency of EA documentation updates: *Updates / project or updates / year* – Needs for updates: *Number of architecture changes made (in a year, in projects) that require documentation update*	own contribution

Cost effectivness of project architecture documentation	– Costs:
	Time and resources needed to produce or update project related architecture description or models
	    o *Man-days needed*
	    o Amount of architectural documentation: *Number of documents/models/project*
	    o Frequency of updates: *Updates / project*Needs for updates: *Number of architecture changes made (in a year, in projects) that require documentation update*
		own contribution

| Architectural Framework and Views | Architecture Framework

EA Framework
− Do there exist architectural framework for EA?
− Is EA framework accepted in organisation?
− Is EA framework used in the EA documentation work?

SA Framework
− Do there exist architectural framework for SA?
− Is SA framework accepted in organisation?
− Is SA framework used in the SA documentation work?

Architectural views:
− Are the suitable architectural views chosen for the company or for the project?
− Relating to each viewpoint is it defined:
    − A Viewpoint name?
    − The stakeholders the viewpoint is aimed at?
    − The concerns the viewpoint addresses?
    − The language, modelling techniques, or analytical methods to be used in constructing a view based upon the viewpoint? | [34], [22], [2], [3] |
| Tools for AD and models | − Support for organisation's framework and viewpoints
    − Does design tools support the framework and viewpoints that organisation has chosen to use?
    − Does design tools support production of the deliverables required?
− Suitability for Stakeholders: Is there ability to represent architecture models and views in a way meaningful to stakeholders (e.g. to non-technical stakeholders)?
− Repository for architectural documentation: Is there an EA repository for storage and dissemination of the captured EA information? | [34], [24] |

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5 Discussion

Architecture descriptions are used as communication tool. Architecture documents of bad quality may funnel the communication to irrelevant aspects. The documents of good quality support and advance communication. Therefore, the quality of architectural documentation is suggested to be considered by architects when they produce these documents. Quality evaluation criteria, questions and metrics for architectural descriptions and models were identified and categorised in this study. These were presented in previous chapter. In the following, practitioners views for these criteria are presented. In addition, it is discussed realities relating architecture documentation.

5.1 Practitioners' Comments for Evaluation Aspects

Practitioners mostly brought out that evaluation aspects and criteria seem to be useful and those help in evaluation of quality of architecture documents. In addition, practitioners accepted the evaluation aspects (stakeholder and purpose –orientation, quality of presentation and quality of content).

According to query results (see appendix 1), quality criteria that should at least to be evaluated seem to be especially:

- o Stakeholder and Purpose-orientation:

  - o *Stakeholders*: Are stakeholders of description defined?

  - o *Purpose*: Are purpose of description in relation to stakeholders defined?

  - o *Models/descriptions suitability for the stakeholder*: Is description suitable for stakeholders and purpose?

- o Quality of content:

  - o *Scope*: Is it defined what part of reality will be described in the description?

  - o *Aspects*: Is it defined what aspects will be described?

  - o *The level of detail*: Is it defined what level of detail will be described?

  - o *Sufficient amount of information*: Is the all required information included in the description? Does description contain irrelevant or superfluous elements? Has each topic just the detail that stakeholder needs?

  - o *Currency of SA descriptions*: Does information of system architecture description reflect a system?

- o Quality of presentation:

  - o *Vocabularity and concepts*: Are vocabularity and concepts stakeholders concepts and are new concepts defined and explained?

> o Documentation management:
>> o Ownership: Is staff responsible for description identified and support?
>> o Architecture views: Are views defined, accepted and used?
>> o Architecture design tools: Are design tools suitable for the documentation needs?

It was received a little number of replies for the query so more answers may have produced a little bit different result. However, author of this report suggest that these criteria could be seen as central evaluation criteria that should at least focused in the quality evaluation of architecture documents.

In focus group interview of practitioners, some comments came also up in which it was seen that it is not essential to evaluate the quality of architecture documents. In these comments, it was seen that the architecture documentation is not central issue in architecture design and management. So focusing on the quality of documentation was not seen relevant in this point of view.

5.2 Architecture Documentation Work Realities

Company's situation affects the possibilities for architecture documentation work. It is needed to know [14]:

> o what people you will have: which skills are available,
> o what budget is on hand, and
> o what the schedule is.

In addition, some other realities relate to architecture documentation work. Some of these are presented in the following.

Resources and time limits: Architects often do not have much time to architectural design and analysis [2]. The process of architecture definition is not usually allocated much time – and the situation architect are trying to model may be complex, difficult, or new to architect and architect's stakeholders. It is not thus reasonable to produce beautiful exemplary documents that will never be used because e.g. the project will have run out of money at implementation time. The reality is that all projects and work make cost/benefit trade-offs to pack all the work to be done into the time and the resources allocated for that work. Architecture documentation is no different [14].

Requirements and needs for architecture documents: A rough-and-ready model that is produced early and becomes established and familiar to the team over time may be more useful than something considered more fully that appears too late [2]. Simple models are more useful in presentations to non-technical stakeholders or early in the architectural analysis to bring out some key features, while sophisticated models are more useful as analysis, communication, and comprehension tools for technical stakeholders, such as software developers [2]. Same model can thus be complete or even too complex in one situation, and in other situation same model can be not sufficiently complete.

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Notation and tools: The range of phenomena addressed by enterprise and system modelling stretches multiple disciplines. Several modelling languages and practices are used, and one cannot always find a single person/profession that can guarantee the consistency of all models involved.

5.3   Restrictions

A limited number of sources for identification evaluation criteria, questions and metrics were investigated in this study. All possible criteria and metrics may not thus have been identified. However, the results give an image of the evaluation aspects for architecture documents.

In this study, mainly EA and SA design and development specialists were interviewed. Their perspectives might reveal much more than the companies' other business and ICT stakeholders' perspectives. Points of views of documentation users were thus not gathered in the interview.

6   Conclusion

Architecture documents seem to have more and more central role in the company management, IT governance and system development. For example, enterprise architecture core diagrams are suggested be used in the company management ([35]). These documents are thus more and more produced in companies.

This study identified the quality evaluation aspects, questions and metrics for architecture documentation. These are suggested to be used by enterprise and software architects in their architecture design and documentation work as well as by reviewers in reviews of architectural documentation. These questions, criteria and metrics relate to the stakeholder and purpose –orientation and the quality of content and visualization as well as to the architecture documentation management.

Future research question is following: how architecture documents can be produced and managed efficiently when reality is that different stakeholders needs documents that contain information on different levels and that present information in different ways.

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Appendix 1. Query Results

Evaluation of the quality of architectural documentation

Respondents:
- 2 persons from ICT service provider companies
- 2 persons from ICT user companies

Crosses indicate the number of responses to the evaluation questions. If multiple responses for a specific question from the same respondent were received, their average was used.

Instructions for evaluation

Either
1) Recall situations that have involved architectural documentation evaluation in your company. These evaluations could be related to either documentation produced in your company or documentation produced by other parties.
Or
2) If evaluations have not been carried out, create mental images from situations where architectural documentation quality is evaluated. What kind of situations would these be and what would be the aspects of relevance in these situations?

In the following, a number of architectural documentation quality criteria, questions and metrics are presented. Please evaluate the usability and relevance of these quality criteria, questions and metrics.

Abbreviations:
AD – architecture description
EA – enterprise architecture
SA – system / software architecture

STAKEHOLDER AND PURPOSE ORIENTATION	1 Important to evaluate (primary evaluation target)	2 Useful to evaluate (evaluated if enough time)	3 Not necessary to evaluate	4 Useless to evaluate
Stakeholders: Are the stakeholders of a model / architecture description (AD) defined and who are them?	xxx	x		
Purpose: Is it the purpose of a model / AD in relation to these stakeholders defined and what it is ?	xxxx			
Model's/ AD's suitability for the stakeholders: • Does model provide the stakeholder with the desired knowledge? • Do model answer/correspond to the objective of stakeholder? • Do model relate to problem? • Is a practical reason for the information evident? • Is the information presented from the stakeholders's point of view?	xxx	x		
The use of AD/models – value of AD/model degree the AD or model is being read, understood, and effectively used (www-source), – *Frequency of Use*: This characteristic describes how frequently the documentation is used or referenced. – *Number of Users*: This characteristic describes the approximate number of personnel who will likely want or need to use this documentation. – *Variety of Users*: This characteristic describes the variety of different functional areas or skill levels of personnel who will likely use this documentation. – *Impact of Nonuse*: This characteristic describes the level of adverse impact that is likely to occur if the documentation is not used properly.		xxxx		

CONTENT QUALITY	1 Important to evaluate (primary evaluation target)	2 Useful to evaluate (evaluated if enough time)	3 Not necessary to evaluate	4 Useless to evaluate
Scope: Is it defined what part of reality will be described in the model/AD (e.g. only primary processes)?	xxxx			
Aspects: Is it defined what aspects will be described?	xxx	x		
The level of detail Is it defined what level of detail will be described	xxx		x	

Currency of EA description:
• Does information reflect the current enterprise?
  – *degree with which the current version of the documentation is up to date* (Percents, subjective evaluation)
  – *Number of architectural effects having projects carried out after EA description has been produced*
  – *Number of architecture changes made after EA description has been produced.*
• Frequency with which AD is kept current
  – *Number of updates / year*
		xxxx		

Currency of SA description • Does information reflect a system? • Frequency with which AD is kept current *Number of updates / project*	xx	xx		
Verification of information: • Is the information included in an AD/model verified? • Is there any incorrect arguments, or in-accurate or untrue reasoning?	x	xx	x	
Correctness of the EA • The number of "subtantive" errors / deficiences found after EA has been released: – *the number and type of change request applied to EA*	x	x	xx	

Correctness of SA
• Correctness for stakeholders:
   – Does model/AD present correctly needs and concerns of stakeholders?
• Correctness of solution:
   – Does model define correctly architecture that will meet stakeholder's needs?
	xx	x	x	

EA completeness EA's coverage of business areas: The degree to which EA addresses needs of each business area (e.g. subjective evaluation score 1-10)	x	xxx		
AD's coverage of required viewpoints The degree to which AD addresses each required architectural viewpoint (e.g. subjective evaluation score 1-10)	x	xx	x	
Sufficient amount of information: • Is the all required information included in the model? Are all topics relating stakeholder's objectives and concerns covered, and only those topics? • Is information repeated only when needed? • Do model contain irrelevant or superfluous elements?	xx	xx		
Sufficient level of detail: Has each topic has just the detail that stakeholder needs?	xx	x		x
Consistency: Are models presenting different viewpoints consistent with each other?	xx	x	x	

PRESENTATION / VISUALIZATION QUALITY	1 Important to evaluate (primary evaluation target)	2 Useful to evaluate (evaluated if enough time)	3 Not necessary to evaluate	4 Useless to evaluate
Conformance to corporate standards: • Does the presentation of the AD/model conform to the corporate standards (if any) for such documents?	x	x	xx	
Presentation way familiar to stakeholder: • Does model have intuitive structure for the stakeholder? • What is the intuitive structure of stakeholder? • Do model correspond to it? Are used structures to which the receiver is used to?	xx		xx	
Notation and structures: • Do model use a defined notation? • Is the notation/structure of model explained ? • Is stakeholder familiar with notation?	xx	x	x	
Vocabularity and concepts: • Is the vocabularity and concepts stakeholders' concepts? Are the terms and concepts used known by stakeholder? • Are the terms used defined? Are the (new) concepts defined and explained? • Are the names of elements descriptive? Are the all of model's elements defined so that their meanings, roles, and mapping to the real world are all clear and not open to different interpretations?	xx	xx		

Information amount: Is there too much information included in the model? – *The number of **elements** in the model* – *The number of **types** of elements in the model* – *The number of **relations** depicted in the model* – *The number and types of **concepts*** – *The number of architectural **viewpoints** (Viewpoints reduce complexity)*		xxxx		
Visual complexity: – **Proximity:** Are the related objects placed near to each other in a model? – **Continuity:** Is there any right angles positioned next to each other? (Right angles should not be positioned next to each other in a model.) – **Closure**: Are objects symmetry and regular? (This increases readability of models and reduces the perceived complexity.) – **Similarity**: Are similar objects presented in the similar way? – **Common fate**: Are similar object presented to move or function a similar manner? (People have a tendency to perceive different objects that move or function in a similar manner as a unit.)	x	xx	x	

ARCHITECTURE DOCUMENTATION MANAGEMENT	1 Important to evaluate (primary evaluation target)	2 Useful to evaluate (evaluated if enough time)	3 Not necessary to evaluate	4 Useless to evaluate
Ownership: • Is staff responsible for AD clearly identified, understood, and supported	xxxx			
Maintenance practice: • Is it know how the AD will be maintained once it has been accepted? • Frequency of updates*: Number of updates / year or project* • Needs for updates: *Number of architecture changes made (in a year, in projects) that require documentation update*		xxxx		
Maintainability of models Ease of update: the relative ease or difficulty with which the documentation can be updated, including revision dates and distribution of new versions.		xx	xx	
Costs: Time and resources needed to produce or update AD or models *Man-days needed*		xxx	x	
Amount of documentation *Number of documents/models*		x	xx	x
Frequency of updates – *Updates / project or updates / year* – Needs for updates: *Number of architecture changes made (in a year, in projects) that require documentation update*		xx	xx	

Architecture Framework • Do there exist architectural framework? • Is framework accepted in organisation? • Is framework used in the documentation work?	xx	x	x	

Architectural views:
• Are the suitable architectural views chosen for the company or for the project?
• Relating to each viewpoint is it defined:
   – A Viewpoint name?
   – The stakeholders the viewpoint is aimed at?
   – The concerns the viewpoint addresses?
   – The language, modelling techniques, or analytical methods to be used in constructing a view based upon the viewpoint?
	xx	xx		

Architecture Design Tools
 	
• **Support for organisation's framework and viewpoints**
   – Does design tools support the framework and viewpoints that organisation has chosen to use?
   – Does design tools support production of the deliverables required?
 	
• **Suitability for Stakeholders**
   – Is there ability to represent architecture models and views in a way meaningful to stakeholders (e.g. to non-technical stakeholders)?
	xxx		x	

Repository for architectural documentation • Is there an EA repository for storage and dissemination of the captured EA information?	xx	x	x	