Factors for Evaluating Architectures Assessment Methods (AAM)-11004

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Problem Statement

Research question

- *How to assess the "goodness" of an Enterprise Architecture?*
  - Define "goodness"
    - *Is there a standard?*
    - *Is there a consistent definition among architects?*
  - What are the architecture attributes that should be assessed?
  - Should all architectures be defined using the same attributes?

First hypothesis

- *If the EA is 'good' the project/program will be successful*

Second hypothesis

- *If one could measure the 'goodness' of EA, one could predict the probability of success.*

Goal

- *Develop a quantitative tool to measure the 'goodness' of EA*

Architectures are the link between requirements and design.

- *Enterprise Architecture defined by DoDAFv2[1]*
  - define the mission – poor definition of mission leads to a poor system
  - Identify information necessary – lack of necessary information leads to poor performance of mission
  - Identify technology needed – incorrect technology identified leads to costly upgrades and or poor performance
  - Implementing new technology – as technologies develop older technologies become obsolete

Architecture should be assessed early in engineering process

- *Assessment should be an iterative process*

Fully frame the problem

Review literature

- *Current state – assessment methods*
- *Direction of future state - tools*
- *Gap analysis*

Develop a quantitative tool for assessing 'goodness'

- *standardize definition of 'goodness'*

Demonstrate validation of tool through a case study

Present Literature Review to date

- *Reviewed several methods*

Present Factors Identified used to Assess Architectures

Identify assessment methods that address identified factors

Present Summary of methods and how they addressed factors

Present direction of future work

Receive feedback from community of interest on research area

Methods Reviewed

Extended Influence Diagram, EID[2]:

- *Develops EID for architecture*
- *Uses ISO 9126 standard for SW quality measurements*
- *Uses GeNIe, a influence diagram tool*

Enterprise Architecture Quality Attributes, EAQA[3]:

- *Preliminary work for expanding SW quality attributes*
- *Developing a framework to assess EA*

ISO quality standards, ISO 9126[4]

- *Defines quality attributes using ISO 9126*
- *Develops a seven step process for conducting analysis*

Methods Reviewed cont.

Military System Architecture Assessment Method[5]

- *Mission oriented approach*

- *Four perspectives – people, process, product and project*

- *Uses SME*

- *Uses Analytic Hierarchy Process, AHP,*

Canonical Decomposition Fuzzy Comparative, CDFC[6]

- *Four individual elements – extensible modeling, canonical design primitives, comparative analysis and fuzzy logic*

- *Used to assist in the architecture search process*

- *Computationally complex and lengthy[6]*

Factors Identified for AAM

Measures ability to meet customers needs

Measure the interactions between people, process, and technologies

Defines quality attributes – 'goodness'

Defines process

Defines metrics

Defines 'use case'

Defines tool used

Ease of use

Identifies purpose of assessment

DoDAFv2 vol. 1[1] states EAs should

- 'Translate the decision-maker's requirements into a set of data that can be used by engineers and analysts to design possible solutions.'

- 'senior executives and managers can view the desired solution in an understandable and logical manner'

AAM should measure the EA's ability to meet customer's needs

- *EID – sets up scenarios*

- *ISO to UP – use case*

- *MSAAM - missions*

- *CDFC –* extensible modeling

Evaluating Factors for AAM

Crider and DeRosa stated in their paper *Findings of Case Studies in Enterprise Systems Engineering*

- *EA should capture the 'interactions between the people, process and technologies among components'[7]*

AAM should measure the EA's ability to measure the interactions

- *MSAAM – four perspective approach*
- *CDFC – extensible modeling*

Purpose of assessing EAs is to determine their 'goodness'.

- *Losavio et al (2004) proposed using ISO 9126-I standard quality model to define 'goodness'[4]*

- *Krka et al (2010) propose non-functional properties (NFPs) be assessed as early as possible[8]*

AAM should define 'goodness'- quality attributes

- *EID – ISO 9126*

- *EAQA – expands general scenarios to concrete scenarios*

- *ISO to UP – ISO 9126*

- *MSAAM – identified risks*

- *CDFC – system performance*

Enterprise architectures are hard to assess

- *Enterprise architecture has a given purpose and needs to be assessed according to that purpose.[2] 'Use cases' help to define the purpose of the EA.*

AAM should define 'use case'

- *EID – two examples*

- *EAQA – demonstrates quality attribute definitions*

- *ISO to UP – developed from functional requirements*

- *MSAAM – mission oriented approach*

- *CDFC – related to customer needs*

An EA assessment is a complicated process

- *a tool assists in capturing the data derived from the assessment and helps organize it.[5]*

AAM should define a tool

- *EID - GeNIe*

- *MSAAM - EE*

- *CDFC - a combination of statistical tools*

Other factors important when evaluating architectures
  - *Method should be well defined. The process should be explained to allow repeatability and consistence in evaluating architectures*
  - *Method should state what is being measured*
  - *Method should define the purpose*
  - *Methods should not be complicated*

AAM should
  - *Have a well defined process*
  - *Have well defined metrics*
  - *Identify how the results of assessment will be used*
  - *Be easy to use*

All AAM evaluated meet these criteria

Models \ Characteristics	EID	EAQA	ISO 9126 to UP	MSAAM	CDFC
Measure architects ability to meet customer's needs	Yes and using different scenierios can calculate the useability and uncertainty for each scenerio.	Does not address users needs	Use customer's needs to define 'use cases'	Missions are developed from customer needs.	Uses extensible modeling to model possible solutions to customers needs
Measure interaction	Arcs in EID represent 'causal' and time precedence.	Interaction is one of the elements used to define the quality attributes	Does not address interaction.	Uses a four perspective approach: people, process, product and project. All or just one perspective may be used.	Extesible modeling is used to model interaction among components and the various levels of the architecture
Define Quality attributes	Used ISO 9126 standard for software quality measurements	Uses general quality attribute scenarios to define. Each quality attribute general scenario has 7 elements: stimulus, source of stimulus, context, view, artifact, possible responses, measures used to characterize the architecture's response.	Used ISO 9126 standard for software quality measurements	Quality indicators are indentified risks within enterprise architecture according to specified use case	Measures systems performance.
Define Process	Step by step process for developing extended influence diagrams and contitional probability matrix	Well defined process for defining quality attributes for EA using general scenarios and then expanding to concrete scenarios.	Seven step process is well defined.	Seven stage, each having several steps, process is followed by an independent third party.	Four element method that can be used individually or in a combination.
Define metrics	Utility and uncertainty	Preliminary work	Comparitive metrics	Kiviat graphs- confidence level	Fuzzy logic output
Define 'use case'	Gives two examples of "use case"	Gave an example of 'use case' to demonstrate development of 'maintainability' quality attribute definition.	Define 'use case' from functional requirements. Prioritizes these 'use case' into 'key use case' which are analyzed	Mission oriented approach - mission defines area of interest which defines scenarios which defines use case.	Use case is related to customer's need.
Tool	Bayesian network analysis tool GeNIe - create large influence diagrams, set conditional probability matrices and perform the Bayesian theory analysis	No specific tool mentioned	No specific tool is mentioned	Evaluation Environment (EE) (available at: http://www.orcacomputer.com/ee)	Uses a combination of statistical tools but no one dedicated tool
Ease of Use	Requires knowledge of extended influence diagrams and Bayesian networks.	Simple to use for development of definitions. No actual assessment presented.	Easy to use	Process steps are well defined. Need assistance of SMEs which might be unavailable.	Computationally complex especially above physical architecture level
Use	To build enterprise architecture models.	To develop framework for assessing EA.	To compare possible baseline architecture models to meet customer's needs.	Assess Enterprise Architectures based on mission approach.	Use in architecture search process

Future Work

Review Literature for current tools

- *Preliminary shows tools for behavior and logic*
- *Determine if there is a standard definition of 'goodness'*
- *Investigate if any measure non–functional properties such as 'goodness'*

Research formal methods

Backup

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Author Biography

Eileen B. McConkie received her Bachelors of Science in Mechanical Engineering from the Virginia Polytechnic Institution and State University (VA Tech), her Masters of Science in Systems Engineering from VA Tech, and she is a doctoral candidate at The George Washington University in Systems Engineering and Engineering Management. Ms McConkie has 20 years experience working with the Department of Navy, Naval Sea Systems Command, Naval Surface Warfare Center, Dahlgren Division and EG&G. Her experience includes working in design and development of gun weapon systems, and anti submarine projectile. Her experience also includes design and implementation of pollution reduction systems for Navy jet engine test cells. She was system safety task manager for the 35mm gun weapon system and ammunition and for the integration of the 57mm gun weapon system on a United States Coast Guard boat. She has presented at several technical conferences and symposiums. Over the past 3 years she has facilitated several continuous process improvement initiatives using LEAN Six Sigma. Also over the past 10 years, Ms McConkie has taught undergraduate mathematic courses as an adjunct professor for University of Mary Washington.

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