

## **An Instrument for Measuring the Quality of Enterprise Architecture Products**

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*On average Dutch Enterprise Architecture products are attractive and provide guidance to the enterprise in times of change. However, they rarely address all issues completely. Only 50% of the Enterprise Architecture products are judged readable. The Enterprise Architecture products are very explicit about their status but do not mention a clear time span for the architecture to be valid or how the architecture should link to the existing enterprise. These are some of the results of a study to assess the quality of Enterprise Architecture products, we conducted in 2005.*

*For many, the term Enterprise Architecture conjures up visions of colorful models and fat documents with guidelines. These products of the Enterprise Architecture process are indeed its most tangible result. Most architects can intuitively tell which models are the most readable and which guidelines are the strongest but that intuition is not objective enough to produce an independent measure of the quality of an architecture product. Until recently, no such measurement existed. This paper explores the concept of Enterprise Architecture product quality and how to measure it in a scientific manner.*

### **Enterprise Architecture products**

In practice, quality measurements are meant to assure "with a degree of confidence that the products are depicting the necessary information in the right way" (Galini 2004). So products can be adjusted in time to negate the risks involved in not meeting the goals of the product. These risks are usually financial in nature.

Richardson et al identified in 1990 the lack of consensus concerning what a good architecture entails (Richardson 1990). Within enterprises, this lack of consensus can impair the effectiveness of the Enterprise Architecture (EA). By building the architecture with quality assured products, the discussion concerning the EA can be focused on its content instead of its quality. In other words, the quality measurements are meant to create consensus about the concept of 'a good architecture product'.

In this paper an instrument for measuring the quality of EA products is presented. For understanding all details of this instrument we kindly refer you to the technical report "Determining the Quality of Enterprise Architecture Products" (Veltman - van Reekum 2006).

When discussing products of any kind inevitably their relationship with processes comes up, since processes create products. However, each concept is very different in nature and therefore requires a different perspective and approach to judge its quality. This research was conducted in close relation with a similar research into a quality instrument for Enterprise Architecture processes (Bent 2006). In this way both instruments are based upon a similar thought pattern on EA quality, enabling architects and consultants to use both instruments simultaneously in the knowledge that there is no overlap between the two instruments.

### Definition of good EA product quality

"Enterprises are constantly subjected to internal and external *changes* (Mintzberg 1992; Bernus 1997; Jonkers 2004). One way to deal with these changes is to be *integrated* (Mintzberg 1992; Wagter 2001; Charpulat 2003; Giachetti 2003; Hoogervorst 2003) and *agile* (Wagter 2001; Bernus 2003; Hoogervorst 2003). Enterprises can use Enterprise Architecture as a way to achieve integration and agility in a *coherent* and *consistent* way (Rijsenbrij 2002), through *EA products* created by the *EA development process*. Therefore, the *quality* of an EA product is its ability to aid *integration* and *agility* in a *coherent* and *consistent* way." Figure 1 graphically depicts the above described principle on which the instrument is based.

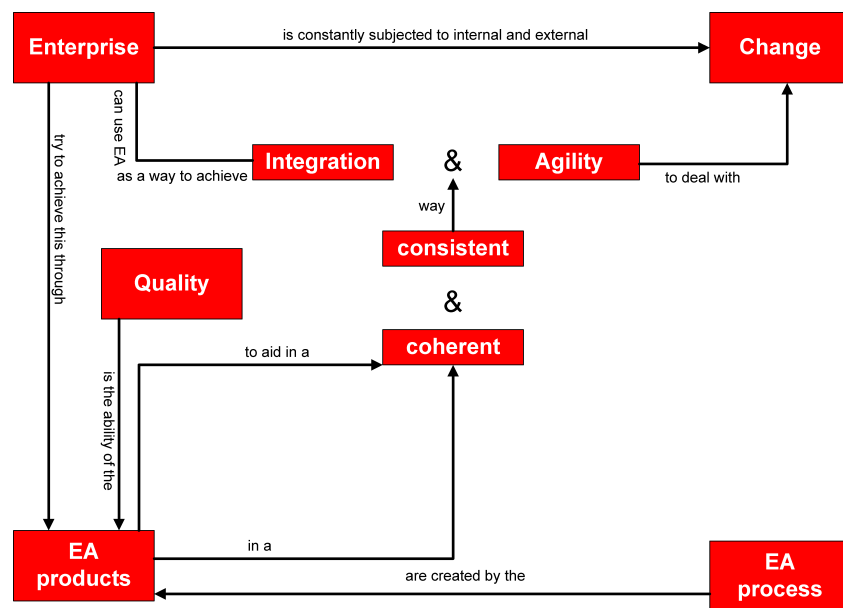
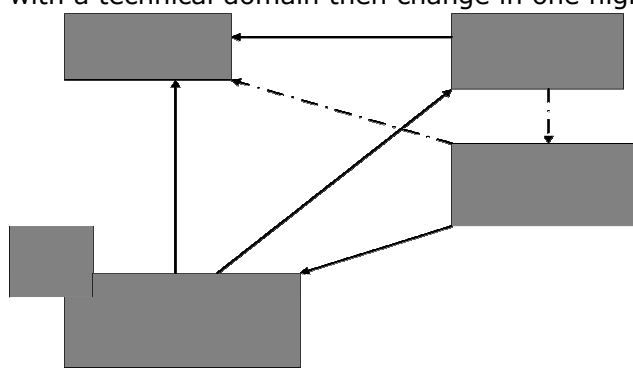


Figure 1: providing integration and agility in a coherent and consistent way

Agility is defined by Dove et al. as "the ability of an organization to adapt proficiently (thrive) in a continuously unpredictable business environment" (Dove 1996). The link between architecture and agility is addressed by The Open group in their answer to 'Why do I need enterprise architecture?'. They describe how a good EA empowers individual enterprise parts, such as a business unit, to innovate safely in their pursuit of competitive advantage (The Open Group 2003) (FAQ). This is clearly a form of agility. The most compelling argument for the use of architecture in creating agility is made by Hoogervorst. He states that architecture can take away inert characteristics that limit the enterprise in taking prompt action (Hoogervorst 2003).

Although agility is a necessity in effectively dealing with change, the enterprise does run the risk of losing internal cohesion. Chances are that the empowered enterprise parts engaging in individual change processes will indiscriminately move in different directions. This can be avoided by relating all the different changes going on in the enterprise to each other and to those parts of the enterprise that are unchanged. We call this integration.

The level of integration of the enterprise is influenced by the relationships between the domains within the enterprise, as demonstrated by the domains depicted as gray blocks in Figure 2. Integration is also influenced by the relationships with the environment of the enterprise. If the relationships are rigid in nature, change can be very difficult to achieve. It is therefore not desirable to blend domains together unrecognizably. This tends to create rigid and slow enterprises, which have trouble incorporating new developments. For example, if a product domain is tied in closely with a technical domain then change in one highly affects the other. If the effects are



unclear then this impairs agility greatly but having no relationship makes each domain ineffectual in achieving the enterprise mission. Integration of the enterprise should therefore be aimed at creating unity through a network of recognizable domains that related together are more responsive and effective than each element in isolated operation. As inspired by (Kosanke 1999).

Figure 2: integration

EA attempts to achieve the goals of agility and integration in a consistent and coherent way. (Richardson 1990; FAWG 2001; Wagter 2001; Rijsenbrij 2002; Bernus 2003; Hoogervorst 2003). Consistence and coherence are concepts that are closely related and are usually understood to be the same thing. In this paper, the meanings found in Merriam-Webster's dictionary are used rigidly to define the concepts individually. The dictionary defines coherent as 'logically or aesthetically ordered', in other words the EA product is logical. Although aesthetics are a part of EA (Rijsenbrij 2004), in the case of change the logical aspect of being coherent is the most alluring. Logic has a deliberate, deductive and formal quality. Consistency is stated by Merriam-Webster to be "free from variation or contradiction". In periods of change, it is important that people can rely without question on the guidance that is offered to them.

### Definition of EA product

To understand the quality of EA products it is important to have an understanding of what such a product entails. Many literature sources state the different formats that these products can have. Such as "...a series of *principles, guidelines, drawing, standards and rules...*" (Boar 1999) or "*graphics, images and/or narratives*" (FAWG 2001) or "...*principles, separated into rules, guidelines and standards sometimes recorded into patterns...*" (Rijsenbrij 2002) and many other sources (Cook 1996; Bernus 1997; IEEE 2000; Wagter 2001; Hoogervorst 2003; The Open Group 2003; Arsanjani 2004; Schekkerman 2004). When closely analyzing the nature of all these different products two properties were found. One, all products have *content* that is related to different enterprise domains. Two, all products have some sort of *format*.

A decomposition of the nature of EA products can be created by combining these two points with the already stated purpose of EA to create agility and integration.

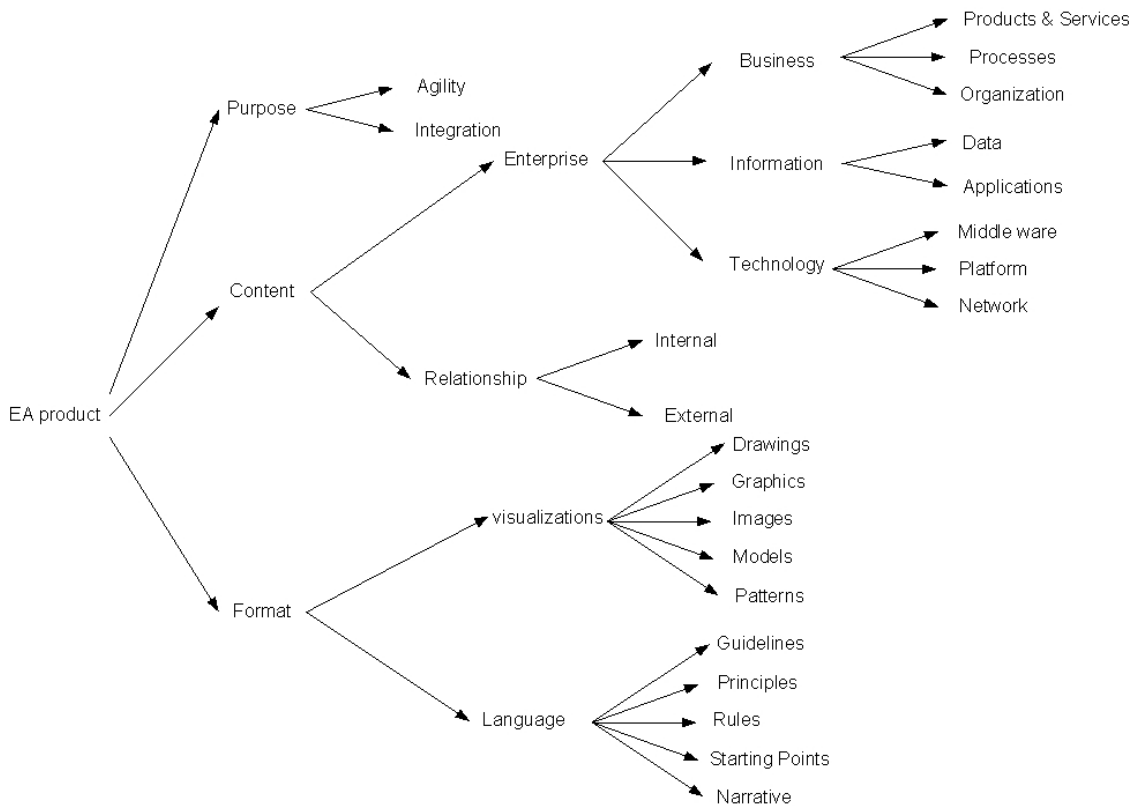


Figure 3: decomposition EA product

From this decomposition, a new definition for products was formulated because none of the existing definitions could break away from its own particular development method or terms associated with format.

If the definition is biased towards a certain type of product then the quality measurements for that product will always be higher than for products not fitting the definition. This is scientifically very unsound.

For this research, therefore, an EA product is defined as *a set of tangible enterprise domain reflections in either language or visualizations*. Complexity in scope often demands to capture the subject of the product in a set of reflections to see the complete picture. Even though *reflections* sound elusive which is very much the opposite of *tangible*, a choice has been made for the term *reflections* because, as Merriam-Webster's dictionary says, they are 'considerations of some subject matter, idea, or purpose'. As stated, many definitions describe EA products in terms of format, such as guidelines or graphics. A graphic is not written and a guideline is not a picture. EA products usually contain a mix of language and visualization formats.

In this paper Enterprise Architecture is understood to be *the products that guide in the design and evolution of the enterprise and its relationships, to coherently and consistently aid the enterprise in achieving integration and agility*.

Logically, this means that the products guiding the design and evolution of the particular enterprise must adhere to the definition to be of a good quality. Therefore the quality of an EA product is *the totality of attributes that bear on the EA product's ability to aid integration and agility in a consistent and coherent way.*

**Measuring quality**

The definition of EA product quality suggests that there are four dimensions that make up that quality. Namely that which the product is meant to aid: Integration and agility of the enterprise and the way the product must be: coherent and consistent. These four dimensions are placed in a 2 by 2 model that defines their relationships.

**Table 1 Quality model of an EA product**

	Integration	Agility
Coherent	<p><u>Logical unity</u> Is there logic in the way the product unites the changing and unchanging parts of the enterprise?</p>	<p><u>Logical adaptation</u> Is there logic in the way the product guides the adaptation of changes within the enterprise?</p>
Consistent	<p><u>Reliable unity</u> Can the enterprise rely on the proposed integration in the product?</p>	<p><u>Reliable adaptation</u> Can the organization safely rely on the guidance in adapting to changes as offered by the product?</p>

The use of such a model is inspired by the AIMQ method for information quality which uses the method of a 2 by 2 model (Lee 2002).

To answer the questions in each quadrant we developed an instrument. Attributes are used to measure the level of quality in the product; together they form the answer to the questions. A set of quality attributes was gathered from methods in the fields of software (Zeist 1996; Moody 1998), information (Kahn 2002) and data (Wang 1996). The comprehensive list of attributes in the developed products together with definitions can be found in Appendix A. This set of attributes is by no means exhaustive. It is a starting point for the instrument, but it is expected to be a promising set because of its basis in such different proven quality methods, all based on the theoretical framework that is presented above and because they were subjected to a sound scientific test (Veltman - van Reekum 2006).

Plotting the attribute set on the quadrant model the instrument for measuring the quality of an EA product looks as shown in table 2. Two attributes describe the product as a whole namely the completeness and assess-ability of the product. They are therefore applicable to the overall quality model.

**Table 2 the quality model filled with attributes**

	Integration	Agility	
Coherent	<u>Logical unity</u> - Implement-ability - Interpretability - Interaction - Conformance	<u>Logical adaptation</u> - Steer-ability - Readability - Attractiveness - Correctness - Concise	- Completeness - Assess-ability
	<u>Reliable unity</u> - Accuracy - Changeability - Recoverability	<u>Reliable adaptation</u> - Explicitness - Stability	
Consistent			

How do you use the attributes explicitness and stability to measure if the organization can safely rely on the guidance offered by the product? Well you need an auditor who decides what the level of explicitness is. But you don't want him to simply decide for himself. You want to give him guidelines which describe explicitness. These guidelines are called items in our instrument. For instance in the case of explicitness an item is: "The product describes its own status" or when judging stability an item is: "The consequences for other solutions of changing a solution are described".

The totality of the items describe the ideal state for an EA product and make up the scale of an attribute. The term scale is used to refer to all items within an attribute (Flynn 1994). It is up to the auditor to state whether or not they agree that the item is applicable to the product under scrutiny. The auditors can express the level of quality by choosing between 'totally disagree', 'disagree', 'agree' or 'completely agree'.

By attaching weights to the four possibilities, the percentage at which an attribute is present in the product can be calculated. A 'completely agree' for all items of 'explicitness' means that 'explicitness' scores 100% present in the product. When a product scores a 0% on stability this means that the attribute is not present in the product at all (I 'totally disagree').

Situations can arise that make items or even whole attributes not applicable to the product in question. This has been taken into account in the instrument. By choosing n/a, the instrument will not use the item in the calculation of the attribute % level. Appendix A also contains the items per attribute.

## Results and Conclusion

We tested the instrument thus developed, on 26 EA products from 23 different organizations. Though this test was primarily meant to check the validity and reliability of the instrument, we were able to present the participants with valuable feedback on their EA products. For instance, one company showed many above average scores except on the consistency quadrants (figure 4).

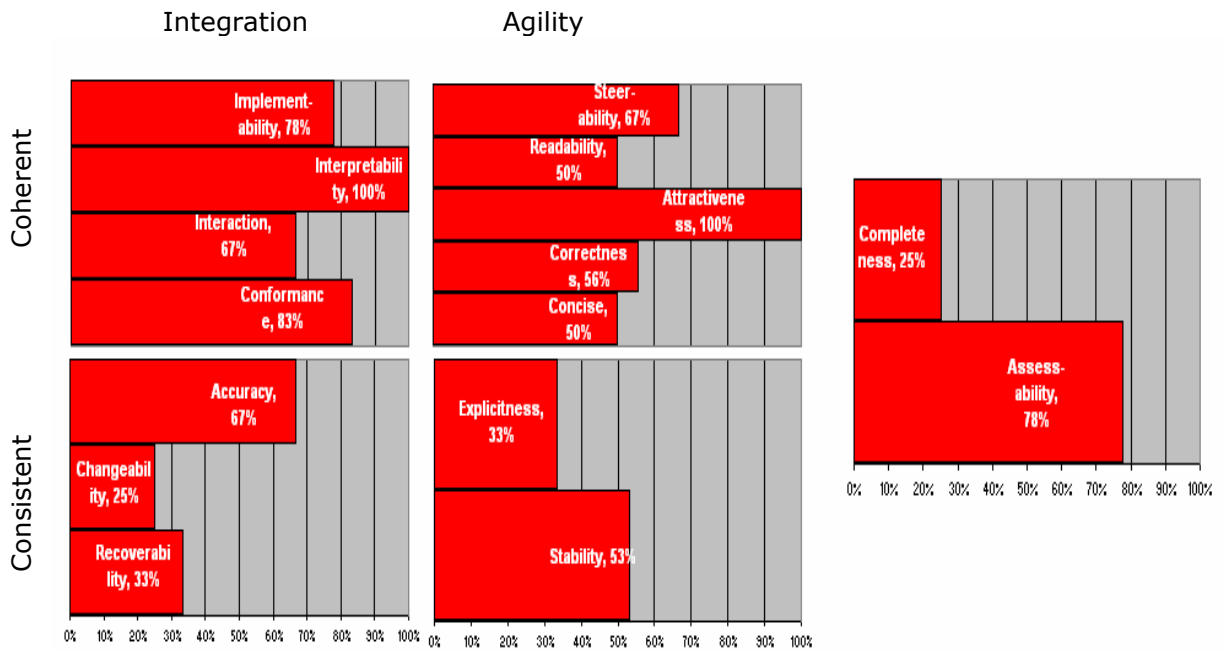


Figure 4: high scores except for the consistency quadrants

Based on these findings it is expected that there is very little focus within the company on being able to assess consequences, both intentional and unexpected, from an EA product (*recoverability* and *stability*). Nor is there a focus on the ease with which unwanted results can be changed (*changeability*). This is supported by the fact that the product is not very clear on its own status (*explicitness*), leaving a lot of room for immature solutions to be interpreted as being ready for use in the enterprise. The EA products are coherent but now must focus on being consistent for the enterprise.

Figure 5 shows the overall score taking all 26 participating products into account. This benchmark graph shows 5 attributes that score lower than 50%, the lowest being the completeness attribute. As stated in the introduction of this paper and proven with our developed instrument: "Dutch EA products are not complete but they are attractive."

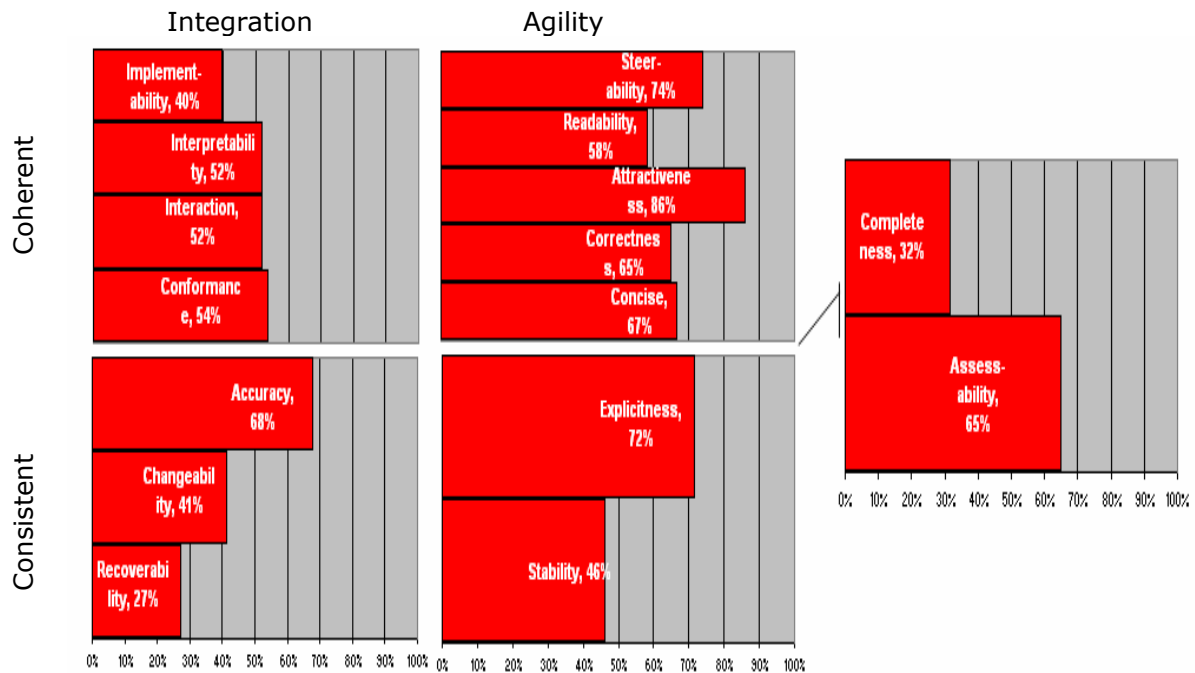


Figure 5: benchmark EA products in the Netherlands

We conclude that EA product quality is measurable in a scientific way. We hope that the instrument we developed will help the Enterprise Architecture industry improve itself and its image.

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## Appendix A: the attributes and their items

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### 1. *Implement-ability*

Indicators that bear on the ease with which solutions stemming from the product can be implemented in the enterprise within the time, budget and technology constraints of the enterprise (Moody 1998).

- The solutions in the product contain a clear time span.
- The solutions of the product fit the financial possibilities of the enterprise.
- The architecture indicates how introduced solutions should unite with the non-changing parts of the enterprise.
- In the case of integration within existing technology the product describes the interfaces clearly.

### 2. *Steer-ability*

Indicators that bear on the extent to which the product guides the enterprise through periods of divergence.

- The product describes the borders between which change can take place within the enterprise
- The product itself describes the way it is related to the goals of the enterprise.

### 3. *Interaction*

Indicators that bear on the ability of the product to interact with enterprise control methods such as project management, IT development and financial management method. *Based on interoperability (Zeist 1996) but renamed because of confusion with the more technical definition.*

- The product itself describes the relationships with other methods in use within the enterprise
- The solutions and presentation of the solutions are synchronized with the methods and techniques within the enterprise appropriate for the product.

### 4. *Accuracy*

Indicators that bear on the extent to which the solutions in the product are (certified) free of error in order to ensure correct implementation within the enterprise (Wang 1996; Kahn 2002).

- The text in the product contains no errors.
- there are no internal contradictions present within the product
- There are no unintentional contradictions with other relevant documents and EA products in the enterprise.

5. *Recoverability*

Indicators that bear on explicitness of the product concerning the risk of being unable to return to the situation before implementation should that be desirable (Wang 1996; Zeist 1996).

- The solutions describe if it is possible to return to the original situation.
- The solutions describe if it is desirable to return to the original situation.
- The solutions describe the risks associated with not being able to return to the original situation.

6. *Concise*

Indicators that bear on the extent to which the product is compactly presented without being overwhelming in order to ensure easy guidance of the enterprise (Wang 1996; Kahn 2002).

- The solutions contain no irrelevant text
- The product contains no superfluous pages.

7. *Readability*

Indicators that bear on the ease with which the products can be understood and read to ensure unambiguous guidance of the enterprise.

- The product can be understood without background knowledge
- The structure of the product is easy to read through.

8. *Attractiveness*

Indicators that bear on the existence of two formats in the presentation of the product to ensure unambiguous guidance of the enterprise.

- The product contains language and visualizations.
- The text in the product contains a relationship between it and the visualizations present in the text.

9. *Correctness*

Indicators that bear on the correctness of the used grammar (Moss 1995) and of the choices made within the product to ensure unambiguous guidance of the enterprise.

- The product contains no spelling errors
- The architecture contains no grammatical errors.
- The product describes why choices concerning the product were made.

#### 10. *Interpretability*

Indicators that bear on the extent to which the product is in appropriate languages to ensure unambiguous fit with the existing enterprise (Wang 1996; Kahn 2002).

- The content of the product is written in terms that are understandable for the enterprise.
- The solutions in the product do not contradict definitions in use within the enterprise without a clear explanation.

#### 11. *Explicitness*

Indicators that bear on the clarity of the product with regard to its status in order to ensure with certainty that the product is ready for use (Kahn 2002).

- the product describes its own status
- The status information in the product can be understood without background knowledge.

#### 12. *Changeability*

Indicators that bear on the effort needed for modification or fault removal after the solutions stemming from the product have been implemented in the enterprise (Wang 1996; Zeist 1996; Kahn 2002).

- The solutions describe if you can change the implementation of solutions in the enterprise.
- The solutions describe in what way the implementations of solutions can be changed.
- The solutions describe the risk associated with changing the implementations of solutions.
- The solutions describe the financial consequences of changing the implementation of solutions.

#### 13. *Stability*

Indicators that bear on the risk of unexpected effects associated with new developments stemming from the product (Zeist 1996).

- The consequences for other solutions of changing a solution are described
- The product describes the degree of connection with other EA products.
- the consequences for other products of changing a solution in the product are described
- The product describes the degree of connection between the solutions and future developments following the product.
- The consequences for future developments of changing a solution are described.

#### 14. *Conformance*

Indicators that bear on the extent to which the product must adhere to industry or country standards (Zeist 1996).

- The product can demonstrate that the product conforms to the laws set by governments appropriate for the enterprise
- The product itself describes the way it conforms to industry or national standards, if appropriate.

#### 15. *Assess-ability*

Indicators that bear on the effort needed for diagnosis of deficiencies or causes of failures, or for identification of parts to be modified (Zeist 1996).

- The information necessary for assessing the previous items was easy to find in the document.
- Assessing the items could be done without additional background knowledge
- The product allowed itself to be assessed quickly.

#### 16. *Completeness*

Indicators that bear on the extent to which the product contains all the content relevant for the process using it (Wang 1996; Moody 1998; Kahn 2002).

- The solutions are addressed completely
- If the product does not completely cover the issue at hand then it is made clear which solutions still need to be addressed.
- The product describes its relationships with other documents pertaining to the same issue.