Needs and Characteristics of Methodologies for Enterprise Integration

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Abstract: Methodologies are one of the main elements in EI Projects. In this paper we present an aggregated and comparative analysis of the methodological aspects of several of the main EI proposals from the state-of-the-art of existing EI Methodologies (CIMOSA, PERA, IE-GIP among others). A definition of the set of characteristics that must be provided by an EI methodology is presented as well.

1 UNDERSTANDING ENTERPRISE INTEGRATION METHODOLOGIES

A generic methodology can be defined as “the system of methods and principles used in a particular discipline”. This definition outlines two main issues. First of all, a methodology is necessarily linked to a particular discipline where it is useful; outside of this discipline, it may not be applicable. Within this work, we focus on IE as the particular discipline of interest. Secondly, the two basic elements of a methodology are methods and principles. Furthermore, Vernadat, (1996) defines a methodology as a “group of methods, models and tools”. This definition is made from an EI perspective and identifies more specifically the three different elements that must be provided by an EI methodology: (1) methods, (2) models and (3) tools.

The authors define an EI methodology as a group of methods targeted to support a business architect in the development of EI projects, supported both by models (the so-called architectures) and tools. Methodologies, architectures and tools are indeed the three main engineering ingredients of EI

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projects, and are thus clearly separated in this definition. This has led the authors to define the MAT (Methodology – Architecture – Tool) concept (Fig. 1) as a general framework to guide EI business architects (Hawa, 2002). The MAT approach is still consistent with commonly accepted definitions in EI (e.g., “a set of instructions that offer the user a step by step guide to carry out all the necessary aspects for the execution of an IE project”(Williams, 1997), and enables business architects to select, and even combine, the specific methodology, architecture and tools that best suit their engineering endeavour.

The role of methodologies is further enhanced based on the fact that the real-world application of any EI methodology is indeed a complex, long and expensive process (Vernadat, 1996, Bernus, et al, 1996, Kosanke, 1997). It requires the co-ordination, understanding and mutual acceptance of multidisciplinary teams (Weston, 1997), and must deal with all the intrinsic complexity of the business entity it is applied to (human, knowledge, structural, operational, technological and financial capitals).

Figure 1: The MAT Concept

Within EI, the main advantage of methodologies lies in the assumption that they can be considered mostly generic, i.e. independent of particular applications and applicable in a large number of projects. Thereby, although the specific details will vary from one project to another, the general guidelines, methods and procedures can still be considered and defined as substantially generic (Williams, 1997, Williams, 1996). The results of the

IFAC/IFIP Task Force On Architectures for Enterprise Integration reinforce this understanding in IE, and stress its added value (Bernus, et al, 1996).

Although each EI methodology is intended to cover a wide range of projects, it must be clear that, on one hand, not all of them suit all real-world applications and, on the other hand, depending on the project considered, some of them stand as more appropriate than others. Based on this statement, there is a clear need to provide business architects with a list of criteria to help them in the assessment of the added value and adequacy of each potential methodology.

2 DEFINING THE SET OF CHARACTERISTICS TO ASSESS ENTERPRISE INTEGRATION METHODOLOGIES

We have developed an aggregated and comparative analysis of the methodological aspects of several of the main EI proposals from the state-of-the-art of existing IE Methodologies (see Annex 1):

- CIMOSA (Computer Integrated Manufacturing–Open System Architecture),
- GERAM (Generalised Enterprise Reference Architecture and Methodology),
- GRAI-GIM (Graphes à Réseaux et Activités Interreliés–GRAI Integrated Methodology), (Domeingts, 1984)
- ICEIMT'97 (International Conference on Enterprise Integration and Modelling Technology) Workshop 2, Working Group 1 Proposal (Kosanke, Nell, 1997).
- IE-GIP (Enterprise Integration– Business-Process Integrated Management - Spanish acronyms),
- PERA (Purdue Enterprise Reference Architecture),

This has led to the definition of the set of characteristics that must be provided by an EI methodology. We have classified those characteristics in Technical o Human oriented

2.1 Methodology Human Oriented Characteristics

1. To explain and justify its steps: Besides describing the steps to solve a problem, a methodology should explain and justify those steps.
2. To be comprehensive and easy to follow: It should be user-oriented and friendly for all project team members profiles (Bernus, et al, 1996)

3. To act as a guide: It should guide the work of the people involved in the IE project (Williams, 1996).
4. To provide different presentations and visions: Depending for example on the profile of the business architect or the problem to be addressed, the methodology needs to provide customised views of the project and/or enterprise (Williams, 1996).
5. To support change management: It must consider intrinsically the migration path concept (i.e. evolutionary path from AS-IS to TO-BE) and provide change management support.
6. To generate documentation: It should specify how to elaborate the project documentation (and even generate automatically this documentation), and among others a Master Plan, similar to the Master Plan of PERA or the deliverables of IE-GIP.
7. To provide the user with a manual: Similar to the Implementation Procedures Manual of PERA that helps the user to plan and defines the work to be done and how to do it.

2.2 Methodology Technical Oriented Characteristics

1. To be exact and precise: i.e. it must specify all the necessary steps of a project. Each phase should have clearly defined its objectives, inputs, delivery documents (deliverables) and roadmap of activities.
2. To cover the complete project lifecycle: The users won't adopt a methodology that doesn't provide support in all the different phases of the project. For some phases, the support may rely upon a specialised methodology (for example a methodology for software engineering). In such cases, the main methodology should provide clear interfaces with that specialised methodology.
3. To be flexible: Within the range of projects covered by the methodology, it must be flexible enough to allow users to adapt it to each particular project.
4. To be supported by a computer tool: The complexity of the application of a methodology requires the availability of a supporting software application. This is a key point and it represents a common drawback of many EI methodologies that lack of such computer-assistance.
5. To be open: It must be open to a rich variety of models and techniques, and not be bounded to a specific model or technique. This can be achieved for example through the evolutionary integration of new technologies, models and techniques (Bernus, et al, 1996).

6. To offer different alternative paths: It should provide different alternative strategies to solve a problem and to support in the selection of the most appropriate path.
7. To be located in a general dimension of continuous improvement: A project begins, is developed, and concludes. The day after the end of a project should be consider in the own methodology. Questions as continuous improvement, reuse of results, next steps, inheritance in next project, etc., should be dealt with by the methodology.
8. To cover project planning: It should give an appropriate methods and procedures to establish and assess the scope and necessary effort for the development of the project (Ortiz, 1999).
9. To support different project paradigms: Depending on the type of considered project, the selected architecture, the involved personnel, the results of previous projects, etc., it should be let the business architects choose the most suitable project paradigm (waterfall, concurrent engineering, etc.).
10. To negotiate in an efficient and effective way the project: For it, the project should be developed inside the budget, of the waited temporary window and of the existent restrictions.
11. To re-use previous efforts: It should allow the direct and easy reuse of the all of some of the results, deliverables and models developed in previous projects (Bernus, et al, 1996).

3 ASSESSING THE ADDED-VALUE OF METHODOLOGIES FOR AN ENTERPRISE INTEGRATION PROJECT

Based on the set of characteristics defined above, a template (table 1) has been developed to evaluate methodologies and assess their suitability to match the specific needs of a project. It is important to point out that this template is defined to assess a unique methodology. Normally, a comparative evaluation of several candidate methodologies is recommended, to select the one that best suits the reality of a real-world endeavour.

In this template *Project Weight* is a score for the project purposes (1, low importance to 5, high importance) and the *Project Threshold* is the minimum score to consider the Methodology suitable for the specific project's needs. *Methodology Support* means the score that we assign to the analysis capability of the Methodology. *Partial Evaluation* scores the specific characteristic for the specific methodology and *Final Evaluation* scores the Methodology (only if the Project threshold requirements have been overcome).

Table 1: Template for methodologies evaluation

Characteristic		Project weight	Project threshold	Methodology support	Partial evaluation
Human Oriented					
1	Explains and justifies its steps	w1	t1	s1	w1*s1
2	Is comprehensive and easy to follow	w2	t2	s2	w2*s2
3	Acts as a guide	w3	t3	s3	w3*s3
4	Provides different presentations and visions	w4	t4	s4	w4*s4
5	Supports change management	w5	t5	s5	w5*s5
6	Generates documentation	w6	t6	s6	w6*s6
7	Provides the user with a manual	w7	t7	s7	w7*s7
Technical Oriented					
8	Is exact and precise	w8	t8	s8	w8*s8
9	Covers the complete project lifecycle	w9	t9	s9	w9*s9
10	Is flexible	w10	t10	s10	w10*s10
11	Is supported by a computer tool	w11	t11	s11	w11*s11
12	Is open	w12	t12	s12	w12*s12
13	Offers different alternative paths	w13	t13	s13	w13*s13
14	Is located in a general dimension of continuous improvement	w14	t14	s14	w14*s14
15	Covers project planning	w15	t15	s15	w15*s15
16	Supports different project paradigms	w16	t16	s16	w16*s16
17	Negotiates in an efficient and effective way the project	w17	t17	s17	w17*s17
18	Re-uses previous efforts	w18	t18	s18	w18*s18
Final evaluation		Sum (wi*si)			

4 CONCLUSIONS

As one of the important part of the MAT Concept (Methodology – Architecture – Tool), we have focused on Methodologies to support EI Projects. We have analysed the main EI Proposal (CIMOSA, PERA, GRAI-GIM, GERAM, IE-GIP and ICEIMT'97 WS2WG1) and a set of characteristics to be provide for an IE Methodology has been identified. Additionally, we have developed a comparative analysis among the methodologies taking into account several key aspects. Finally, we have defined a method to evaluate IE Methodologies, this method consider that the real added value of a Methodology depends of the specific purpose and project. Therefore the proposed method allows business architect to identify the most appropriate IE Methodology considering the weight given to each characteristic, the support provide for each methodology to this characteristic and taking into account that is necessary to overcome the defined threshold.

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6 ANNEX I: COMPARATIVE ANALYSIS OF CONSIDERED METHODOLOGIES:

The following Methodologies have been analysed in terms of the characteristics identified in the template (table 1) with specific reference to the life cycle concept of pre-EN ISO 19349 and GERAM.

1. CIMOSA = CIM Open Systems Architecture
2. GERAM = Generalised Enterprise Reference Architecture and Methodologies
3. GRAI
4. IE-GIP
5. PERA = Purdue Enterprise Reference Architecture

References to the template characteristics are in brackets (Tx)

Aspects related to the company where the methodology is applied	
Supports the business entity concept? (T3/T9)	PERA, GERAM, IE-GIP
Supports the enterprise system concept? (T3/T9)	CIMOSA
Supports the domain concept? (T3/T9)	CIMOSA, IE-GIP
Provides identification of the company type (for example manufacturing, continuous, etc)? (T3/T9)	GERAM, CIMOSA, IE-GIP, PERA
Supports a company life cycle concept (T3/T9)	all.
Supports the life history concept? (T3/T9)	GERAM
Supports the relationship between company life cycle and project life cycle? (T5) (T3/T9)	GERAM, PERA, IE-GIP
Supports a product life cycle concept? (T3/T9)	CIMOSA, GERAM
Supports the relationship between company life cycle and product life cycle? (T3/T9)	CIMOSA, GERAM
Supports the business-process life cycle concept? (T3/T9)	CIMOSA
Supports an engineering environment concept? (T3/T9)	CIMOSA
Supports an operation environment concept? (T3/T9)	CIMOSA
Supports a continuous improvement concept? (T14)	CIMOSA, IE-GIP, GERAM
Aspects related to the development of the methodology	
Provides a methodology? (T1/T2/T8)	CIMOSA, PERA, IE-GIP, GRAI
Supports a structured Approach? (T1/T2/T8)	PERA, GRAI-GIM
Provides Methodology Functional abstraction (T4)	CIMOSA, IE-GIP
Supports a project concept (T9)	all
Supports a program concept (T3)	PERA, IE-GIP
Supports a project life cycle (T9/T15)	all
Supports the relationship between company life cycle and project life cycle? (T9/T15)	GERAM
Supports the life history concept (T3/T15)	GERAM
Supports a program life cycle concept (T9/T15)	PERA (with reservations)
Supports a project life cycle concept (T9/T15)	all

Supports a project management concept (T9/T15)	CIMOSA, GERAM
Supports a program management concept (T9/T15)	PERA, IE-GIP
Supports a simultaneous change processes concept (T5/T15)	CIMOSA, GERAM
Supports the macro and detail level (T3/T9)	IE-GIP
Supports the functional and temporal presentation (T4)	GERAM
Supports the engineering environment (T3/T9)	CIMOSA
Supports the operation environment (T3/T9)	CIMOSA
Supports the master plan (T3/T9)	PERA, IE-GIP, GERAM
Provides an implementation procedures manual (T1/T8/T19)	PERA
Supports continuous improvement (T14)	CIMOSA, IE-GIP, GERAM
Aspects related to human aspects of the methodology application	
Defines project teams (T3/T9/T15)	IE-GIP, GRAI-GIM, PERA
Provides user and technology orientation (T2)	GRAI-GIM
Provides implementation procedures manual (T7)	PERA
Supports meetings (T3/T9)	CIMOSA, GRAI-GIM, IE-GIP
Supports interviews (T3/T9)	CIMOSA, GRAI-GIM, IE-GIP
Supports knowledge management (T4)	all
Aspects related to the Change Management	
Supports change management (T5)	all
Describes current system (or as-is) (T4/T5)	all
Describes future system (or to-be state) (T4/T5)	all
Describes migration path (T4/T5)	all
Describes change process (T4/T5)	all
Describes simultaneous change processes (T4/T5)	GERAM, CIMOSA, PERA
Provides performance indicators (T4/T5)	GERAM, IE-GIP
Aspects related to the computer application of a methodology	
Provides a supporting tool? (T11)	IE-GIP, CIMOSA, GRAI-GIM
Supports the relationship between the supporting tool and the methodology? (T11)	IE-GIP,
Supports the relationship between language / modelling technique and methodology? (T11)	GERAM
Displays functional and temporal presentation? (T17)	GERAM
Supports in the master plan development? (T3/T9)	PERA, IE-GIP, GERAM
Provides an implementation procedures manual (T7)	PERA