

# DEVELOPING AN IMPLEMENTATION PLAN FOR A DOMAIN-SPECIFIC PROCESS ARCHITECTURE IN A MULTIMODEL ENVIRONMENT

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**Abstract** - Process-focused organizations operating in a multimodel environment have increased their interest in managing and improving their business processes. This is due to that these organizations are adopting several process improvement technologies simultaneously in their improvement programs, which has generated several problems. Process Architecture has been explicitly proposed as a tool to address with problems that arise in this multimodel environment. Much of the literature has been written on process architecture design for different business domains. However, there are very few works that attempt to outline the critical activities that lead an organization to the successful implementation of a process architecture in a multimodel improvement environment. The purpose of the paper is threefold: (1) to identify meta-activities of the process architecture life cycle; (2) to outline critical activities to define a successful implementation process encompassing the process architecture life cycle; and (3) based on the above two points, an implementation checklist was built as a tool to guide users in practice and allow them to derive their implementation plan.

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**Keywords** - Domain-Specific Process Architecture, Multimodel Environment, Process Architecture Life Cycle, Implementation Plan.

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## I. INTRODUCTION

Many organizations in different business domains have embarked on Process Architecture (PA) implementation as improvement initiatives [1]. From the beginning of this century, these initiatives have been introducing process improvement technologies (i.e., reference models, standards, best practices, regulatory policies, and other types of practice-based improvement technologies) and have resulted in significant improvements in business processes [2]. Business Groups, such as Banking [3], Aerospace [4], Automotive [5], Software development [6] among others, have developed domain-specific PA applying these process improvement technologies in a multimodel environment. These PAs have made industry coordination much more efficient.

Multimodel environment in an organization occurs when improvement initiatives seek to integrate and harmonize simultaneously several process improvement technologies. In this environment, multimodel problems arise such as: 1) correlation or dependences analysis; 2) traceability; 3) changeability; 4) repeatability and documentation; 5) supporting multimodel appraisals; 6) optimizing improvement infrastructure; 7) enabling coordinated improvement project; and 8) multimodel measurement framework [7], [8]. PA in a multimodel environment is also called an integrated process architecture or interoperable process architecture. It is defined as set of process elements and its relationships that support adding, removing or modifying any process improvement technology and allowing it to be derived to standard processes. Therefore, PA has been recognized as a means of

supporting the harmonization of process technologies and addressing the above problems [7]–[9].

In the literature, many PA works focused on its design and analysis has been found [10]. But very few works have addressed the successful implementation of a process architecture in a multimodel improvement environment in an organization. Some factors that we believe have led to a problematic implementation of PA are the lacking understanding of PA and its purpose, the complexity of the multimodel environment and be seen as a one-time project where the post-design phases are neglected.

There are several definitions of the implementation term depending on the perspective of the research area. This work defines PA implementation as: Getting artifacts of a domain-specific PA, such as domain model, reference and operational architecture, harmonization and maintainability mechanisms, together with an PA awareness and the new way of working in an organization when it operates in a multimodel improvement environment.

Thus, the purpose of this work is to develop an implementation plan for a domain-specific PA in an organization operating in a multimodel improvement environment. To achieve this, three stages were developed. First, activities of five PA design methods were examined to understand their commonalities and to propose a set of main activities related to the PA lifecycle and thus can be easily integrated into their multimodel improvement projects. Second, critical activities with strategies, methods, and techniques were identified and outlined to be applied in the PA implementation phase and thus can clarify how to perform this phase go through PA lifecycle in order to achieve a successful long-term PA. Third, the outcome is a detailed implementation checklist

composed of seven critical activities: 1) discover, 2) plan, 3) design and construct, 4) prepare, 5) communicate and train, 6) deploy, and 7) maintenance. Clearly, the checklist, when applied to PA projects, produce a detailed implementation plan that specifies activities to be performed before, during and after the implementation in an organization.

The structure of the paper is as follows: Section 2 describes main definitions and objectives to use a PA. Section 3 presents meta-activities of the process architecture lifecycle. Section 4 outlines the proposed activities that can lead to a successful implementation of a process architecture in a multimodel environment. The implement checklist instrument is showed. The last section concludes the paper and gives several directions for further research.

## II. DEFINITIONS AND OBJETIVES

- Multimodel improvement environment, it is when organizations aim to achieve business goals, develop quality products through a mature process applying multiple process improvement technologies simultaneously, and reduce time-to-market and production costs. Problems have arisen within organizations working in this environment, such as: process technologies have different internal structures, terminology and requirements, chaotic relationships, traceability from these technologies to standard process descriptions is not well established, the changeability of technologies among others.
- Domain-specific process architecture is a conceptual framework for designing and maintaining business processes and its relationships, which must be aligned with business objectives and strategy, enterprise architecture and it is built for a domain or business area.
- Process architecture domain assets set is a set of information that consists of fundamental domain information, domain model, reference architecture for the domain, directions for

customizing the operational architecture, and directions for future maintainability.

- Objectives to design and implement a process architecture. Some organizations are using it to 1) understand processes, 2) measure process performance, 3) control of processes, 4) process documentation, 5) global process management 6) reuse domain processes and 7) harmonize multiple process technologies within an organization.

## III. PROCESS ARCHITECTURE LIFECYCLE

### A. Meta-activities of the Lifecycle

Several works [11]–[18] were used as a basis for identifying the meta-activities. Thus, this meta-process to design a PA is described in TABLE I.

From a technical point of view, the focal deliverable of this meta-process is the architectural description document, specifying the structure of the process system in an organizational unit through various views. However, though design meta-activity is at the heart of this meta-process, it is just one of several meta-activities critical to the creation of a good PA. Requirements elicitation and analysis are needed to focus the design activities. Construction meta-activity allows the specification of sufficient low-level details to design standard processes and define project processes. Lastly, a validation meta-activity provides early indicators of, and hence an opportunity to resolve, problems with the PA. Furthermore, these meta-activities can be conducted iteratively with multiple cycles through requirements, design, construction and validation.

From a management and organizational point of view, PA projects are susceptible to three major organizational sources of failure: uncommitted management; being ignored or resisted by process stakeholders; and lack of mechanisms to support process changes [14], [18]. The management and organizational processes help address these pitfalls. The meta-activities related to those processes are commitment, deployment and maintenance.

Meta-activity	Description
Commitment	<p>Gain management sponsorship and form the PA group:                      Show how the architecture contributes to long-term business success to help align the PA group and gain management sponsorship.</p> <ul style="list-style-type: none"> <li>• Identify the PA stakeholders and their communication needs.</li> </ul> <p>Establish and document the architectural requirements:                      Establish which business objectives apply to the process system to ensure that the PA is aligned with them.</p>
Requirements	<p>Understand the process system context. Determine its system boundary, what is in scope and what is out of scope.</p> <ul style="list-style-type: none"> <li>• Identify and analyze PA requirements: improving processes, existing documentation, level of detail of processes, impact analysis updating process.</li> <li>• Identify constraints: legacy processes or SPI models or older versions of PA.</li> <li>• Identify and analyze quality attributes: processes should be easy to find</li> </ul>

(simplicity and usability); architecture should be easy to update (flexibility and maintainability); common processes can be generic (degree or levels of commonality); allow for future expansion and identify building blocks (extensibility and reusability).

- Document the requirements.

Define the process architecture:  
 Analyze structural alternative and identify solutions: identify layers of hierarchy and which components are required; identify level of detail of process mappings; establish process groupings and views.

Design

- Identify process, process element and their interfaces.
  - Identify lifecycle phases to be process mapped.
  - Specify guidelines and standardized processes.
- Select and evaluate tools to design and specify PA.
  - Build the architectural specification:
    - Collect and catalogue process and their elements.
      - Group processes into views.
        - Identify interfaces.
        - Map to lifecycles.
        - Build standard processes.
        - Adjust defined processes.

Validate that the architecture meets the requirements:  
 Questioning techniques: methods used to generate discussion based on qualitative questions. Questionnaires, checklists or scenarios can be used.

Validation

Conduct PA assessments: these could involve assessment by experts who look for gaps and weaknesses in the PA based on their experience.

- Measuring techniques: methods to provide quantitative answers to specific questions. Metrics, simulation, prototypes or formal analysis can be used.

Deploys the PA in an organization:

Deployment

- Communicate and display posters of the architecture models throughout the organization. Help the organization to understand the PA and its rationale through consulting, tutorials, demos and ongoing involvement in solving problems in the process system.
  - Ensure that the projects adhere to the PA.

Actively respond to the need for changes in the PA:

- Establish change control mechanisms, tools, and methods.

Maintenance

- Monitor implementation and updates to ensure that PA is maintained.
- Integrate updates of your PA into your process management activities
- Refactor as necessary, in response to process creep, new or expanded functionality needs.

TABLE I Descriptions of Lifecycle Meta-activities

### B. Analyzing Methods into Context

These meta-activities are explained in terms of five design methods of PA. The objective is to understand where the meta-activities in the five methods have their major application and impact. **Error! Reference source not found.** shows the methods and meta-activities.

Meta-activities	Process Architecture Methods					
	Ould[15]	Jeston&Nelis[14]	Maldonado & Velazquez [13]	Dai et al. [12]	Borsoi& Becerra [11]	Pesantes et al. [9]
Commitment	-	x	-	-	-	-
Requirements	x	x	x	x	x	x
Design	x	x	x	x	x	x
Construction	x	x	x	x	x	x
Validation	-	x	-	x	-	-
Deployment	-	x	-	-	-	-
Maintenance	-	x	-	-	-	-

TABLE II Methods and Lifecycle Meta-activities

These methods were selected because they are the most representative and complete found in the literature and they clearly specify the activities for designing a PA. As a result of this, the majority of methods consider technical activities. Only Jeston&Nelis's method considers management and organizational activities. Finally, just one method mentions the activity of commitment, but an important step is sponsorship commitment and involvement of all the relevant stakeholders in order that buy-in, agreement and usage of the PA can occur. A common mistake made by PA groups is that when the management is not involved with the creation of the PA, they run the risk of it becoming more complex and its adoption fails.

#### IV. IMPLEMENTATION PLAN

##### A. Implementation Process

The process diagram in **Error! Reference source not found.** depicts seven activities that must be performed by a specific domain organization to implement a PA operating in a multimodel improvement environment. This process complies with all the above-mentioned meta-activities and adds activities focused on getting the organization to use the developed PA methods, artifacts and tools. It attempts to bring together the most useful aspects from review of the literature and our experience in PA implementation projects.

##### The activities that lead to implement this kind of process architecture are:

1. Discover the current multimodel organizational environment. Before creating a PA in an organization is important to have the commitment of top management and people within it. This activity examines the organizational current practices (documentation, methods, techniques, process improvement technologies among others) for designing and implementing a PA in a multimodel improvement environment. The result of this analysis is expressed in an organizational domain description, a problem description of the multimodel environment, a high-level improvement solution alternative and its management approach for the implementation project. This solution must be aligned with the organizational objectives and involves the selection of improvement technologies for a particular domain. The management approach determines whether the improvement activities will be executed in an isolated project or in a coordinated set of projects. An organization could have several areas to improve, and these could be implemented separately and compete with each other. Therefore, these areas have to be prioritized, coordinated and derived to improvement projects.
2. Plan the implementation project. Organize the

multimodel improvement project to implement the selected improvement technologies in the high-level solution applying a PA that operates in this organizational multimodel environment. First, the project team leaders (Project manager and Process team leader) are assigned by the Project Director. They will decide the size of the project team, which depends on the size of the project. Second, a project plan is developed by the project team leaders, it will provide the relevant information to make a decision to approve and fund the project proposal. Project team roles and project activities can be adapted from a defined method for creating a PA supporting a multimodel environment (**Error! Reference source not found.**). Method [9] was taken as a basis to generate those points in the plan, since it supports the construction of a PA in a multimodel environment. Third, this plan will guide the project during its execution.

3. Design and construct your process architecture. This activity is adapted from the method [9]. First, an architectural configuration in this multimodel environment is a particular way in which process components and their connectors are put together to result in an organizational process system. These process components and their connectors are identified from selected improvement technologies in the high-level solution. Thus, this solution is refined until obtaining the process architecture alternative that meets the multimodel improvement objectives. This process architecture alternative will include a selection of processes from selected improvement technologies, and their integration strategy with legacy improvement technologies and process support systems. Second, the construction of a PA in a multimodel environment is organized into four phases, which are: conceptual PA, reference PA, operational PA and project PA. A business process in each phase is defined at a different level of abstraction from high-level process meta-models, reference process models and organizational standard processes to instantiated processes in a specific project. Harmonization mechanisms ensure the establishment of a process and a strategy to put two or more improvement technologies in tune with each other. It is important to highlight that an AS-IS-PA is extracted and harmonized with the reference PA based on selected improvement technologies, to later create a TO-BE-PA. Third, PA is validated for completeness and consistency. This can apply some qualitative or quantitative technique for its validation. Fourth, a measurement framework and technical infrastructure are integrated into the TO-BE-PA. In other words, metrics are identified to improve business processes and tools to support its implementation and execution in the

- organization.
4. Prepare the future multimodel organizational environment. It is important to adequately prepare the target organizational environment to ensure the transition to the next maturity level of the organization in the adoption of PA in its daily operation and minimize the resistance to change from the stakeholders involved in the processes. Since the business process, its process elements and role structure for its implementation have a major impact on the knowledge and ability of process groups to do their work. First, an integrated process architecture committee is established across selected improvement technologies. Each technology could provide its own structure of roles for its implementation, perhaps generating duplication of similar functions and consequently the duplication of costs in the organization. For the integration of role structure, permanent (e.g., change control boards) and temporary (e.g., cross-technology experts) roles could be identified, all aligned to the achievement of the improvement objectives. Second, a pilot project is conducted to test the PA on a small scale before full implementation. This is important when companies have no experience or are not mature enough with the practice of designing and implementing a PA in a multimodel environment. In addition, a measurement framework and tools that support its execution are adjusted. Third, during the pilot's execution, efforts of different process technologies are coordinated to operate a set of processes. Thus, the PA is verified, and adjustments are made.
  5. Communicate and train end users. Informing stakeholders of the parameters of the transition to the new multi-model environment, which will require effective coordination between teams of different improvement technologies. This can be a complicated process and should allow us to understand the short-term impact. This transition can affect productivity in processes. It is vital to generate a training program for end users and make sure that it is very easy for them to access the new environment, or if it is the case, redirect them if they try to do it with the old processes.
  6. Deploy the process architecture. Tools to support the PA implementation play a very important role, they are designed to make the implementation plan come true. As this progresses, incremental deployments of a portion of the PA can be scheduled to easily synchronize and get the information you need to move to the destination. In this organization, a domain-specific process architecture is constructed, which can be reused by another organization of this domain.
  7. Maintain the process architecture. After deployment or implementation, verify that the

target environment is working properly, and that data integrity is maintained in the processes. An organization establishes and maintains a set of process architecture domain assets include domain information, domain model, reference architecture, guidelines and criteria for tailoring, maintainability and harmonization, organization's process database and library of process-related documentation. All these assets are considered as the architectural knowledge base that can aid in the extraction, design, and maintainability of the PA through domain.

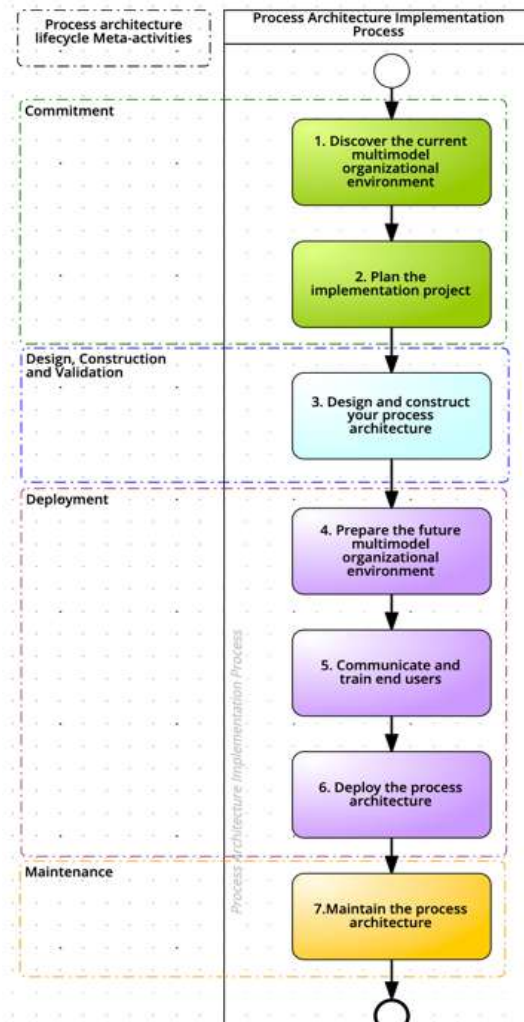


Figure 1: Activities to implement a domain-specific process architecture in a multimodel environment

### B. Implementation Checklist

The development of the implementation process aided the construction of the checklist instrument. **Error! Reference source not found.** shows verification sub-elements and elements for each activity on the checklist. It is important that management conduct a review at the end of each activity to make sure everyone agrees on its outcome before moving on to the next stage. Without the review, it would be difficult and expensive to go back and correct mistakes. This checklist will serve as a point of reference to generate an implementation plan

of a PA, since it contemplates all the phases from its maintenance in an organization operating in a extraction in the domain, design, implementation and multimodel improvement environment.

Element	Sub-element
<b>Activity 1: Discover the current multimodel organizational environment</b>	
<ul style="list-style-type: none"> <li>• Top management commitment</li> <li>• Characterization of the organization                             <ul style="list-style-type: none"> <li>• Problem description</li> <li>• Domain description</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Documentation</li> <li>• Multimodel environment</li> <li>• Maturity in process architecture</li> <li>• Process technical infrastructure</li> </ul>
<b>Activity 2: Plan the implementation project</b>	
<ul style="list-style-type: none"> <li>• Project team</li> <li>• Implementation plan</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Implementation strategies</li> <li>• Work breakdown structure (WBS)</li> <li>• Effort, resource and schedule                             <ul style="list-style-type: none"> <li>• Costs</li> </ul> </li> </ul>
<b>Activity 3: Design and construct the process architecture alternative</b>	
<ul style="list-style-type: none"> <li>• Architectural configuration</li> <li>• Process architecture (To-Be)</li> </ul>	<ul style="list-style-type: none"> <li>• Domain categories</li> <li>• Selection of process models</li> <li>• Process architecture alternatives                             <ul style="list-style-type: none"> <li>• Integration</li> </ul> </li> <li>• Conceptual process architecture</li> <li>• Reference process architecture</li> <li>• Operational process architecture                             <ul style="list-style-type: none"> <li>• Project process architecture                                     <ul style="list-style-type: none"> <li>• Validation</li> </ul> </li> </ul> </li> </ul>
Integrated measurement framework (To-Be)	
Process technical infrastructure (To-Be)	<ul style="list-style-type: none"> <li>• Process support tools</li> <li>• Process assets</li> <li>• Process assets library (PAL)</li> </ul>
<b>Activity 4: Prepare the future multimodel organizational environment</b>	
<ul style="list-style-type: none"> <li>• Management</li> <li>• Pilot</li> <li>• Final adjustments (test result)</li> </ul>	<ul style="list-style-type: none"> <li>• Leadership</li> <li>• Communication</li> <li>• Integrated Process architecture committee</li> <li>Operational process architecture (To-Be)</li> <li>Integrated measurement framework (To-Be)</li> <li>Process technical Infrastructure (To-Be)</li> </ul>
<b>Activity 5: Communicate and train End-users</b>	
<ul style="list-style-type: none"> <li>• Coordinated training design</li> <li>• Communicate to end-users before starting</li> <li>• Perform coordinated training</li> </ul>	<ul style="list-style-type: none"> <li>• Approach</li> <li>• Delivery method</li> <li>• Training material</li> <li>• Estimated time to do the change</li> <li>• Coordinated training schedule</li> <li>• Training strategy and method</li> <li>• Display posters of the process architecture models throughout the organization</li> </ul>

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Activity 6: Deploy the process architecture

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- Type
- Change management
- Perform deployment (Go-live)
- Review

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Activity 7: Maintenance of the process architecture

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- Maintainability mechanisms
  - Change control process
  - Change control committee
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TABLE III Activities, Elements and Sub-elements of the Implementation Checklist

## V. CONCLUSION

For any company that operates in a multimodel improvement environment, it will be very important to consider the design and implementation of a PA, with the aim of solving the existing problems in this environment, as well as providing order and facilitating the adoption of processes by part of the staff of an organization. This kind of PA should primarily allow coordinated projects that include shared roles, resources and infrastructure, as well as coordinated training derived from an understanding of the organization's goals.

The implementation checklist is a tool that will guide users (e.g., process architect, process engineer, process owner, process participant among others) in the design and implementation of a PA in a multimodel environment at different phases of its development: planning, execution and maintenance. With this in mind, the organization will be successfully implementing its goals and process improvement technologies to processes with the help of a robust PA. Another important point to consider are the process architecture assets of a domain, which can be reused by other institutions of the same domain, a topic that requires more research.

Finally, this checklist will be used in a project to create and implement a process architecture in a higher education institution operating in a multimodel improvement environment with the aim of improving the quality of education.

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