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Understanding the Approaches to Create a Process Architecture for Lean Thinking

Myrna Flores[1], Karina Flores[1], Alan Cabello[1], Sergio Terzi[2], Monica Rossi[2]
[1] *EPFL, Lausanne, Switzerland, {myrna.flores, karina.flores, alan.cabello}@epfl.ch*
[2] *Politecnico di Milano, Milan, Italy, {sergio.terzi, monica.rossi}@polimi.it*

Abstract

Nowadays consumers are expecting the launch of new products with lower prices and shorter development times. One key strategy for companies to achieve this challenge is to implement a lean product development process. Aligned to the lean thinking implementation, many companies have defined a process architecture. Such process architecture enables teams working on projects to understand the value added activities, define roles and identify the interdependencies among the different tasks to be carried out when developing a new product. There are various approaches to develop a process architecture. Thus, research was carried out within the LeanPPD project to understand the approaches followed by different organizations to develop their process architecture. A cross-industry sample of 18 companies from Switzerland, Italy, UK, Germany, USA and Mexico was interviewed. This paper summarizes the results highlighting the companies preferred timeframes, frameworks, organizational structures, tools and resources. To conclude, based on the findings a model is proposed to summarize a set of identified best practices which are recommended when developing and implementing a process architecture.

Keywords

Process architecture, best practices, approach, framework, process modelling

1 Introduction

Research has confirmed the benefits of applying Lean in many fields of business [Baines, et al. 2006]. Companies around the globe are following the trend and aligned their innovation strategies to Lean Thinking. Yet, this has proven to be difficult given the organizational-wide changes needed in all systems, practices and even culture [Baines, et al. 2006]. In order to understand and continuously improve a process, it must first be defined through its Process Architecture [Flores, et al. 2011]. An established Process Architecture (PA) permits finding the state of optimal profitability of a system and enabling it to occur. The approach taken to develop a PA is often seen as the base of any management initiative, given that it lays the foundation of a framework for the existing processes and their relationships. Therefore, depending on their needs, management will view different levels of detail and scope. In many cases, as companies begin to understand more and more about their operations, defining a PA becomes an iterative process. However, it is usually more convenient to develop the PA during the early stages of an organization [Frolov, et al. 2009]. Nevertheless, while studies reveal that these approaches may be widely deployed in large companies, NPD in most small companies is conducted in an ad hoc manner. Insufficient planning and inadequate resources, coupled with a resistance to change, are characteristic [Millward, Lewis, 2005]. The main value of defining an architecture is the possibility to establish a complete and unified blueprint of both the business and its goals.

Having reached this point, the possibilities of evaluating and understanding complete, incomplete, or inconsistent intersections among the processes and activities will be of tremendous value in aligning the company to its strategy [Hendrick, Hendrick, 2010]. Although the benefits of creating a process architecture have been described by many authors, there are very few literature sources that explain the way in which a process architecture is actually implemented in companies and the key decisions that must be taken for its deployment.

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2 Methodology

The motivation for this study comes as the result of a second stage of research on PA done by the LeanPPD Consortium. An initial study was carried out to: 1) identify the level of application of process architecture in companies within the product development area, and 2) to understand the perceived benefits and the best performance measures for the product development process [Flores, et al. 2011]. Building on that first stage of research and focusing on the companies that had declared having a PA in place, this study has two main objectives: ***1) to recognize the different approaches taken by companies to define and implement a Process Architecture, their focus, primary objectives and the perceived success and weakness factors and 2) to identify the best practices to develop a process architecture that when grouped represent a recommended approach for other companies to enable them implement lean thinking principles.***

A questionnaire was designed and applied to ***18 companies (including the 5 companies of the LeanPPD consortium)***; 4 of these were SMEs. From the sample of both SMEs and large companies a diverse set of industry sectors was covered: life sciences, automation, robotics, components, materials, telecommunications, energy and automotive. The companies are located within Switzerland, Italy, UK, Germany, USA and Mexico. Within the companies, the respondents were NPD department managers, NPD project managers and executives responsible for technology development or in the case of SMEs the top management. The findings have been grouped into three subsections depending on their relationship to a process architecture initiative: 1) Strategic considerations, 2) Operational elements and 3) Implementation results and success factors.

3 Strategic considerations

As companies need to establish a strategy for creating and implementing a process architecture, it is essential for them to first understand the definition of this term. Therefore, companies were asked to choose from some of the most commonly used definitions of PA in the literature. Some companies opted to choose two or three definitions, yet others decided that none of the given options reflected their definition of PA (cf. Table 1). We can conclude that the creation of a process architecture can be a complex task, but companies are in favour of a simple definition of this term.

Proposed definitions	Responses
The architecture of the business processes of an enterprise is defined as the type of processes it contains and the relationships among them. [Barros 2007]	7
Process architecture is the picture that says what process types there are in the organization and what their dynamic relationships are; a network of instances at work, all operating at the same time, some activating others and some interacting. [Ould 2005]	4
Process architecture is a methodology for identifying and aligning an organization's key business processes against business requirements and to determine how to organize and implement formal process management. [Performance Design Lab 2011]	4
Process architecture is a schematic that shows the ways in which the business processes of an enterprise are grouped and inter-linked. [Frolov, et al. 2009]	3
Process architecture is the structural design of general process systems and applies to fields such as computers (software, hardware, networks, etc.), business processes (enterprise architecture, policy and procedures, logistics, project management, etc.), and any other process system of varying degrees of complexity. [Dawis, et al. 2001]	2
Did not choose any of the previous definitions.	3

Table 1: Chosen definitions of a process architecture

Companies were also asked to declare where the initiative to define and implement a PA came from, as this can give some insights on the type of leadership and support required for the initiative. **According to the respondents, in 61% of the companies, top management proposed the initiative.** This shows that generally top management leads and supports the process architecture initiative in order to achieve a successful implementation. Another important element to understand was the degree of implementation of the PA strategy. Companies were asked if their strategy had been fully defined and if every member of the organization is aware and knowledgeable of it. This would represent the involvement of the organizations' participants, not only in their daily tasks but also in its continuous improvement processes encouraging a better corporate culture. **In 61% of the companies, the PA strategy had already been fully communicated while in the remaining 39% it had only been partially communicated.** The results show that in most cases, clear communication throughout the organization is the most successful approach. Since there is no possibility of a strategy without a set of fixed objectives to achieve, companies provided their main objectives behind the definition and implementation of a PA.

The two main objectives of the PA development in companies are: a) to satisfy customers' requirements and b) to achieve more efficient processes (cf. Figure 1). This is no surprise given the strain on the market resulting from increased competition, a faster paced development and a globalized field, which is a reality for the large multinational firms that were interviewed. Other objectives mentioned by the interviewed companies were: To develop a simple and scalable architecture that can be easily implemented at new sites as the company grows, to improve quality of the product (for special or unexpected features), to standardize the way of working, to generate freed up capacity for new markets, etc.

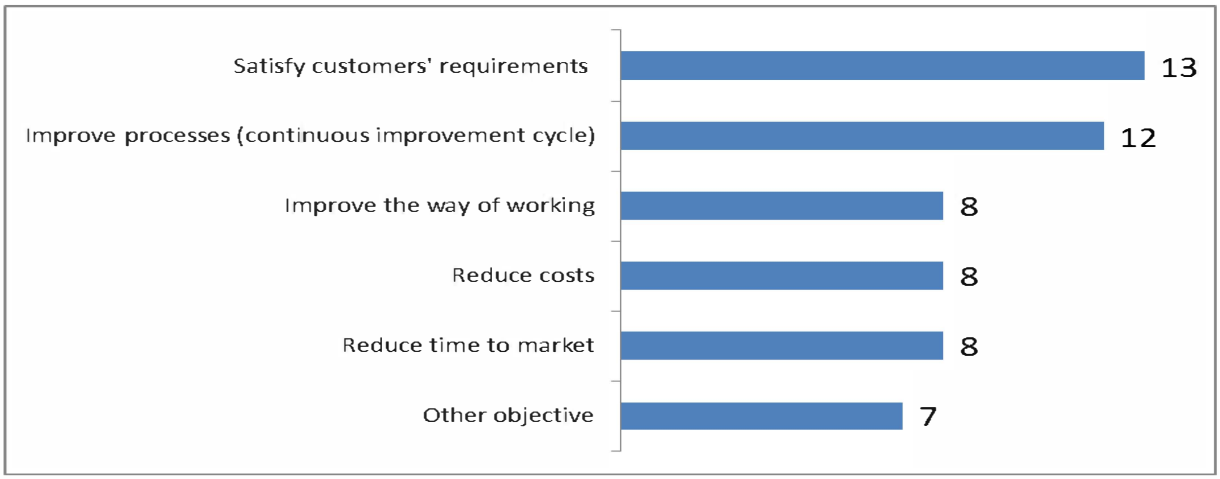

Figure 1: Main objectives to develop a process architecture

Another important factor related to the process architecture strategy is the definition of the **governance for its implementation**. It is necessary to define who will be involved in managing the process architecture, for instance, a team, one dedicated person, process owners, the quality department or someone else. The appropriate person or group should be selected according to the organization's characteristics. The faculties and responsibilities of that person or group must be defined as well as the manner in which people will be interacting and taking decisions related to the PA. **According to organizations' answers, the preferred approach for governance is to distribute the necessary tasks to develop a process architecture among team members, usually with a particular leader or department** (e.g. Quality Department) in charge. Among the other governance models described by the companies were those of Project Managers as owners of the PA development, in another case each department had a resource assigned to this task.

As important as the actual definition and implementation of a PA, is the implementation of a change management process to ensure a smooth transition and sustainable continuous

improvement. Change management must pass from being a process, to an integral part of the organization's culture. The interviewed companies had different perspectives about the need of a change management process for PA implementation (cf. Figure 2).

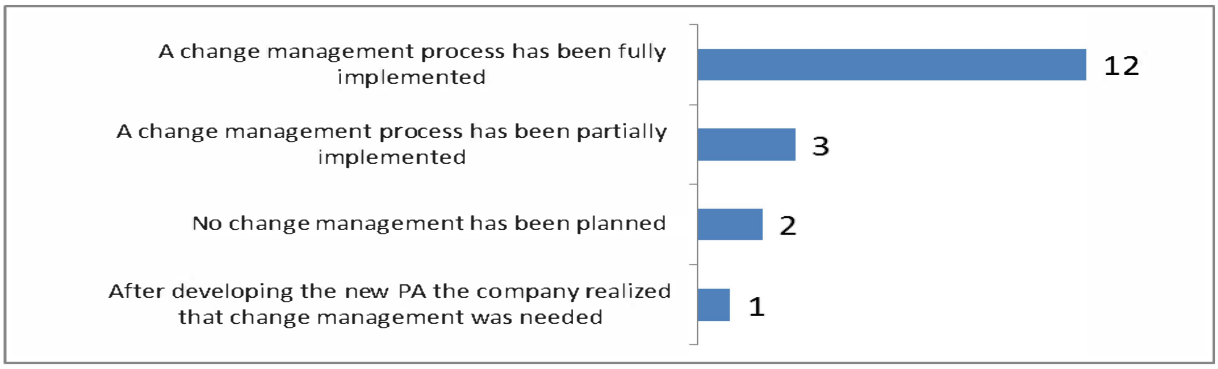

Figure 2: Implementation of a change management process

Most of the interviewed companies declared having already analysed and implemented a change management process at least to a certain extent. It is important to understand the value of such a process within an organization in order to sooth the adaptation to a new or enhanced corporate culture. Those companies that declared not having planned a change management process, recognized during the interview that an appropriate initiative should be taken.

There are three more strategic elements related to the process architecture implementation: The modelling focus, target time for modelling the architecture and way of mapping. When modelling the processes in order to define and implement a PA, an organization must determine the modelling focus. This may be the model of how the processes should be (TO-BE), how they currently are (AS-IS) or both. The interviewed companies were asked to select which was their focus. **Most of the companies prefer to model both the AS-IS and the TO-BE processes, although not the majority** (cf. Figure 3).

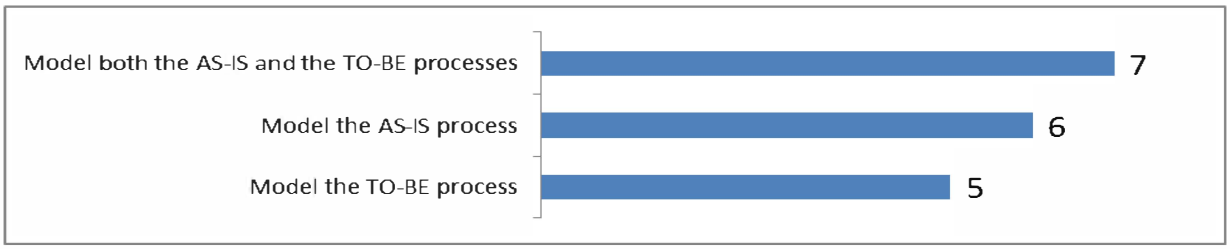

Figure 3: Modelling focus used in the process architecture

It is fundamental to map the current state of a process, to later apply the necessary techniques to create an improved future state vision of the process. To develop this future state applying lean thinking, non-value-added tasks need to be identified and eliminated. Besides the modelling focus, it is also necessary to define the manner of mapping the process on a workflow level. This may be by different products, organizational functions or end-to-end processes. **Most respondents (56%) map their end-to-end processes** (cf. Figure 4).

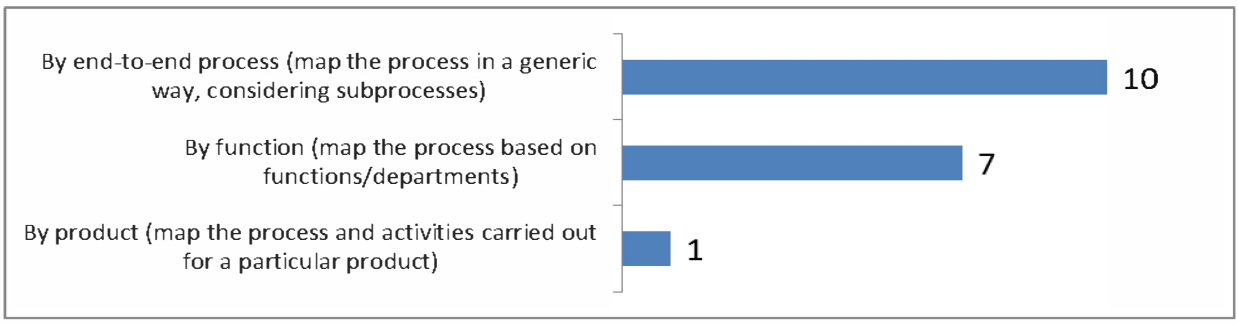

Figure 4: Direction of mapping the process workflow of the process architecture

The last factor related to the PA strategy is the definition of a target time for the process architecture major release. It is important to establish this target time at the beginning of the initiative. Companies were asked to declare what was their initial target time. Although the majority of the interviewed companies originally estimated up to a year to reach the major release of their architecture's model (cf. Figure 5), they required more time. Modelling the PA is a continuous and evolving task, which develops with the organization's strategic focus.

Figure 5: Target time to model the last release of the process architecture

4 Operational elements

This section includes the findings related to the elements that have to do with the execution of the product architecture strategy. One of these elements is the experienced human resources needed. As it is not always easy for a company to define and implement a PA, especially at the beginning, it is sometimes necessary to hire external experts. Another possibility is to develop resources internally and generate in-house knowledge and expertise. **50% of the interviewed companies opted for an Internal Trained Team and 44% for the combination of both an external expert and internal participants.** Time and budget are two factors very likely considered when defining the team.

As mentioned previously, at the moment of defining and elaborating a PA it is necessary to count or gather knowledgeable resources on modelling techniques. As well, it is through training and education that organizations aim towards a continuous improvement development. Most of the interviewed companies train a few employees on modelling techniques; these latter will be the modelling specialists of the process architecture team. (cf. Figure 6).

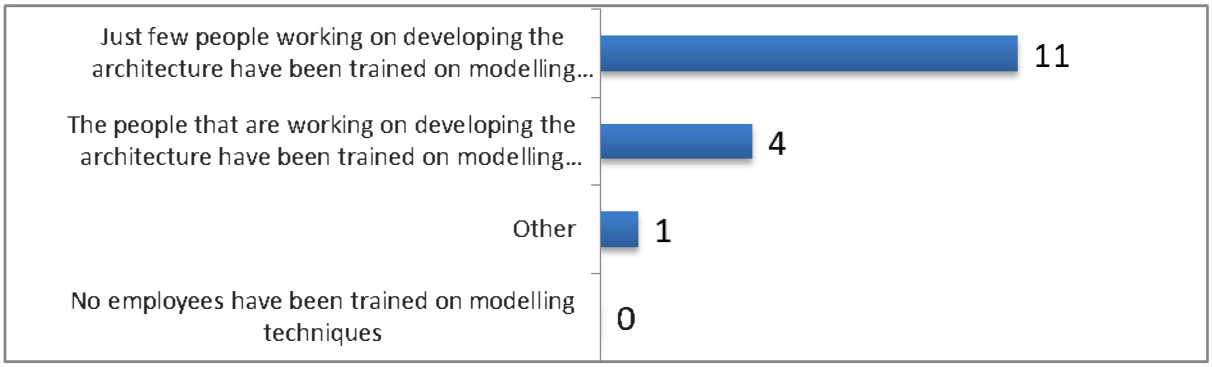

Figure 6: Training of resources on modelling techniques

Once the process architecture has been defined, the human resources that will execute the processes should be allocated. 61% of the interviewed companies declared having trained resources to carry out the processes; this demonstrates that most companies make sure that their employees have the necessary knowledge to do the work as expected (cf. Figure 7).

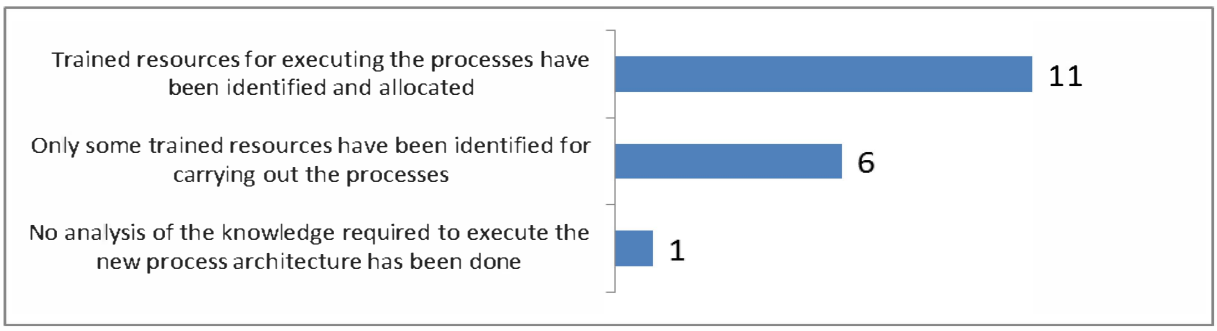

Figure 7: Allocation of trained resources

As a first step in the definition and implementation of a PA, it is necessary to map the existing (AS-IS) processes. When a company begins to do so, it must make a decision about another important operational element which is the mapping approach. There are three main approaches for mapping: 1) Top-Down: Start mapping the high-level processes and then define the sub-processes, 2) Bottom-Up: Start mapping the activities and sub-processes that people do in the different areas and then group sub-processes to define high-level processes, 3) Merged approach: Both Top-Down and Bottom-Up approached are used. Among the respondents, **56% of the companies opted for a Merged Approach and 33% for a Top-down.**

In addition to the mapping approach, the number of levels in the process architecture must also be considered. Therefore, the interviewed companies were asked up to how many levels were defined in order for them to model their PA. The objective is to determine the level of detail in the definition of their PA, which may vary widely depending on a wide variety of factors. **Nonetheless, more than 61% of the companies used 3 or 4 levels to model their architecture.**

Given its importance and potential, a PA has not only been studied and developed in academic research, but also by the industry and diverse organizations. As a result of this research, diverse frameworks or methodologies have been proposed and made available commercially entitled either as PA or more commonly in a holistic approach: Enterprise Architecture. Although of high and strategic importance, PA is only a piece within a complex and large body that is an enterprise. A large sample of frameworks currently exists in the market. Although most of these frameworks aim to be flexible, some might adapt or better fit into a particular industry or company. In other cases some companies choose to look at several of them, so that these might be used as a reference. Hence, the use of a framework is an element considered by companies when trying to design its process architecture.

Companies in our study were asked to select from a list of industrial frameworks those that they used to define and implement their PA (cf. Figure 8). Large companies have dealt with quality management exhaustively and most of their departments count with a person or team in charge of quality. Therefore, usually all the tasks related to processes, regulations, standardization and continuous improvement are overseen by this department, hence the relationship made by the interviewees of a methodology such as TQM with PA. Some companies, after having revised and in some cases even used a particular methodology or tool, have concluded that none of those available satisfies their needs, which have led them to create their own internal framework, usually consisting of a mix-match of different tools.

Modelling any process, particularly a NPD process in a traditional manner has proved difficult and resulted in many modelling tools and techniques proposed by the literature and industry. In order to capture the different characteristics of a process, academic research has developed modelling methods classified between graph-based and matrix-based techniques.

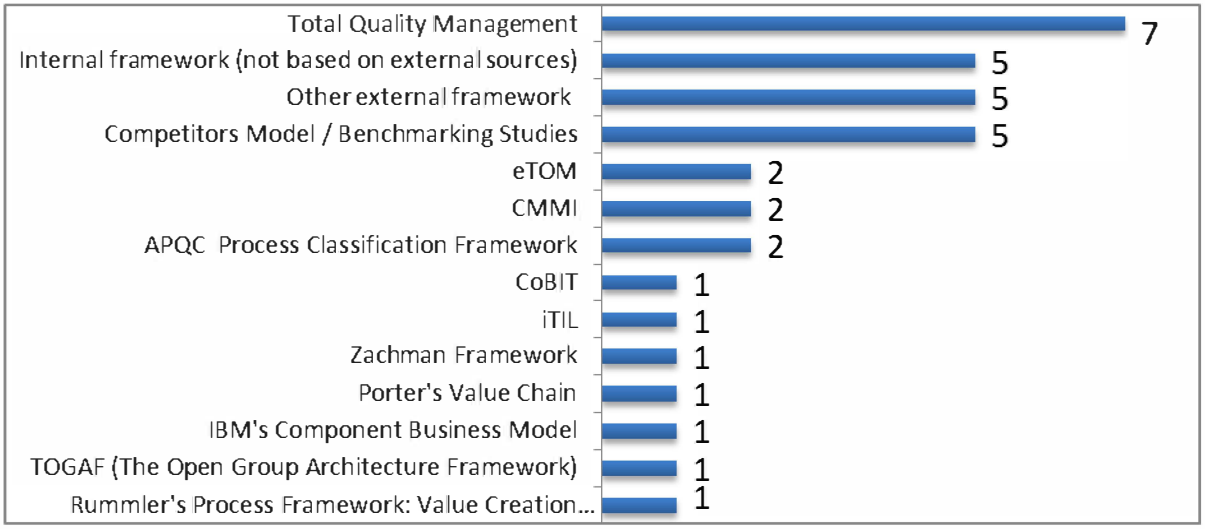

Figure 8: Used or referenced frameworks to define a process architecture

Different authors [Zachman 2008, Ould 2005, Rummler 2008] have proposed models most commonly used in the industry, some of which have led to sophisticated IT tools. The current importance of IT tools in any organization is undeniable. Yet this does not necessarily translate to the use of the most appropriate IT tools. The interviewed companies were asked to select the IT tool or set of tools that has been used for modelling their PA. Results indicate companies are still unaware or unwilling to invest in IT tools designed specifically for the task. Microsoft Office (power point) has resulted to be the preferred option to model a PA. Besides the evident ease of use and availability of Microsoft Office, it is likely that companies view specialized tools as something costly. Nonetheless, given that developing a PA ought to be a continuous task, it would seem worthwhile for an organization to invest in such a tool. Among the other IT tools for modelling the PA we may find: Mega, MagicDraw, Jira, IS Modeller and Sparx Enterprise Architect.

The last operational element considered in the study is the method that companies use to track and improve the key performance indicators (KPIs) defined for the processes within their process architecture. The measurement of performance aids an organization to align the day-to-day activities with clearly defined strategic objectives. Studies have shown that many models are useful to identify performance parameters that affect the management of a company. By investigating each parameter, a company may realize the capacity and potentiality of its operations. These performance measurements may allow for an identification of adjustments that may improve the results, not only for the company but for the extended enterprises in the value chain [Laptaned 2008]. It is important to establish which are the best and/or most commonly used tools or methods to track and improve these performance indicators. By far, either for its ease of use or common use, 55% of the interviewed companies use Excel to track KPIs. A notable trend that is gaining momentum in many organizations is the use of an Enterprise Dashboard as a visual and interactive mechanism of communicating objectives and results to employees. Another tool identified by companies to track and improve KPIs is SAP.

5 Implementation results, success factors and weaknesses

Building on the answers, comments and experience gathered during the interviews, companies ranked their perceived performance and success at defining and implementing a PA. Of those interviewed, 22% declared having achieved a low level of success in the implementation, 50% a medium level of success and 28% a high level of success. Those who declared having a low level of success attributed it mainly to communication issues, lack of appropriate support from the necessary parties and the complexity of executing large projects based on the defined process architecture. The majority of the interviewed companies consider their PA to be a work-in-

progress, not necessarily due to its status but because they believe that this is a task of continuous improvement and development, hence their ranking as a Medium Level of Success. The level of success in the PA implementation is linked to the progress made in the implementation of the PA initiative (based on the implementation plan). Not all interviewed companies have yet managed to declare having a fully implemented PA. Having inquired previously on the time it would require to produce the last major release, some of the interviewed companies had not yet reached that point at the moment of the interview. **Although only 56% of the interviewed companies declared having a fully implemented PA, 78% of these consider it highly successful or having achieved a relative medium level of success. On the backside 22% of the interviewed companies declared having achieved a relative low level of success while 44% have just only started or have partially implemented their PA.**

The last element considered in the study was the application of lean thinking in the process architecture. After defining the process architecture, companies will review it periodically to identify activities that do not add value, which can be considered waste. This can lead to the creation of a new or improved version of the architecture, ensuring the processes within the architecture become leaner. Interviewed companies were asked to select those activities carried out within their organization related to lean thinking. Results show that more than 60% of the interviewed companies carry out activities to keep processes that add value, eliminate those that generate waste or both. Nevertheless, the level of rigor applied when carrying out these activities is not specified. Besides, 34% of the companies do not try to change the process towards lean which clearly shows the opportunity area of applying the tools developed by the LeanPPD Project.

Finally, the following are the main key success factors and weaknesses for a PA implementation identified through the study:

Key Success Factors:

- Periodical review, update and improve the PA
- General involvement and strong team effort
- Alignment within the organizations established structure (e.g. Quality System)

Key Weaknesses:

- Poor guidance, understanding and leverage from the owners
- Not enough or inappropriate performance indicators
- Failure to set an adequate schedule and meet the deadlines

6 Proposed model to develop and implement a Process Architecture integrating best practices

After a careful analysis of the presented data, a set of common best practices have been found as a basis for any organization to define and implement a PA. A best practice is a technique, method, process, activity or incentive which has proven to be most effective in providing a certain outcome [The Best Practice Network, 2012]. Therefore, for the different elements of a process architecture implementation asked to companies during interviews and for which the main findings have been presented in this paper, we can conclude that the answers provided by companies who confirmed achieving a high or medium level of success in the PA implementation can be considered best practices. In contrast, the answers provided by companies that achieved low level of success cannot be considered best practices.

The main best practices identified through this research are aimed to be generic and when carried out together constitute a recommended approach for process architecture implementation [Flores, Flores, 2011] (cf. Figure 9).

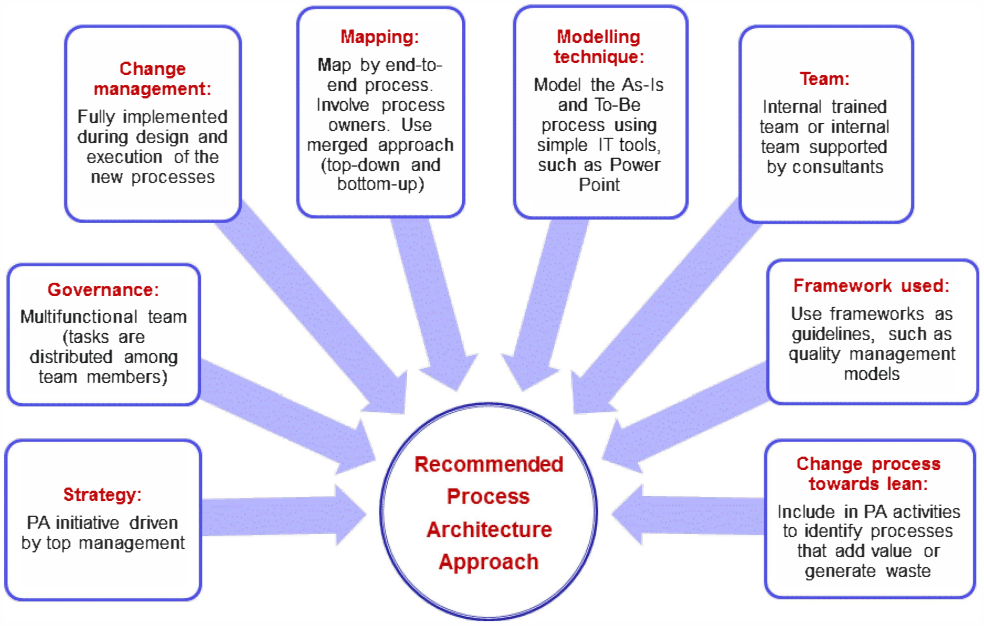

Figure 9: Model with recommended based practices for process architecture development and implementation based on results of a questionnaire applied to 18 companies [Flores, Flores, 2011]

It is also important to point out that even though some of the provided best practices may be supported by the literature, they have been mainly identified through the interviews carried out with companies. The lack of available literature in the way of executing the process architecture in organizations was evidenced through this research.

The proposed model for process architecture implementation includes as a first best practice the process architecture strategy driven by top management in order to guarantee the necessary leadership for the implementation. It is also important to fully communicate the strategy within the company. Another best practice related to strategic considerations is to have a clearly defined governance to develop and maintain the process architecture, based on a multifunctional team that has a leader but also team members that distribute tasks among themselves. In some companies a Project Management Office function can be created to support the team members to do their work. Besides, a fully implemented change management process is essential to attain a successful PA initiative.

Some strategic and operational elements have been also considered in the model: An end-to-end process mapping is proposed and it is especially important to involve process owners in this task. A merged approach for mapping processes, using both top-down and bottom-up approaches is suggested. Another best practice is to model both the AS-IS and TO-BE processes to better visualize areas of improvement and to use simple IT tools for the modelling. A crucial operational best practice is to define the team that will be involved in the PA initiative, we recommend to select trained internal resources for the task (some employees could be sent to take some training if time permits) or to select a team with relevant employees and hire an experienced consultant to work with them (this option could be more used if there is not enough time to train internal people). On the other hand, using existing frameworks as guidelines for developing a company's process architecture is a good practice to follow. There is no single framework that can be suitable for all companies, but there are several process architecture frameworks or business process management frameworks that can be consulted by companies. Finally, we recommend applying lean thinking in the process architecture, by including some activities to identify continuously the processes that add value and the ones that generate waste.

7 Conclusions

This paper presents the results of the interviews carried out to a group of 18 companies from different sectors to understand their strategic considerations, operational elements, critical success factors and weaknesses when developing and implementing a process architecture. As a result, a generic model was proposed to enable firms understand the main elements that should be considered for a successful process architecture implementation considering the best practices for all elements. The latter best practices were identified by a detailed analysis carried out from the information gathered through the interviews.

Acknowledgement

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