

Initial Conditions to Implement a Process Redesign Methodology for Manufacturing Enterprises

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Process redesign methodologies have several conditions that enterprises must reach to obtain a more efficient implementation process. Up to now, there is not a clear definition of these requirements. This paper presents the conditions for manufacturing enterprises, based on a review of the maturity models that apply to these kinds of companies. These conditions include five organization aspects: strategy, process, people, control and information systems. After the review of the maturity models' practices for the aspect "process", ergonomics and maintenance were considered to complement this category.

Keywords: *Initial Conditions, Manufacture Process Redesign, Maturity Models, Process Improvement*

1 Introduction

The methodologies of process redesign present the improvement process as a strategic option that contributes to increase productivity and business competitiveness. It also considers that the strategy should be complemented with elements like appropriate information systems, mechanisms for control and monitoring processes. The redesign presents an evolutionary approach, which permits the organization to move forward in a managed way, it also permits to achieve an average impact, and visible and forceful profits [1] [2].

In this context, organizations need basic competence to get started on process redesign projects, understanding that redesign is a way to achieve a high performance process [3]. To establish initial conditions is identified as a need that organizations should accomplish to ensure they are prepared to implement more efficient methodology for process redesign.

For this reason, the maturity models are considered to establish the criteria required for a process redesign, in this case, in manufacturing companies, because these models establish practices and conditions that must be implemented to achieve a degree or level of maturity.

This paper aims at identifying the initial conditions that a manufacture enterprise needs to

accomplish for being prepared to implement a methodology of process redesign.

The organization of this paper is presented as follows. The first section states the conceptual foundations of process redesign methodologies and maturity models for manufacturing companies. The second section describes the methodology implemented. The third section describes the initial condition needed to implement a methodology for process redesign and the final section contains the conclusions of the present work.

2 Literature Review

Process Redesign

The concept of process redesign was initially developed with the approaches of Taylor in 1911 and the Gilbreth spouses in 1917, which decomposed each task into an ordered series of movements, in order to identify those that should be removed, simplified or merged with others [4]. Davenport and Short focused the concept on the description of the processes, defining critical processes and analyzing them, to reduce cycle times, to strengthen the value chain and to improve competitiveness [5]. Tenner and De Toro argue that process redesign is focused not only on small improvements to solve problems, but also on the improvement of all organization processes [2].

Jackson and Sloane in [6] suggested that there are three dimensions to improve processes: a) improving business processes, focusing on small improvements, with a low impact, b) process reengineering, there are radical changes in structure and form, its improvement impact is medium, c) re-architecting business processes, focusing on real change, its impact is high. Within the framework of this concept it has been raised the importance of the sustainability of continuous process improvement, this concept is built as an adaptation of the theories presented by Imai and Harrington; they propose that exist incremental improvements that rise continuously the processes performance, but process redesign is done periodically to have a greater impact on improvement [2].

Based on the literature review about process redesign methodologies, it is possible to identify those that apply to manufacturing companies. The most recent methodologies will be presented below.

Related to the Toyota Production System methodology it is generated the Value Stream Mapping, VSM, by Hines in 1997, Rother and Shook in 1998. This methodology seeks to facilitate the use of techniques and tools of lean manufacturing. This methodology aims at identifying, demonstrating and decreasing the waste in the manufacturing process [7] [8].

Moreover, Herron and Braiden formulated the "Methodology for the Development of Sustainability of Continuous Improvement" focused on helping manufacturing companies to implement improvements which are targeted to use the principles of Lean. It has three key elements that allow the implementation of improvements: (PNA) analysis of the needs of productivity, (MNA) analysis of manufacturing needs, and (TNA) training needs analysis [9].

In order to integrate the production optimization, cost minimization and quality control it is established the "Multidimensional Integrated Process Improvement Methodology" for manufacturing systems, IMPIM [10]. This methodology proposes that the analysis will be performed from a global vision of the

production system, which must be modeled. This generates the need of a robust information system that provides the data needed for such modeling, which can be a factor to limit its implementation.

In 2006, a methodology called CQT (Cost-Quality-Time) was presented, focused on quality improvement, reducing costs and processing time. This methodology makes its contribution trying to combine principles of manufacturing improvement processes with methods of business process management [11].

Another methodology identified is HY-CHANGE [12], which was generated by performing an integration of methodologies. It includes a support guide for the "change exercises". This methodology brings together concepts of Business Process Reengineering and Continuous Quality Improvement, taking into account not only the methodological steps, but also the tools applied.

Based on this review, it is recognized that companies need to know their processes in depth to analyze their production system, to keep their process in control, to have a defined model for making decisions, among other things to redesign.

Maturity Models

The concept of maturity emerged as a structured measurement of organizational performance and can be defined as "the state in which an organization is in perfect conditions to achieve their objectives" [13]. When it reaches a mature state, it manages to combine the performance of a process and the attitude of the organization [14].

Then, a maturity model can be defined as a structured collection of elements that describe the characteristics of a product or process in a defined aspect, assuming its evolution in time to reach the ideal state or "mature", where the organization reaches its highest level of performance in this aspect [13]. These models represent the evolution of the organization in stages with objectives patterns that describe it, which allow a valid an objective measure and comparison between a group of organizations with common characteristics [15].

From a literature review is possible to establish a classification of maturity models for process management in generic models and specific models. Generic models can be used by any company, either service or manufacturing. The specific models are those that apply only to a specific production sector [15]. Within specific models, a group of sectors

can be identified as: software, projects, trading companies, manufacturing enterprises, among others. In specific models there have been identified some maturity models that apply to manufacturing companies. Table 1 presents those models that are selected as reference in this work and its classification.

Table 1. Content details

Model Name	Author, year	Type
CMMI Development version 1.3 [17]	SEI, 2010	Software
Business Process Maturity Model – BPMM [18]	Fisher, 2004	Generic
Process and enterprise Maturity Model PEMM [3]	Hammer, 2007	Generic
Business Process Maturity Model (BPMM) [19]	Lee et al, 2007	Generic
Process Management Maturity Assessment (PMMA) [20]	Rohloff, 2011	Generic
Manufacturing Capability Maturity Model MCMM for SMEs [21]	Sharma y Alí, 2010	Manufacture
Industrial Process Maturity Model- IPMM [22]	Doss, 2006	Manufacture
Model for identify the process maturity, case: small manufacture enterprise. [23]	Montaño, 2010	Manufacture
Supply Chain capability Maturity Model - S(CM)2 [24]	García y Giachetti, 2010	Supply Chain

Based on the review of the maturity models, it is possible to define an average maturity level for organizations. This level includes companies that have characterized processes, i.e., clearly defined goals, inputs, activities, roles and products; standardized and understood processes. Likewise the organizations have process owners who are responsible for their execution.

Also, these companies have defined processes performance metrics and they take control of product quality. These companies have a clear organizational strategy and search for techniques to make a better use of resources and reduce waste. The above definition is consistent with a general description of the characteristics of a company that can implement a methodology for process redesign.

3 Methodology

For the identification of the initial conditions for the processes redesign in manufacturing

companies, the following steps were developed:

- Systematic review to answer the question: Which existing maturity models can be used by manufacturing companies?. For answering this, the information was searched in databases such as ISI - Web of Knowledge, SCOPUS, SpringerLink, ProQuest, Elsevier, EBSCO, Emerald, Redalyc.
- A long list of maturity models were identified in a preview research, but an inclusion criterion was used to select the models that are shown in the table 1: maturity models that apply to manufacturing companies and those that have a clear definition of their maturity levels.
- Revision of the general definition of the levels in each identified model was done, to find which level is suitable according to the implementation of a process redesign methodology.

- With the levels identified in the previous step, the initial conditions were defined by the review of their practices or detailed descriptions.

4 Initial Conditions for Process Redesign

This section shows the initial conditions for the process redesign in manufacturing enterprises, considering that practices related to a medium level of maturity in the selected models do not include aspects related with

the machines' maintenance and ergonomics, understanding ergonomic as "the design of the workplace, tools, equipment and environment to fit the human operator" [4].

The structure of the Business Process Maturity Model [18] is used to define the initial conditions, which have four organization aspects: strategy, processes, people, control and information systems, and they are classified in two main groups as in Figure 1.

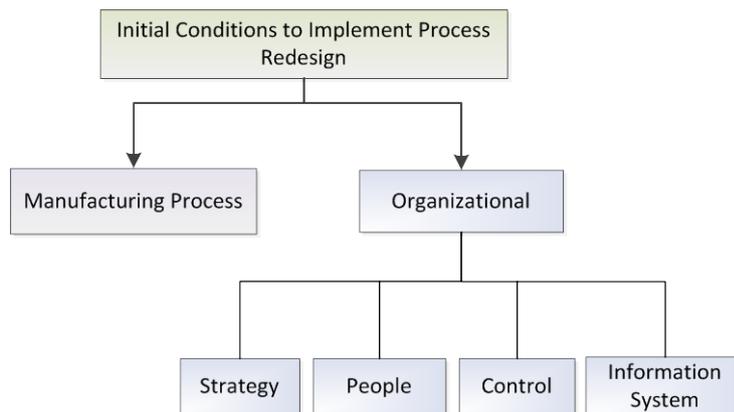


Fig. 1. Initial Conditions Classification

Strategy

This aspect refers to the important role of the enterprise's senior executive in the strategic understanding of an improvement culture, which is focused on the whole enterprise. Besides, the senior executive is responsible for the decision making in support of overall company objectives.

- The enterprise's senior executive should have a participative management style, it can form a committee integrated by the leaders of key process and some adviser experts [3].
- There should be a production process management lined with the corporative organizational policy [17], [22].
- Quantitative objectives for quality and performance in the production process have to be clearly defined and used as management criteria [21].
- The enterprise should have process leaders [3], [20].
- The enterprise's senior executive has to consider the production process as part of the core business [21].

- The enterprise's senior executive should identify improvement targets for the production process [3], [21].
- The enterprise's senior executive should be aware that there are always opportunities for improvement [3].

People

People aspect deals with human resource environment characteristics, including skills, organization culture and organizational structure.

- People who execute the production process must have the knowledge and skills required [17], [3], [22], [18].
- The processes leaders have to define, develop, improve and maintain processes [17], [3], [18].
- The enterprise should have formal teams for the improvement of the processes [3].
- The staff must be prepared to manage changes in the production process [3].

Control

The enterprise management implicates a monitoring of the aspects that can impact the

process performance. For this reason in this aspect it is included the practice about the metrics of the process.

- The organization must have a quality control of products in the production process [3], [22].
- The organization has to define a mechanism to monitor and control the production process, both individually and globally [17], [21], [24], [18], [19].
- The organization has to monitor and analyze the performance of the production process by quantitative methods [21], [22].
- The organization must perform audits or reviews to verify compliance with the standards in the production process [22].
- The organization has to take corrective actions when failures are identified in the production process [17].

Information System

This aspect refers to the systems that guarantee the data that comes from the enterprise processes, which can be used for the decision-making process and the strategic planning.

- The enterprise must have an information system to monitor the processes management [20].
- The enterprise should have an information system which integrates the organizational process such as production, selling, purchasing, and logistics, among others [3].
- The enterprise should have standardized formats and data that are generated in the processes [20].
- The enterprise must to define a responsible person to collect the data of the processes [20].

Manufacturing Process

This aspect refers to the systems that guarantee the data that comes from the enterprise processes, which can be used for the decision-making process and the strategic planning.

- The production process should be characterized, documented, approved and understood by the personnel involved. It has to describe standards, procedures, tools and methods [17], [3], [21], [22], [24], [19].

- There must be guaranteed the necessary resources for the production process proper execution [17].
- Outsourced processes must be clear and controlled [22], [24], [18].
- There should identify key components in the production process, which have to be controlled quantitatively [21].
- There must be evidence of semi-automation at some stages of the production process (materials, operations, and others) [21].
- The computer-assisted tools should be used in the production process (design, production scheduling, production control, etc.) [21].
- There should be an inventory management system (materials, work in process and finished product) that tends to optimize their levels and prevent delays in the production process [24].
- There must be a maintenance program for machines and equipment in the production process.
- The manual labor must be designed taking into account human capabilities and limitations.
- Ergonomic conditions of workstations and its environment should be guaranteed: adequate flexibility of equipment and tools according to worker characteristics, lighting, noise, ventilation, temperature, vibration and radiation.

5 Conclusions

Based on a review of the process redesign methodologies that are applied to manufacturing enterprises and also in the identification of the maturity models levels that describe the organizations characteristics related with the implementation of a process redesign; It is recommended to companies the achievement of a medium level of maturity to implement a process redesign. This level includes companies that have: characterized, standardized and understood processes, process owners, performance metrics, clear organizational strategy and search for techniques to make a better use of resources and reduce waste.

In this paper the initial conditions are shown in groups that define the aspects which an organization should analyze to validate if it is prepared to start a process redesign. These aspects are: strategy, processes, people, control, and information system.

Enterprises that are considered prepared for a process redesign, should have an adequate information system and the commitment of the senior management to lead the initiatives of improvement which must be part of their strategic planning. In addition, it is necessary to have a suitable workplace for all the personnel and a maintenance program; both aspects were not considered in any of the maturity models for manufacturing enterprises that have been reviewed.

Future research can be focused on how the organizations could verify the accomplishment of these conditions by the evaluator's profile definition, taking into account his objectivity and knowledge in each organizational aspects of the company.

Acknowledgment

This work was supported by the "Jovenes Investigadores e Innovadores Virginia Guitierrez de Pineda 2010" program of the Colombian institution COLCIENCIAS.

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