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## Article

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## A LOGISTIC PROCESS IMMATURITY MODEL PROPOSAL

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**Abstract:** Aims: To develop an immaturity model for the assessment of logistic processes that can assess the practices that describe the level of criticality, which maturity models do not evaluate, of these processes. Originality: Application of the little-known variation of maturity models and immaturity models in business logistic processes. Research method: The research is conducted from a literature review primarily with terms such as immaturity models and process immaturity. As literature is poor, it is supported by the maturity models developed by various authors in multiple domains. Main findings: As a result, an immaturity model is obtained for the assessment of the main logistic processes of manufacturing companies. Likewise, the evaluation and the experiences collected from its application in a company of a case study are obtained. Implications for theory and practice: The studies about immaturity of processes are few. The model is designed for manufacturing companies whose logistics management differs from service companies.

**Keywords:** immaturity model, logistic processes, process assessment, criticality, business management.

**JEL Classification:** L23, L60, M11.

### 1 Introduction

The creation of value through the availability of goods and services is the main added value of the logistics activities in any company (Hofmann and Rüsch, 2017). This area allows the flow of information and resources both inside and outside organizations, making the operation of companies possible. Hence, there is a need to study, manage, improve, and optimize business logistics processes (Battista and Schiraldi, 2013) and thus ensure the efficient operation of the company's operations.

It is possible through the analysis and improvement of logistics and supply chain processes in general, to positively impact company's overall performance (Garcia-Reyes and Giachetti, 2010). To support such process improvement, multiple studies propose numerous strategies, methodologies, tools, and techniques (Harrington, 1991). Maturity models are well-known and well-established tools used traditionally in information systems research to mainly support the management, analysis, and improvement of software development processes (Hausladen and Schosser, 2020).

The most frequently used maturity models is the Capability Maturity Model (CMM) developed by the Carnegie Mellon University (Paulk, 2009). CMM establishes five levels that describe the level of development of the company, or maturity levels, in terms of the best practices associated with software development (CMMI Product Team, 2010).

However, in the case of the CMM, a large number of companies that are evaluated under this model are evaluated within the lowest levels proposed, which is misleading because they can really be much less mature than what is established in the low maturity level (Schorsch, 1996). Hence, the companies need to assess their true maturity by expanding traditional maturity models, thus evaluating their low maturity or simply immaturity (Finkelstein, 1992).

In this way, immaturity models are coined as an extension to maturity models, both CMM and others used from the literature. These immaturity models are presented simply as the inferior or negative part of the maturity models and seek to describe and calculate the level of criticality of the processes of the company and the company itself (Piney, 2009), which traditional maturity models fail to assess.

The efforts made so far to assess the immaturity of processes have not been clearly documented or documented as parody or joke (Finkelstein, 1992) besides being limited in content and quantity.

This work seeks to define clearly and seriously an immaturity model for the assessment of logistic processes mainly in manufacturing companies.

The remainder of this article is organized as follows.

Section 2 introduces the traditional maturity models, so that it is possible to give a context and understand the immaturity model proposal.

Section 3 mentions works found in a literature review, which mention the immaturity of processes or the use of immaturity models.

Section 4 presents the proposal of a logistic immaturity model, including the processes, characteristic practices, and form suggestion for its implementation.

Section 5 presents a case study in which the model is used in a real company as well as the initial perceptions of its implementation.

Finally, Section 6 presents the conclusions of this article and the direction of future research.

## **2 Maturity models as antecedent to immaturity models**

The first step in defining immaturity models is to understand maturity models, their origin, importance, and potential. Maturity models are organizational maps that represent a simplified view of the reality of a process or an organization for their analysis and assessment through the so-called maturity levels (Enke, et al., 2017). This assessment aims to improve the current state of development of the object of evaluation through an improvement in its performance, in addition to allowing comparison working as well as a benchmarking tool (Enke, et al., 2017).

These types of models were originally created to support software project companies to maintain their competitive advantage, reduce operating costs, ensure product quality through process quality, and reduce the time taken for the company to reach the end customer (de Bruin, et al., 2005; Nurdiani, et al., 2019).

However, the term maturity has been used strongly since the 1980s, thanks to IBM. Subsequently, the term is reinforced and given greater importance by the Software Engineering Institute (SEI) (Paulk, 2009). This term is used to express the level of development of an entity or object subject to evaluation and, together with methodologies such as the Total Quality Management (TQM) and the European Foundation Quality Management (EFQM) approach, gives rise to maturity models as such.

The greatest exponent and reference of maturity models is the CMM created by the Carnegie Mellon University, the organization responsible for managing the SEI (CMMI Product Team, 2010). It is perhaps the most worked, imitated, and studied model of all the maturity models in the world, being of great popularity and confidence for researchers from multiple areas of knowledge. At present, it has three main variants, each one focused on the focus of the company and the object of evaluation.

The first variant of the CMM focuses on the evaluation of software development processes in companies.

The second variant focuses on the processes in software companies that provide some type of service.

Finally, the last variant focuses mainly on the evaluation of the processes of acquisition of goods or services in software development companies.

In general, the maturity models including the CMM consider a five-level evaluation scale (CMMI Product Team, 2010), also called maturity levels, which seeks to give a rating to the processes according to their development (Pérez-Mergarejo, et al., 2014). However, the five-level scale to define process maturity is not a mandatory condition for maturity models; there are models with three (Meng, et al., 2011), four (Lahti, et al., 2009), six (Hausladen and Schosser, 2020), and even more levels.

Clearly, the higher the number of levels, the more precise it is to assess the maturity, sacrificing the practicality of the model. Regardless of the number of levels that the maturity model has, and whether it considers a level zero or not, they all describe positive levels of maturity.

### 3 Immaturity models in the literature

While maturity refers to the level of development of processes (Pfleeger, 1995), immaturity refers to the setback of advances and lack of interest in process performance. The term immaturity is used in contexts in which it is referred to as a means to determine how critical a process area is (Battista, et al., 2012).

The level of criticality referred to in the term immaturity is reflected in poor performance, lack of development, constant problems, execution errors, and, obviously, the lack of maturity of the processes. From the immaturity measured as the level of criticality of the processes, hundreds of problems that can manifest in multiple ways arise, being sources even to break businesses.

Immaturity models come originally as a critic and an informal proposal complementary to the traditional maturity models. The first documented proposal of immaturity model is focused on the evaluation of characteristics beyond the chaotic in the processes of software development companies (Finkelstein, 1992). This model is presented as a necessary extension to the CMM, and although it has a certain degree of informality in the proposal and mockery, it has served as a source to develop additional proposals for both maturity and immaturity models.

Other authors without directly mentioning immaturity models as such refer to the immaturity that exists and the problems that affect the performance of traditional maturity models, such as the CMM (Bach,

1994), justifying the creation and need for extension provided by immaturity models.

Later, the evaluation of immaturity of processes is given a little more development without significantly improving the seriousness or rigor of the study (Schorsch, 1996). Previously developed approaches regarding immaturity are taken as the basis for proposing the Capability Immaturity Model (CIMM) (Schorsch, 1996).

This immaturity model proposal is a counter proposal to what is established by the CMM. The CIMM, despite not establishing a clear methodology for the assessment of immaturity, details a proposal of high interest in terms of defining the characteristics of each of the assessment levels or immaturity levels.

These two initial proposals of immaturity models subsequently serve to develop additional models for the assessment of the immaturity of business processes. One of these proposals is a model focused on the assessment of the immaturity of project management processes (Piney, 2009), differing from the previous proposals focused on the evaluation of software development processes.

In addition to defining the immaturity model framework, the project management immaturity model proposes a methodology to perform the immaturity assessment as well as a method to interpret the results. Table 1 summarizes the main, among the few existing, models of immaturity found in the literature and mentioned previously, which serve as a reference for this work.

Table 1. Main immaturity models found in the literature  
(Source: Authors' own research)

Model Name	Focus Area	Levels of Immaturity	Author
A software process immaturity	Software engineering capabilities	Level 0 Foolish Level -1 Stupid Level -2 Lunatic	(Finkelstein, 1992)
The Capability Im-Maturity Model (CIMM)	Chaotic software development processes	Level 0 Negligent Level -1 Obstructive Level -2 Contemptuous Level -3 Undermining	(Schorsch, 1996)

Table 1. Main immaturity models found in the literature (cont.)  
(Source: Authors' own research)

Model Name	Focus Area	Levels of Immaturity	Author
A Project Management Immaturity Model	Companies in general that work with projects	Level 0 Incompetent Level -1 Obstructive Level -2 Antagonist Level -3 Psychotic	(Piney, 2009)

Although each new proposal of immaturity models or in the use of the concept of immaturity is more formal than the previous one, they always have a small component of informality and lack of seriousness. A part of the objective of this work is to formalize, to a certain degree, the concept of immaturity, showing that it can be a serious and useful work, through a serious proposal and implementation of an immaturity model.

#### 4 Logistic immaturity model proposal

The immaturity model proposal of this article focuses on assessing the logistic processes of mainly manufacturing companies. The processes considered in the model are part of the proposal and are the most representative when defining the logistics area of a company (Battista and Schiraldi, 2013). In this way the model proposal is called the Logistic Process Immaturity Model (LPIM). The processes corresponding to the LPIM and are subject of immaturity assessment are:

- Warehouse Management and Control (WMC),

- Inventory Management and Control (IMC),
- Production Control (PC),
- Customer Relationship Management (CRM),
- Supply and Procurement Management (SPM),
- Logistic and Production Planning (LPP),
- Organizational and Human Resource Management (OHRM),
- Sales and Internationalization (SI),
- Technological Appropriation and Logistics 4.0 (TAL).

The logistic processes considered are assessed on a scale of immaturity that determines and is able to generically describe their level of criticality (Battista, et al., 2012). Table 2 shows the scale used for the assessment, referred to as the immaturity levels of the model. Each of the levels in Table 2 is given a name that allows to have a quick initial idea about the critical conditions that the process has. Similarly, each process is associated with a characteristic practice that determines a generic behavior for processes at that specific level. Each level is described in greater detail below.

Table 2. Immaturity levels of the model (Source: Authors' own research)

Immaturity Level	Level Name	Characteristic Practice (CP)	Criticality level
Level -1	Negligent	Failure to allow a successful execution process	Medium
Level -2	Obstructive	Counter-productive effects of the process	High
Level -3	Contemptuous	Total disregard for any order or sense of management	Very High

Considering that what would be a Level 0 in various proposals of maturity models found in the literature represent a degree of ignorance of the process (Pérez-Mergarejo, et al., 2014), the immaturity levels of the LPIM begin from a Level 1 to be consistent with several of these proposals. The conditions and description of a process in each of the immaturity levels, based on the mentioned immaturity models, are discussed in the remainder of this section.

#### 4.1 Level 1: Negligent

The processes included in Level 1 are characterized by their disorganization, while their staff are characterized by indifference toward the improvement activities for the process. The process presents multiple failures when attempting a successful execution. The client of the process, internal or external, is not allowed to participate and intervene in it. The administration and control of the process are usually the references to identify a process at this level.

These are activities that are severely lacking in the process because of a low cost-benefit ratio perception the company has. The administration of the process has no vision for the future, so there are no goals, plans, calendars, or resource allocations. The staff is dedicated to short-term activities, intervening in isolated daily tasks, without seeking long-term solutions.

The rules of the process are constantly changed according to the specific need of the moment. The process does not have defined standards, and if there are manuals and documentation, these are not used. Each new trend that is tried to be reproduced in the process is introduced with great fanaticism but ends up getting forgotten mainly because of lack of commitment and responsibility.

All the problems presented in a Level 1 process are designated as merely technical, justifying this as the cause of the poor quality presented; however, there is insufficient technical knowledge to affirm it. Despite this, the process is declared as "successful" without any valid criteria.

#### 4.2 Level 2: Obstructive

The processes included in Level 2 are characterized by being rigid and generating stress by imposing unnecessary efforts on employees. The processes at this level insist on complexing at the will of individuals with approaches for which the necessary tools or knowledge are not available, forcing to perform tasks more than once. It has the mentality that the strategies and techniques used are applicable to all cases and serve both for everything and forever. Normally, these strategies are outdated or little known, so documentation is scarce. The strategies used are accompanied by a certain myth, which is supposedly responsible for the success of the process.

The administration of the process is diffuse. There are many administrators or managers of the process, so it is difficult when problems arise to identify the causes as well as assign or find those responsible. There is a total separation between the execution of the process and the administrative area responsible for the supposed supervision and improvement of the process. There are no interested parties or methodologies to change and improve the process, where any attempt to do so is discouraged.

There are no training programs for new employees; they are expected to learn alone. However, new employees are not given the space or time to generate a learning curve. The lack of training is justified as the process is critical and for which there is only time to produce; there is no time for improvement activities or knowledge transfer. Thus, the quality control of the process consists solely in verifying that the process is being executed; time is not taken to review the quality of the product or process.

#### 4.3 Level 3: Contemptuous

The processes included in Level 3 are characterized by total carelessness and arrogance of the staff in charge. The process presents a terrible performance. As long as the process generates a cash inflow to the company, the satisfactory execution of the process is neither important nor a matter of concern. It is valued more when the process is carried out than when it is improved, rejecting any attempt to improve the organization through the process.

These are processes in which any effort to correct elements of the execution of the process is consciously discredited and in which the administration is indifferent towards any good institutionalized practice.

Neither the process nor the staff associated with it care about meeting minimum quality standards as long as they ensure that the job is sustained over time and that money continues to enter the organization, even if the balances are negative. Instead of trying to improve, the process and its administration seek to discredit and disorganize other processes to look good. The supposed correct execution of a Level 3 process is a facade; the process normally lacks any adequate operation or administration technique.

#### 4.4 Immaturity assessment methodology

The methodology to perform the assessment of the logistic processes with the LPIM consists in assigning to each one of the processes a level of immaturity, according to the characteristic practice that best describes the criticality of the process. It is also suggested to understand the extended description given for the processes at each of the immaturity levels. For this purpose, a form shown in Table 3 is proposed to assess the immaturity of the processes. This form corresponds to a proposal to perform an easy and efficient assessment, where it is also possible to total the assessment of the processes by immaturity levels and determine the percentage of the processes in each of the levels.

Table 3. Immaturity assessment form (*Source: Authors' own research*)

LPIM Immaturity Assessment Form					
Immaturity Model Processes		Immaturity Levels			Not applicable
#	Processes	Level -1 Negligent	Level -2 Obstructive	Level -3 Contemptuous	
1	Warehouse Management and Control				
2	Inventory Management and Control				
3	Production Control				
4	Customer Relationship Management				
5	Supply and Procurement Management				
6	Logistic and Production Planning				
7	Organizational and Human Resource Management				
8	Sales and Internationalization				
9	Technological Appropriation and Logistics 4.0				
TOTAL COUNT:					
PERCENTAGE (TOTAL COUNT / 9):					

The procedure to use the proposed form is given as follows: one process is taken at a time and, whether assisted or not, an immaturity qualification is given to this process if it is reflected in the characteristic practice and is described by one of the immaturity levels. The box with the corresponding immaturity level in which the process is reflected and described is marked. In case the process is not reflected in any characteristic practice because it has certain level of development, the "Not applicable" box is checked. Finally, in the lower part, it is suggested to count the number of processes by immaturity level, as well as to calculate a percentage of the total processes assessed at each level to have a first approach to understand the overall immaturity of the company's logistics.

Normally, companies that are immature do not admit it and ensure that they can improve their processes with a small technical help (Finkelstein, 1992). However, the first effective step to ensure improvement is the acceptance of the criticality of the process or processes by the manager or staff in charge.

Unlike the maturity models in which the improvement must be incremental and staggered (Pérez-Mergarejo, et al., 2014), it is suggested for the LPIM that the improvement be radical by directly seeking that the process does not fit into any level of immaturity proposed. In case it is highly complicated for the company in methodological terms to make the radical improvement, a scaled improvement, pointing to the level closest to zero, is suggested. It is also suggested that the first processes to intervene with improvement actions, according to the particular case of each process, are those with the highest immaturity level.

## 5 Case study and implementation of the LPIM

The LPIM is tested and used in a medium-sized company in the furniture sector in the city of Medellín in Colombia. The company is classified as medi-

um according to the Colombian norm that establishes the number of employees and the total value of the company's assets, the parameters for this classification. For its part, the company manager was responsible for founding the company in 1993, overseeing operations since then. In addition, the manager has limited unfinished university studies, finding the company as a source of work to live.

During the time that the company has operated, the processes in general have changed little and little has been the effort to seek to improve or optimize them. Although the company has been in the market and has survived economically during its years of operation, it shows great problems at first sight, especially in the logistics area. The employees and the manager himself refer and express in their own words the critical problems that the company has. Knowing that the company has problems, it has never undergone any type of diagnosis and much less logistic analysis.

The company is contacted to request a visit in order to test the immaturity model. Considering that the model can be aggressive and acid for the company, the conditions of the assessment are explained from the beginning. Rather than being a criticism of the strategies taken by the company, the model seeks to be of help by serving as a starting point for other actions focused on improving the company, besides being a merely investigative exercise in search of experiences and knowledge on the implementation of the proposed model.

During the guided tour of the company, the processes considered in the LPIM are indicated to the manager, generating a discussion to finally reach an agreement on the immaturity level of that process. Some processes are found to not apply to any of the levels proposed by their level of development and relatively positive performance. The rest of the immaturity qualifications given to the LPIM processes are summarized in Fig. 1.



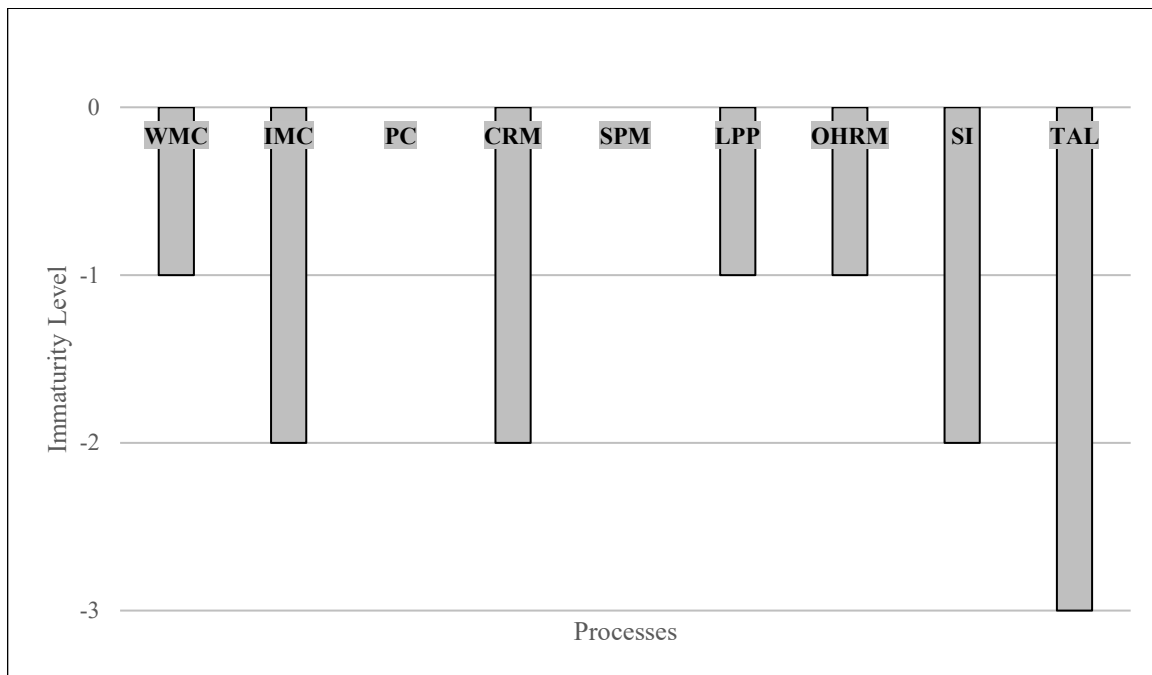


Figure 1. Plot with the results obtained in the case study company (*Source: Authors' own research*)

The plot with the results of the assessment shows that the TAL process is the most critical of all the logistic processes assessed by the LPIM in the case study company. As mentioned above, the PC and SPM processes do not apply to any of the immaturity levels, thanks to their relative level of development that does not match them with any characteristic practice of the respective immaturity levels.

According to the suggestions given previously, the company should seek to establish a team responsible for improving the TAL process, being the most critical of all. This team must have a technical component, internal support, and the manager's constant participation to ensure the improvement in the process.

The improvement efforts made should be focused on ensuring that the process does not qualify at any of the proposed immaturity levels. Thus, the improvement spaces generated by the company are justified and taken advantage of efficiently.

Finally, the results are delivered to the company and an accompaniment is followed to improve its processes, based on the priority of criticality given by the LPIM.

## 6 Conclusions and discussions

Immaturity models result in a good methodology to expand traditional maturity models, which frequently fall short at their lowest levels to express the low levels of process and business development. Immaturity models require more studies and greater seriousness, so that researchers are encouraged to expand studies on this front and consequently increase their implementation. As such, the concept of immaturity and immaturity models is aimed at detecting more accurately the low development of the processes and the criticality associated with it.

The immaturity model proposal, LPIM, presents the key logistic processes to be assessed, along with the necessary levels and assessment methodology, to make it a simple, applicable, and replicable model.

The logistic processes exposed in the LPIM are usually the most representative for all manufacturing organizations. The immaturity levels are summarized, so that they are easy to understand; however, they also have enough level of detail to understand them in depth.

The proposed assessment methodology makes it an attractive methodology for the quick evaluations of business processes.

As the concept of immaturity model is not widely studied in the literature, a light model such as the one proposed encourages future research in this subject. From the case study, positive experiences in the use of LPIM are reported, helping to guide the improvement of the company's logistics processes

Future research should focus on exploring the immaturity models in greater depth: their creation, implementation, and usefulness in the identification of the immaturity of business processes. Also, take advantage of the immaturity models approach in the logistics area, which is a great source of problems for companies.

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