Assessing sub-process maturity

- An action research study of an organizational sub-process

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ABSTRACT

Maturity models represent a feasible approach towards assessing business processes and identifying their potential improvements. Specifically, the Process and Enterprise Maturity Model (PEMM) has attracted much attention since its publication in 2007. However, few studies have explored its practical applicability. The large size of some business processes suggests that assessing their maturity at a sub-process level can help to uncover hidden inefficiencies and understand more accurately existing complexities. This paper therefore aims to examine the degree of applicability of the PEMM to an individual sub-process. To this end, an action research study was conducted in an organizational sub-process at a large Swedish organization. Data collection entailed in-situ participant observations involving employees and managers who were working in the sub-process. The results indicate that the PEMM was a useful framework for conducting an in-depth maturity analysis and identifying feasible improvements, which evidence that the model was applicable to the studied sub-process.

Keywords: Sub-process maturity, Process and Enterprise Maturity Model (PEMM), applicability, organizational sub-process, business process management, action research
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1. INTRODUCTION

1.1 BACKGROUND
In the current economic landscape, global competition and increasing customer expectations require companies to intensify their efforts to achieve higher levels of efficiency. These challenges require that companies streamline their operations and make an effective management of their key business processes. One of the contemporary fields dealing with the management of business processes in organizations is business process management (BPM), which has been the result of developments from succeeding concepts such as total quality management in the 1980s (Crosby, 1979; Powell, 1995) and business process reengineering in the 1990s (Hammer and Champy, 1993).

Among the various approaches that support BPM, maturity models have acquired increasing attention among academics and practitioners (Rosemann and de Bruin et al., 2005; Rosemann et al., 2006; Weber et al., 2008; Röglinger et al., 2012). Process maturity models typically include a set of assessment criteria arranged in a sequential manner that help to assess the current capabilities of a business process and define where and how to improve it (Rosemann et al., 2006; Hammer, 2007). In this respect, process maturity models have been commonly used as evaluation tools for assessing the current maturity of business processes and identifying their potential improvement paths (Maier et al. 2009; Röglinger et al., 2012).

1.2 PROBLEM STATEMENT
To date, the amount of literature focused on process maturity models has been extensive, including the publication of numerous maturity models (Rosemann et al., 2006; Hammer, 2007; Lee et al., 2007; Weber et al., 2008). However, while these models have acquired certain standing in the BPM community, very few studies exploring their practical applicability have been publicly known (Rohloff, 2009). One probable cause for this little prior research may be, in part, their relatively recent publication, which has led academics in the BPM field to repeatedly call for more empirical research on investigating these models (Rosemann and de Bruin et al., 2005; Palmberg, 2010; Parkes and Davern, 2011).

One of the most widely recognized maturity models was presented by Michael Hammer in 2007 in *Harvard Business Review* and was entitled the Process and Enterprise Maturity Model (PEMM) (Hammer, 2007; Röglinger et al., 2012). Unlike other maturity models, the PEMM was claimed to provide detailed assessment criteria to assess process maturity and identify potential improvement paths, and was subject to extensive tests and revisions (Röglinger et al., 2012). However, despite its assessment capabilities and solid foundation, solely two published articles were found in the current literature that substantively used the
model (see Palmberg, 2010; Parkes and Davern, 2011). While Palmberg (2010) partially used the PEMM to contextualize the organizational implications when implementing process management, she nevertheless did not deepen into exploring the analytical value of the model. Parkes and Davern (2011), by contrast, used the model to examine the implementation of a workflow system, which provided an in-depth analysis of the model at the level of an individual process. In this context, Parkes and Davern (2011) empirically demonstrated that the PEMM represented a useful framework that was applicable to the scale of an individual process. However, something that has not been contemplated yet is how adaptable the PEMM would be if the context of application was an individual sub-process instead.

Because of the large size that some processes can attain in real-life organizational settings, it can become an arduous task to assess their maturity as a whole. For this reason, Beecham et al. (2005) claimed that breaking down a process into separate sub-processes can facilitate a detailed assessment of its maturity as it can help to uncover hidden weaknesses. Assessing maturity at a sub-process level, in fact, can represent a meaningful way towards understanding more accurately existing complexities embedded in the entire process. It can allow for an in-depth assessment of the process at a lower level view while providing a detailed picture of its maturity separated into its interconnected sub-processes. This differs from adopting a more holistic approach and assessing maturity at a process level, which may run the risk of losing analytical depth and not being detailed enough to discover potential inefficiencies. Consequently, an important aspect to consider is to explore the applicability of maturity models at the level of individual sub-processes.

This paper therefore aims to examine the degree of applicability of the PEMM to an individual sub-process through an action research study of an organizational sub-process. Addressing this purpose, I seek to contribute to the need for more empirical research on maturity models and extend current knowledge of the PEMM with respect to its scope of application. Moreover, applying the PEMM to an organizational sub-process expects to provide valuable insight into the practical usefulness of the model for practitioners involved in the management of organizational sub-processes. With previous discussion in mind, I attempt to answer the following research question:

To what extent is the PEMM applicable to an individual sub-process?
2. THEORETICAL FRAMEWORK

2.1 BUSINESS PROCESS MANAGEMENT (BPM)

2.1.1 A historical perspective

The concept of business process management is not an entirely new notion. In fact, Shewart (1931) and Deming (1953) were one of the first authors arguing about process control in a context of product and statistical control respectively. During the 1970s, a quality control methodology termed Total Quality Management (TQM) appeared, which drastically changed the process landscape by focusing on statistical measurements of mainly manufacturing processes (Crosby, 1979; Powell, 1995). But not until the late-1980s, an approach developed at Motorola and coined Six Sigma was developed, which began to supersede TQM and commenced to address continuous analysis of processes with help of advanced statistical quality control techniques (von Brocke and Rosemann, 2010).

A great deal of attention was paid by that time to business process re-engineering when Hammer and Champy (1993) published the book “Re-engineering the corporation: a manifesto for business revolution”. By then, business process re-engineering was referred to as “the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed” (Hammer and Champy, 1993; p. 46). However, a considerable debate arose when it was considered simply as a one-off intervention to redesign processes rather than an on-going management of business processes (Armistead and Machin, 1997). This originated what is today known as business process management, which involves an integrated approach to continually manage business processes with the aim of managing business performance (von Brocke and Rosemann, 2010).

2.1.2 Concepts and definitions

A recent literature review has revealed that there are still no widespread definitions around the concepts of processes and business process management (Palmberg, 2009). When it comes to the definition of business process management, some authors have referred to as the management and improvement of single organizational processes (Zairi, 1997; Lee and Dale, 1998; Biazzo and Bernardi, 2003). Others, however, have shared a more holistic view and have considered business process management as a part of managing the entire organization (McAdam and McCormack, 2001; Bawden and Zuber-Skerritt, 2002). This latter view assumes that an organization views its operations as a combination of processes that exercise significant influence in shaping the organizational structure. However, an organization does not necessarily need to be shaped in accordance to processes. Rather, an organization can view its processes as single entities that need to be individually managed and improved.
without considerably influencing the way the organization is structured. These arguments support the former view of business process management described above, which is presented by Palmberg (2009) as follows:

“A structured systematic approach to analyze and continually improve the process” (Palmberg, 2009; p. 210)

With respect to the definition of process, some authors have principally described it as a sequence of interrelated activities with a purpose or value for stakeholders (Talwar, 1993; Ljunberg, 2002; Isaksson, 2006). Others have included the concept of an input that initiates the process and an output that is the result of the process (Davenport and Short, 1990; Harrington, 1991). A third view has further distinguished processes as being horizontal and cross-functional (Jacobson, 1995; Armistead and Machin, 1997). However, none of these views have shared a clear and comprehensible definition of what a process really involves. Rather, authors have tended to define the term process in their own words, which has created confusion in the academic circle. A more integrated definition of process has been provided by Palmberg (2009). It essentially incorporates all the components discussed above, which suggests consolidation of previous theories and a unifying approach to define the term. The definition of process is presented below in the following terms (see also Figure 1):

“a horizontal sequence of activities that transforms an input (need) to an output (result) to meet the needs of customers or stakeholders” (Palmberg, 2009; p. 207)

Figure 1. A net process definition (Palmberg, 2009; p. 208)

2.2 PROCESS MATURITY MODELS

2.2.1 Concept and aims

To evaluate and ultimately improve processes, a common approach is to conduct a maturity analysis (Röglinger et al., 2012). A process maturity analysis principally serves as a method to assess the maturity of a given process and identify potential improvement paths (Rosemann et al., 2006). In this respect, process maturity models have represented a feasible way aiming towards assessing such a maturity (Röglinger et al., 2012). Essentially, process maturity models involve step-by-step road maps, generally embracing best practices, which fundamentally help organizations identify their current process maturity levels (As-Is) and
define where and how to improve them (To-Be) (Hammer, 2007; Röglinger et al., 2012). Consequently, the aims of these models are commonly twofold:

- **Descriptive**: A maturity model serves for As-Is assessments when current capabilities of the unit under investigation are assessed with respect to certain criteria (Becker et al. 2009). The maturity model is then used as a diagnostic tool (Maier et al. 2009).

- **Prescriptive**: A maturity model indicates how to identify desirable maturity levels and provides guidelines or courses of action on improvement measures (Maier et al. 2009).

### 2.2.2 Literature review on process maturity models

In recent years, a broad array of process maturity models has been proposed by researchers and practitioners across multiple process-related domains (Fisher, 2004; Rosemann et al., 2006; Hammer, 2007; Lee et al., 2007; Weber et al., 2008). Nonetheless, while some have been criticized as oversimplifying reality, others have been claimed to be too complex to measure (Rosemann and de Bruin, 2005). And when some encountered problems to use objective measures (Maull et al., 2003), others lacked empirical foundation (McCormack et al., 2009).

Rohloff (2009), in this context, claimed that most of the existing models solely focus on one dimension to assess maturity. However, he presented some exceptions that cover a broader range of criteria, which included the BPM Maturity Model (BPMM) of the OMG (Weber et al., 2008), the Process and Enterprise Maturity Model (PEMM) of Hammer (2007), and the maturity model of Rosemann et al. (2006). In a recent literature review on maturity models, Röglinger et al. (2012) also distinguished these three models as allowing for descriptive and prescriptive use and being applicable to organizations independently of size, location or industry. However, while the BPM Model of the OMG was not published in a peer-reviewed research article, the maturity model of Rosemann et al. (2006) was claimed to leave not enough space for detailed assessment criteria and guidelines, thus being limited to potentially address adopters from practice (Röglinger et al., 2012). By contrast, the Hammer’s PEMM was claimed to be published in *Harvard Business Review* and was subject to extensive tests and revisions (Röglinger et al., 2012). In addition, the model was said to provide detailed explanations for descriptive and prescriptive use, and present further advice by means of self-assessment sheets (Röglinger et al., 2012). Consequently, the Hammer’s PEMM was primarily selected and was accordingly subject to a preliminary exploration.

### 2.2.3 Preliminary exploration of Hammer’s PEMM

The Hammer’s PEMM, structurally, has two major constituents: a set of five process enablers and a set of four enterprise capabilities (Hammer, 2007). While the maturity level with respect
to the process enablers concerns specifically a given process, the maturity level with respect to the enterprise capabilities applies to the entire organization (Hammer, 2007). Given that the scope of this study is concentrated on a single sub-process, the focus was only put on the process enablers. This is in line with Parkes and Davern (2011)’s study, who similarly focused on Hammer’s PEMM process enablers when examining the implementation of a workflow system in an individual process. However, while it became clear from their study that the scope of the Hammer’s PEMM process enablers was on individual processes, I sought to examine in this paper if it equally applied to an individual sub-process. This expects to increase existing understanding of the PEMM by incorporating a new perspective in relation to its scope of application. In the next section, the Hammer’s PEMM process enablers is briefly described.

2.3 THE HAMMER’S PEMM PROCESS ENABLERS

2.3.1 Nature, dimensions and maturity of process enablers

In his model, Hammer (2007) identified five distinct process enablers: design, performers, owner, infrastructure, and metrics. Each of these process enablers are further broken down into more finely grained dimensions, a total of 13, which are given four levels of maturity. The four levels of maturity range from P-1 (i.e. least mature) to P-4 (i.e. most mature). In a high-level view, the process enablers are briefly described below with respect to their nature, dimensions and maturity (for a detailed description, see Hammer’s PEMM process enablers in Appendix 1).

- **Design**: involves the specification of which tasks people must perform, in what order, together with when, in what location, with what information, and to what degree of precision. The process design enabler is divided into three different dimensions: purpose, context, and documentation. A highly mature process is denoted by a design that fits with customer and supplier processes, provides clear performance expectations and is documented in a way that allows rapid response to environmental changes and process reconfigurations.

- **Performers**: refers to the different set of skills and knowledge of people who work in the process in terms of understanding of the overall process, their ability to work in teams as well as their capacity to manage themselves. This process enabler is broken down into the following three dimensions: knowledge, skills and behavior. High maturity here is reflected when performers are skilled at proposing feasible process improvements, can identify trends in their industry and are effective at change management.

- **Owner**: refers to the ownership of the process and the degree of authority to articulate process changes. There are three different dimensions concerning this process enabler:
identity, activities and authority. A mature process is one where the process owner is part of the senior executive body, is engaged in strategic enterprise-level decisions and controls the process’s budget.

- *Infrastructure:* is concerned with the alignment of IT and HR systems to support the process. This process enabler is divided into two differentiated dimensions: information systems and human resource systems. A process in its highest maturity involves an integrated IT system with a modular architecture that fully supports the process as well as HR policies that reinforce the importance of intra- and inter-organizational impacts of the process.

- *Metrics:* reflects the quality of the measures that assess the process performance and what they are used for. There are two dimensions in relation to this process enabler: definition and uses. Maturity in this enabler requires inter-organizational reliable metrics and a regular review and refresh of them.

### 2.3.2 Use of the model

The Hammer’s PEMM process enablers is displayed in a structured table in which each dimension of the five process enablers contains four statements that correspond to the four different levels of maturity (see Appendix 1). Each statement or maturity level is built on the preceding level, in such a way that it allows to identify the prerequisites for the next level. These statements are framed in cells that need to be colored in accordance to three types of conditions. If the statement is largely true, it means that is at least 80% correct and is colored in green. If the statement, by contrast, is somewhat true, it indicates that the statement is between 20% and 80% correct and is colored in yellow. Lastly, if the statement is considered to be largely untrue, it means that is less than 20% correct and is colored in red. In this context, the green cells show things that facilitate the process’s progress and do not need a closer focus; the yellow cells suggest areas where a significant amount of work needs to be done; and the red cells indicate roadblocks that prevent the process from achieving a high performance.

For reasons of simplicity and fluid discussion in the analysis chapter, the evaluation of the statements will proceed in a slightly different, yet equivalent manner as compared to Hammer (2007)’s:

- A statement that is largely true and thus colored in *green* will be generally indicated by “*in line / in accordance to*” the specific level of maturity proposed by Hammer (2007).

- A statement that is somewhat true and is colored in *yellow* will be referred to as “*partially / in part*” in accordance with the specific level of maturity proposed by Hammer (2007).
- A statement that is largely untrue and is colored in red will be denoted by “did not permit / prevent” the sub-process to achieve the specific level of maturity proposed by Hammer (2007).

* Note that in few cases it is mentioned that the findings encountered in the sub-process “differ” from Hammer (2007)’s description of the specific level of maturity. This is because the formulation of the statement is written in a way that leads to deny the statement. However, the statement or maturity level in these specific cases does not represent any roadblock that prevents the sub-process from achieving a higher level of maturity. Rather, the sub-process can perfectly progress to the next level of maturity, which Hammer (2007) indicates with the green color. Thus, these statements will be colored in green.
3. METHODOLOGY

3.1 SETTING THE RESEARCH FRAMEWORK: THE ORIGINS OF THE JOINT COLLABORATION

The very beginning of this story arose merely as a genuine interest of the researcher in the area of BPM as he had developed a theoretical understanding of the issues underlying some of the key areas in a previous practical experience. This interest turned into a search for BPM-related projects upon which he could deepen more his own understanding of the topic. Meanwhile, the organization thereafter subject to study detected the need for an external intervention in an already ongoing BPM project and made public a research proposal. Once the researcher raised awareness of this situation, he initiated first contacts with project managers with responsibility for the project. These initial contacts were followed by successive meetings with different project members, which ultimately led to the researcher’s involvement in the project.

The project, in its entirety, dealt with a process-based transformation in the testing process at the R&D department and mainly aimed to achieve considerable process improvements of different types, ranging from increased information quality to reduced lead times. The time scale of the researcher’s involvement was mutually set at the start, spanning over a 6-months period. Likewise, research conditions were also negotiated and both project managers and the researcher agreed to discuss openly confidentiality questions. Some aspects related to access to information and places were addressed and it was decided to grant full access to them as needed by the researcher.

Once set down at the research site, the researcher and project managers had continuous discussions about the scope and degree of the researcher’s responsibilities, which led to a refinement and narrowing of the research topic. It was particularly considered the time span given to the researcher and it was determined which sub-process within the testing process could be suitable for both research and organizational purposes. After several discussions, we jointly decided to narrow down the research scope to one sub-process within the testing process, namely the material handling process of prototype parts. This was because it was the next sub-process that required closer attention in the project and, after evaluating its particular characteristics, it showed to be a suitable sub-process for addressing the research purpose.

3.2 ACTION RESEARCH

Given the characteristics of the project and the researcher’s agenda, it was carefully considered a series of major criteria that would inevitably influence the development of the research. These were three: the researcher’s active involvement in the organization, the
researcher’s goal of his intervention (i.e. to promote organizational change in form of process improvements), and the process approach to interpret data, which was to follow a reflexive way with the aim of extracting deeply-rooted information.

One particular research strategy that was closely examined was *action research*. Unlike other research strategies, action research involves an active and deliberate self-involvement of the researcher in the context of investigation (Huxham and Vangen, 2003; Saunders *et al.*, 2009). This high degree of the researcher’s involvement was, in fact, one of the major factors influencing this research, as the researcher was actively involved in the research context. In addition to this, action research also rests on the basis of mutual collaboration between researcher and what is frequently described as “problem owner” (i.e. in this case project managers responsible for the project) (McKay and Marshall, 2001). This collaboration, as similarly argued by Lewin in the 1940s who is believed to be the first person to coin the term “action research” (Susman and Evered, 1978; Eden and Huxham, 1996), is vital to research and must take place within a mutually acceptable ethical framework (Lewin, 1946). In the research context, the researcher together with project managers discussed and agreed upon ethical and confidentiality issues concerning with access to and disclosure of information, as explained in the previous section. We were also constantly in contact with each other by means of weekly follow-up meetings to discuss researcher’s ongoing advances and plan subsequent courses of action. All these discussions can be argued that led to a tight collaboration between us and facilitated data collection and planning of the research.

Action research is further commonly differentiated from other types of research strategies by its dual goal of both improving the organizational context and, at the same time, generating academic knowledge (McKay and Marshall, 2001; Kock, 2004). By working collaboratively with concerned actors, the researcher is generally expected to bring about improvements through making changes in a problematic situation, and must also aim to generate new knowledge as a result of his activities (McKay and Marshall, 2001; Kock, 2004). In this research, the researcher aimed to detect, understand and ultimately change the problematic situation. Or, expressed differently, the researcher intended to discover inefficiencies in the sub-process under study, understand its associated complexities and identify improvements paths. This was expected to bring about organizational development in terms of process improvements and generate new insight in form of an in-depth examination of the applicability of the PEMM to the sub-process under study, which was, in turn, in accordance to the dual goal of action research.

In action research, data is generally interpreted in a reflexive manner through recurring cycles of action and reflection to critically understand hidden meaning in participants’ behaviors (Dickens and Watkins, 1999; Chiasson and Dexter, 2001; Huxham and Vangen,
This was a crucial element of this research since deeply-rooted information about specific employees’ working behaviors was strictly needed. Accordingly, the researcher combined different data collection techniques in a reflexive manner, in such a way that it could allow to gather detailed data while following a cyclical process of fact-finding to deepen the understanding of the studied process. A reflexive process was therefore deemed to be an important element of this research and was subsequently pursued and carefully designed.

Besides action research, another research strategy was also considered and it was identified some advantages and disadvantages associated to it. It was distinguished that whereas a case study strategy could be helpful for deeply examining a single “case” (Saunders et al., 2009), namely the material handling process of prototype parts, it might fail to provide an in-depth examination of the sub-process by means of the researcher being actively involved in the organization. Instead, the researcher in a case study strategy is argued to be an impartial spectator on the research context (McKay and Marshall, 2001), thus being insufficient for collecting in-depth data in the context of this research. In spite of the low degree of the researcher’s involvement in the organizational setting in a case study strategy, which had arguably deteriorated the data quality of the research, it was also questioned the goal of the researcher’s intervention. The researcher was to adopt a problem-solving approach that would bring about organizational change in form of identification of process improvements. This is contrary to the goal of a case study strategy, which primarily aims to examine a certain real-life phenomenon (Saunders et al., 2009), but in no way its goal is meant to change a problem situation. Therefore, it was considered that a case study strategy was neither a suitable research strategy nor compatible with action research.

### 3.3 MANAGING THE PITFALLS OF ACTION RESEARCH

A common discussion thread among action researchers has been the very limited use of action research in academic research (Kock, 2004). Obviously, there are various reasons why action research has been underrepresented, which has scared away many potential adopters. A review of research literature found out that action research poses unique “threats” to research success, which have the potential to lead the researcher to a high proportion of failures (Kock, 2004). However, if managed properly, those threats can turn into strengths and research results can generate new insights for research (McKay and Marshall, 2001; Kock, 2004).

One of the main threats that repeatedly challenges action research is subjectivity (Rapoport, 1970; Kock, 2004). The subjectivity threat revolves around the fact that the researcher’s personal involvement in the organizational context is likely to push him into interpreting research data in potentially subjective ways and, as a result, his interpretations may result in bias (Rapoport, 1970; Kock, 2004). In the researcher’s view, a certain degree of
subjectivity was present in the research when interpreting data, which could have occasionally biased the research findings. Nevertheless, it is not enough by solely saying that the researcher was partially biased but it is also needed to understand the broader context of the situation, which can be described as a double-edged sword. While, on the one hand, the researcher sacrificed a degree of detachment and independence with his involvement in the organization, on the other he gained a sense of empathy and identification with respect to organizational issues which produced more valid information than what might have been gathered from a more detached way. Therefore, the researcher argues that even though he was somewhat biased by interpreting data in a subjective way, this was a necessary condition to produce more accurate interpretations of data.

In action research, there might also be the risk of **intrusiveness**. This occurs when employees participating in the research begin to view the researcher more as a person who is there to solely gather research data rather than as an interventionist who supports them in their work (Huxham and Vangen, 2003). If this occurs, the possibilities to get rich insight that is argued to be a distinctive feature of action research can rapidly disappear (Huxham and Vangen, 2003). In the beginning of the researcher’s immersion in the organizational setting, it was explained to all the employees the reasons of the researcher’s intervention, which made the researcher gained legitimation as well as employees’ acceptance and trust. This also made the researcher have a legitimate reason to be involved that was independent of the immediate research aims, which facilitated employees’ openness and collaboration. As time passed, the researcher also tried to hold an interventionist mode rather than a researcher’s. This brought the intrusiveness levels down to be deemed as irrelevant and helped to get in-depth and reliable information from employees.

Last but not least, there is a final threat that bears on **generalization** issues. Action research has received criticism for being “context-bound” and “situation-specific” rather than being valuable for other contexts and situations (Checkland and Holwell, 1998; Huxham and Vangen, 2003). This is in part because the researcher is concerned with solving practical problems pertaining to the domain of the project and may find difficult to achieve results that can be made richly meaningful to people in other situations (Checkland and Holwell, 1998; Huxham and Vangen, 2003). In this research, it was born in mind from the beginning that while results should be useful for organizational purposes, so they should be for research purposes. Therefore, in the process of selecting an organizational sub-process to be investigated, it was decided that results from the sub-process should have implications beyond the immediate project. In this context, the material handling process of prototype parts was selected and is argued to be a sub-process that can be valuable for investigating the degree of applicability of the PEMM to an individual sub-process. The results of this study, therefore, are expected to provide new insight with respect to the scope of applicability of the model.
3.4 RESEARCH DESIGN AND DATA COLLECTION METHOD

It has been discussed in action research literature that action research does not strictly need to apply either qualitative or quantitative methods (Nereu and Kock, 1997). It however tends to be context specific and the decision of which method to use mainly depends on both the researcher’s background and specifics characteristics of the research project (Nereu and Kock, 1997). In this particular research project, data was gathered to investigate employees’ working behaviors and sub-process specificities. Since the aim was not to collect numerical data from employees or the sub-process itself but rather to respond to “why-and-how” questions regarding human behaviors, it was decided to focus on qualitative methods.

The data collection method process mainly took the form of a series of in situ participant observations involving employees, a senior manager and a manager who were all working in the studied sub-process. The senior manager and the manager were both responsible for the sub-process in varying degrees, whereas that employees, a total of 11, primarily held one of the three following roles: goods receiver, goods allocator or goods picker. One employee regarded as “process expert” participated centrally in the discussion of the research issues. He was working as goods allocator and was specially chosen because he also had previous experience as goods receiver and goods picker and, therefore, had a clear overview of the entire sub-process. Very often, it happened that either employees or managers joined our conversations and clarified specifics aspects of their working behaviors or they were just directly asked for clarifications as we usually stayed at the same place. These joint conversations led to refinements of the data gathered, which provided more in-depth information and helped dissipate doubts.

In each round of observations, it was discussed activities and tasks that each employee and manager were performing as well as information systems that they were using. It happened frequently in conversations that employees or managers brought up problems with regard to inefficiencies in their way of working or systems they were using, which were further discussed and analyzed. Following each participant observation round, a detailed set of notes was produced, which formed one of the main data set for the research. These were reviewed and further discussed in subsequent rounds, where a process of fact-finding from previous observations was conducted with employees and managers. It was spent considerable time in these rounds in understanding more profoundly relevant issues through constructive dialogues, which ensured the reflexivity of the process. This reflexive process is illustrated by the “inputs” box and the central cycle of Figure 2 in next page.
These rounds of in situ participant observations approximately spanned over an eight-weeks period, with additional validation rounds taking place two weeks later. In each observation round, it was spent about three hours a day collecting information, which was examined later the same day. It was decided to spend no more than three hours a day to ensure that all the information was appropriately digested and facilitate the subsequent sensemaking process. In the first validation rounds, it was asked to employees and managers about certain aspects that were not clear enough after examining the initial information gathered. After that, in succeeding validation rounds, researcher’s notes were made public and were discussed with them, which allowed to gather useful feedback. This validation rounds were also argued to bring reflexivity to the process in the sense that it made employees and managers share their experiences.

During and after the participant observations and validation rounds, several meetings were held with project managers and other project members from whom feedback about research’s advances was gathered. When notes were officially validated, it was proceeded to their subsequent analysis. To this end, a maturity analysis of the sub-process was conducted, which led to the identification of improvement paths. All this served as a foundation for examining the degree of applicability of the PEMM to the sub-process under study (see the “research output” box at the top right corner of Figure 2).
4. THE ORGANIZATIONAL SUB-PROCESS

4.1 CONTEXTUAL BACKGROUND

4.1.1 Company's background

The action research study was conducted at Scania, one of the world’s largest truck manufacturers headquartered in Södertälje, Sweden. Its operations span over 100 countries and include the manufacturing of heavy trucks, buses, and industrial and marine engines. The company currently employs approximately 36,000 people across different locations around the globe, including production facilities, assembly plants, and own subsidiaries among others. Research and development (R&D) operations are concentrated in Södertälje, where there are nearly 3,000 employees performing their tasks.

At the R&D department, there is a total of 3 divisions and 15 departments that focus their activities on developing prototypes for specific parts of trucks and buses. In each of the different departments, there are several roles with different responsibilities, ranging from designers and engineers who design and develop prototype parts to mechanics and fitters who prepare and assemble those parts for their subsequent test. One thing that they all share in common is the process they follow to test the prototype parts. It is regarded as the testing process of prototype parts and encompasses various enterprise-wide areas, including material procurement, material warehousing and R&D.

4.1.2 Contextualizing the unit of study: The testing process of prototype parts

To provide perspective to the sub-process under study (i.e. the material handling process), its parent process (i.e. the testing process) is briefly described below. However, the aim here is not to provide a detailed description of the testing process but rather to put the concerned sub-process in its broader context. Having said this, the testing process of prototype parts is considered to be a core process at Scania’s operations and mainly aims to support the development of new products. Taking a high-level perspective, the testing process is composed of the following sub-processes: initiation, planning, material procurement, material handling, preparation for test, testing & analysis, and filing & scrapping.

The testing process commences in the initiation phase, where a test assignment is created when designers and engineers detect the need for new features or design changes on already existing parts. When the scope and the purpose of the test assignment is defined, it starts the planning phase, where the development of the test is planned and the newly designed parts are ordered. These orders are sent to the material procurement area, which is responsible for contacting and selecting suppliers to produce the prototype parts. When suppliers produce the parts, they are delivered to a warehouse at Scania, where the material
handling process takes place. In the warehouse, prototype parts are received and temporarily stored until all the necessary equipment to perform the test is prepared. At that time, prototype parts are picked up from the warehouse and transported to the R&D department, where the test is performed and results are consequently analyzed and reported. Then, the report is archived and the tested parts are scrapped, archived or sent back to the warehouse building to be reused later in time. The testing process is graphically represented below in Figure 3.

![Figure 3](image_url)

Figure 3. The testing process of prototype parts

In this context, the focus of this paper is put on the material handling process of prototype parts, which is a sub-process that takes place between material procurement and preparation for test (see Figure 3). To describe the sub-process, the Hammer’s PEMM process enablers perspective is adopted, so that its description is structured around the five process enablers. By structuring the findings encountered in the sub-process in this way I do not attempt to assess maturity levels but provide a purely descriptive view of the sub-process under investigation.

4.2 THE MATERIAL HANDLING PROCESS OF PROTOTYPE PARTS

4.2.1 Design

The material handling process, from beginning to end, was observed to have an established flow that had been subject to refinements at earlier stages. In its essence, the sub-process was comprised of three interconnected areas: goods reception, goods allocation and goods delivery. In accordance to each respective area, employees held three different roles: goods receivers, goods allocators and goods pickers. Overall, there were 11 employees who were distributed nearly equally among the three aforementioned areas. Adopting a flow perspective, the sub-process followed a horizontal sequence of activities that occurred in one
area and moved on to the next. In a high-level description, the sub-process started when the prototype parts arrived to the goods reception area from carriers, where they were registered and carried into the warehouse. The number of carriers coming to the warehouse everyday, however, was something unknown by goods receivers as IT systems connections with carriers were lacking. Once in the warehouse, the parts were placed onto racks at the goods allocation area and waited until engineers or test coordinators sent an order to pick them up. When that order was received at the goods delivery area, the parts were picked up by goods pickers and were delivered to the R&D department. There, engineers, mechanics and other roles started preparing for the test (for a more detailed description, see Figure 4 in next page).

Along the entire sub-process, prototype parts were individually handled and tracked, from their arrival to goods reception to their delivery to the R&D department. The sub-process was identified to start when a particular supplier sent the parts to the warehouse through a contracted carrier and finished when the parts were delivered to engineers or test coordinators at the R&D department. Formally, there was no documentation of the entire sub-process design as such. Rather, there were defined written routines and established procedures explicitly agreed in each area. This lack of documentation created uncertainty and non-visibility for engineers and test coordinators in the next sub-process about how parts were handled in the warehouse.

### 4.2.2 Performers

In its original setting, employees primarily kept adherence to their respective area. They followed agreed activities and tasks in accordance to the established flow, and were aware of existing challenges that were encountered in their corresponding area. To handle exceptions such as parts with missing or incorrect information, employees adhered to specific procedures that indicated certain steps to pursue to resolve the problem. Employees were not only able to recognize their performance indicators but also to calculate them, and could describe how their work affected to succeeding areas. For instance, if engineers or test coordinators needed a certain number of parts for a test in two weeks, goods pickers at the goods delivery area had a set of folders sorted by time to plan and organize the picking in advance and deliver it in time for the test preparation. In this sense, employees kept a customer focus in mind and strove to satisfy customers’ needs appropriately and timely.

Whenever some conflict or difficulty arose, employees tended to collaboratively reach an agreement together and find a consensual point. This was, in part, favored by their job location as they stay, in each respective area, at the same place. When some problem occurred outside the bounds of their areas, employees turned to their colleagues in the other areas and together usually identified the root of the problem. Specifically, the “process expert” who participated in the research data collection was found very useful by the other employees as
Figure 4. Flowchart of the material handling process

- **Receive part**
  - Register part information in IT systems
  - Move part to the warehouse
  - Origin, Expart

- **Check part information**
  - Place part onto a rack
  - Expart

- **Register part location in IT system**
  - Mexlab

- **Receive picking order**
  - Check part information in IT system
  - Register withdrawal in IT system
  - Expart, Mexlab

- **Pick up parts**
  - Transport parts to R&D

**IT system**

Engineers or test coordinators at R&D
he had broad knowledge about the three areas. Although employees were able to collaboratively solve problems, they were not observed to be skillful towards facing significant changing circumstances. This may be, in part, because they had never gone to date through any significant change program that substantively affected their work.

4.2.3 Owner

Responsible for the three sub-process areas, there was officially a manager whose main responsibilities were to control employees, find out process improvements and ultimately improve existing working methods. He met employees on a daily basis and coordinated and planned their daily work. He also informed employees about long-term goals, future plans for the warehouse and possible changes that might occur and could affect their work. Every week, both the manager and employees met all together and discussed suggestions for improvement. These were further reviewed and, if found feasible, a responsible person was assigned to put them into practice.

The manager also attended regular meetings with a senior manager and a manager who was in charge of other logistics process. In these meetings, they discussed difficulties in their respective areas, identified potential process improvements and planned common future courses of action. In this sense the senior manager was the ultimate responsible for the logistics areas of the testing process and so was for the material handling process, although he delegated responsibility to the aforementioned manager. The senior manager, particularly, formed part of a steering group at the R&D department where high-level decisions were made. He participated in strategic initiatives and long-term planning around the logistics areas of the testing process, and controlled and supported the implementation of process change initiatives. Nonetheless, these initiatives were carried out by another group at the R&D department who were in charge of technology developments and had control over their budget.

4.2.4 Infrastructure

When it comes to the IT infrastructure, the sub-process was supported by two different modules of one mainframe IT system and one independent IT system. The modules were named “Origin” (fictitious name) and “Expart” respectively, and the independent IT system “Mexlab”. To provide a clear description of the IT systems’ interconnections in the sub-process, a flow perspective is subsequently taken below (see IT systems’ interconnections along the sub-process graphically displayed by the small cylinders in Figure 4).

At the start of the sub-process when parts arrived to the goods reception area, each individual part was initially registered in Origin. This was to primarily inform other enterprise-wide area about the country of origin of the part and facilitate its custom
declaration. The same part information was then double-registered in Expart, which was a module that was specifically configured in the 80s to perform the functions of a warehouse management system. At the goods allocation area, then, the part information registered in Expart was cross-checked by goods allocators against that specified in the physical part by the supplier. After this checking activity, the part was placed onto a rack and its corresponding location was registered in either Expart or Mexlab, depending upon the type of part it was. If the part was a chassis-related component, its location was registered in Expart. By contrast if the part concerned an engine-related component, its location together with the initial part information registered at the goods reception area were registered all over again in Mexlab. This double-registration sometimes generated mistyping errors, which took considerable time to detect and correct. Mexlab, alike Expart, was a warehouse management system but was a fairly newer system that displayed information more clearly and simply. This was, in particular, necessary for engine parts as their tests generally comprised a large amount of them and information needed to be presented in a clearly visible manner. After this, when an order was received from R&D to pick up the parts, goods pickers made use of either Expart and Mexlab to check and register the subsequent parts withdrawal information.

With respect to the infrastructure of the sub-process in terms of HR systems, the manager of the three sub-process areas used an HR system where he mainly evaluated employees’ working time. He also gathered some performance figures based on employees’ suggestions for process improvements and the amount and type of training they were taking in relation to their job position, which all together served as additional measures to reward employees. The manager and the senior manager were together responsible for hiring and firing staff. To present job descriptions and hire new employees, they adhered to a specific job profile that was referred to as “logistics co-worker for prototype parts”. In this job profile there were explained basic competencies that were needed to work at the warehouse.

4.2.5 Metrics

To measure metrics in the sub-process, employees calculated distinct indicators in accordance to their respective area in a manual and paper-based manner, as they could not automatically collect them from IT systems. At the goods reception area, goods receivers annotated in a paper the number of carriers that were daily coming to the warehouse. Then, at goods allocation, goods allocators marked in a whiteboard the number of prototype parts that they were storing in the warehouse. And similarly at goods delivery, goods pickers counted the number of orders sent from R&D to pick up the parts. These numbers were then transferred to excel sheets, which primarily served as indicators for the manager to measure employees’ performance and identify volumes of handled parts. Based on the volumes of parts that were handled at the warehouse, the manager could distinguish temporal trends, which helped him
allocate appropriate human resources in the different sub-process areas. In addition to these metrics, the manager also controlled metrics related to costs. He was mainly responsible for general warehouse and personnel expenses.
5. THE PEMM ANALYSIS

5.1 MATURITY ANALYSIS

In this section, I seek to conduct an in-depth maturity analysis of the sub-process under study in terms of the five process enablers of the PEMM. The purpose here is to measure the maturity level of each of the different dimensions of every process enabler. This will subsequently facilitate the examination of the degree to which the PEMM is applicable to the studied sub-process. For reasons of smooth fluidity and clear comprehension of the analysis, a discussion about the degree of applicability of the model will be included at the end of each process enabler.

Note that each maturity level corresponds to a statement in the model, so that each statement will be discussed with respect to the findings encountered in the sub-process and will be subject to evaluation (see chapter 2.3.2 Use of the model to consider the evaluation of the statements). The evaluation of these statements will be done progressively, starting from P-1 level to the highest possible level of maturity that the sub-process can achieve. It is also worth noting that this evaluation involves certain degree of subjectivity since the statements are not value-free and need to be individually judged. Nonetheless, the discussion that will be provided in each statement expects to justify such an evaluation.

5.1.1 Design

The design enabler is divided, as noted by Hammer (2007), into three different dimensions: purpose, context, and documentation (see Hammer’s PEMM process enablers in Appendix 1).

- **Purpose.** The sub-process can be argued to have a clearly defined flow that was structured around its three interconnected areas. This manifest structuredness of its flow evidenced that the design of the sub-process, in effect, had been subject to earlier refinements to meet past needs. This drastically differs from Hammer (2007)’s description of P-1 maturity level in which he indicates that the process has not been designed on an end-to-end basis. However, it stays in line with P-2 level, where Hammer (2007) stressed that a process needed to have been redesigned to optimize its performance.

Further, the design of the sub-process was configured to fit with other company’s processes and their IT systems, as Hammer (2007) claimed at P-3 level. At the goods reception area, for instance, goods receivers used an IT system called Origin to register information about the country of origin of the part, which enabled the custom declaration process in other enterprise-wide area. However, the design of the sub-process partially supported supplier processes, which was only partially in line with P-4 level. While, on the one hand, carriers contracted from suppliers were received at the goods reception area without any problem, on
the other their IT systems connection with the sub-process did not exist, which made goods receivers be unaware of how many carriers were coming to the warehouse everyday.

- **Context.** Inputs, outputs, supplier and customers of the sub-process were clearly identified, as noted by Hammer (2007) at P-1 level. Prototype parts were recognized as inputs and outputs, and contracted carriers from suppliers together with engineers or test coordinators at the R&D department as suppliers and customers respectively.

Moreover, the needs from customers were known and agreed upon, as Hammer (2007) distinguished at P-2 level. Goods pickers at the goods delivery area knew about the existence of tests at the R&D department and had defined procedures to pick up the parts needed for the tests and deliver them in time. To reach P-3 level, Hammer (2007) explicitly emphasized the establishment of mutual performance expectations between the process owner and other owners of other interrelated processes. In the studied sub-process, quite remarkably, the manager responsible for the sub-process met with a senior manager and another manager in charge of other logistics process, and all together planned common future courses of action. This led, naturally, to the establishment of mutual performance expectations, which made the sub-process achieve P-3 level. However, there were no mutual performance expectations agreed between the manager responsible for the sub-process and the carriers’ process owners, which did not permit the sub-process to attain P-4 level.

- **Documentation.** There were specified certain written routines and procedures in each of the three sub-process areas that employees used to perform their activities. This is, as Hammer (2007) pointed out, in line with P-1 level in which the documentation of the process is primarily functional. However, there was surprisingly no documentation of the whole sub-process design. Despite the sub-process design was clearly defined, no documentation of the entire sub-process existed at all, which created uncertainty and lack of visibility for engineers and test coordinators about warehouse operations. This lack of documentation did not permit the sub-process to achieve P-2 level, which is described by Hammer (2007) as a process in which there is end-to-end documentation of its design.

5.1.1.1 **Degree of applicability of PEMM**

The design enabler, as a whole, showed to be highly adjustable to the sub-process under study. Each of its different dimensions and levels of maturity left room for providing a transparent view of the sub-process design in its original setting, which allowed for an in-depth analysis of its current state of maturity (see Figure 5 in next page). Specifically, the model allowed to shed light on concrete specificities of the sub-process as it attained higher levels of maturity especially in the first two dimensions, which helped to gain a rich understanding of the context and purpose of its design.
5.1.2 Performers

Alike the previous enabler, the performers enabler is equally broken down into three distinct dimensions. These are: knowledge, skills and behavior.

- **Knowledge.** Employees were perfectly able to name the sub-process and identify its key metrics, which Hammer (2007) considered to be necessary to achieve P-1 level. In fact, employees were the ones calculating the metrics of their own performance. Although employees primarily kept adherence to their respective area, they knew what employees in the next area or sub-process were expecting from them. They were aware of the needs of customers and were able to describe the sub-process’s overall flow, specially the “process expert”. This is in accordance to P-2 level, which Hammer (2007) describes as when performers can describe the process’s flow and how their work affects customers and other employees in the process.

  Furthermore, employees were familiar with fundamental business concepts related to the sub-process such as parts information or performance indicators. However, despite their deep understanding, employees nonetheless had little knowledge beyond the immediate sub-processes connected to their sub-process. This made the sub-process only partially attain P-3 level, which is referred by Hammer (2007) as when performers are familiar with fundamental business concepts and can describe how their work affects other company’s processes.

- **Skills.** Employees were able to identify existing problems and challenges in their corresponding area and find consensual solutions. They collaborated with each other, even with others in other sub-process areas if appropriate, and tried to find common ways to solve problems. This in line with P-1 and P-2 levels, which are principally described by Hammer (2007) as performers who are skilled at problem solving and teamwork.
In addition, employees were aware of business concepts in a process context and were capable of making decisions that influenced the subsequent sub-process area, which Hammer (2007) noted at P-3 level. If necessary, they even adhered to specific procedures followed under certain circumstances, which helped them make decisions. However, they were not skilled at change management and change implementation, as Hammer (2007) noted at P-4 level. They had never gone to date through any significant change program substantively affecting their work nor were observed to be skillful towards change, which prevented the sub-process from attaining P-4 level.

- **Behavior.** Hammer (2007) distinguished P-1 level as a process in which performers show some allegiance to it, but owe primary allegiance to their function. In the studied sub-process, employees certainly owed primary allegiance to their respective area, which might be seen as functional. However, the three sub-process areas were interconnected in such a way that facilitated the sub-process flow. This, I argue, made employees keep primary allegiance to the sub-process while focusing their activities at the area level.

Moreover, employees were aware of the sub-process’s needs in succeeding areas and followed defined activities and tasks that precisely enabled work in subsequent areas. This is in accordance to P-2 level, which Hammer (2007) distinguished as when performers try to follow the process design and facilitate work to other people who similarly execute the process. In addition, Hammer described P-3 level as when performers strive to ensure that the process delivers the results needed to achieve the enterprise’s goals. In the studied sub-process, employees endeavored to perform work appropriately and timely, and satisfy their customers’ needs, which made the sub-process attain P-3 level. Additionally, employees tried to identify improvements in the sub-process and bring them up in weekly meetings with the manager responsible for the sub-process, which is in line with P-4 level referred to as performers who look for signs of improvement and further propose them.

### 5.1.2.1 Degree of applicability of PEMM

The performers enabler, similarly to the previous enabler, was considered to be highly adaptable to the material handling process. There was, in fact, no dimension in this enabler that limited the applicability of the model to the actual sub-process. Each dimension together with its levels of maturity provided a detailed picture of how employees were doing in terms of knowledge, skills and behaviors. This became especially relevant in order to understand the extent to which employees were capable of performing work in the sub-process, which facilitated the identification of the current level of maturity of this enabler (see Figure 6 in next page).
5.1.3 Owner

The owner enabler is divided into three different dimensions: identity, activities and authority.

- **Identity.** The owner of the sub-process was officially a manager who was in charge of the three sub-process areas and their performance. Nonetheless, it can be argued that a senior manager was the ultimate responsible for the sub-process. This differs from Hammer (2007)’s description of P-1 level in which the process owner is an “informal” group or individual with responsibility for the process’s performance. More in accordance to the studied sub-process, I argue, is P-2 level, which Hammer (2007) described as a process in which a senior manager with clout and credibility is the owner. Even though the senior manager was not formally appointed as the sub-process owner, he exercised significant influence over the sub-process and had clout and credibility at the R&D department, which is in line with P-2 level. However, the senior manager solely allocated part of his time and personal goals to the studied sub-process. It was the manager officially appointed as owner of the sub-process the one who allocated all his time and personal goals. This is therefore only partially in accordance to P-3 level, which Hammer (2007) refers to as the process coming first for the “senior” process owner. Nonetheless, the senior manager was a member of the company’s most senior decision-making body, which is in line with Hammer (2007)’s description of P-4 level.

- **Activities.** Hammer (2007) described P-1 level as a process in which its owner identifies and documents its design and sponsors small-scale projects. The manager officially appointed as sub-process owner, in effect, set up small-scale projects when feasible improvements were found, and assigned employees to develop them further. He also identified the sub-process and its flow but he did not document it though. This, I argue, made the sub-process only partially attain P-1 level.

Further, the manager informed employees about future goals and changes. Together with the senior manager, they controlled and supported the implementation of change initiatives. This
is in accordance to P-2 level, which Hammer (2007) defined as when the process owner articulates the process’s performance goals and a vision of its future, and sponsors redesign and improvement efforts. To reach P-3 level, Hammer (2007) emphasized that the process owner works with other process owners to integrate processes to achieve the enterprise’s goals. The manager in the studied sub-process regularly met with the senior manager and another manager of other logistics process to plan common future courses of action, which is in line with P-3 level. The senior manager, moreover, participated in enterprise-level strategic initiatives and developed long-term planning of the sub-process. Nonetheless, neither the manager nor the senior manager worked with suppliers of the sub-process to sponsor redesign initiatives, which made the sub-process partially achieve P-4 level.

- Authority. The manager officially responsible for the sub-process collaborated with the senior manager and together discussed possible improvements and the possibility to make changes in the sub-process. This differs from P-1 level, which Hammer (2007) distinguished as when the process owner can only encourage functional managers to make changes. However, neither the manager nor the senior manager could convene a redesign team and had control over the technology budget for the sub-process, as claimed by Hammer (2007) at P-2 level. They controlled and supported the implementation of change initiatives but it was another group at the R&D department who was responsible for convening redesign teams and controlling the technology budget. This prevented the sub-process from achieving P-2 level.

5.1.3.1 Degree of applicability of PEMM

Similar to the two previous enablers, the owner enabler provided a clear picture of the existing situation encountered in the studied sub-process. Nonetheless, the fact that Hammer (2007) referred to a single process owner in most of his statements precisely gave rise to certain confusion when analyzing the level of maturity of each dimension. This was due to the shared responsibility exercised between the manager and the senior manager over the sub-process. Especially, it was found that the higher the level of maturity that each dimension attained, the greater the manifestation of such a dichotomy and the more difficult it became to separate that double ownership. This became apparent in Figure 7 in next page, which illustrates the actual level of maturity of this enabler. Interestingly, there appears to be two dimensions that are colored against the natural sequence of maturity of the model (see yellow-framed statements coming before green’s at P-3 and P-1 level in identity and activities respectively).

In the identity dimension, the reason for this unnatural sequence can be attributed, in fact, to the ownership issues discussed above. This made P-3 level be colored in yellow while P-4 level in green, which may create some confusion. However, the fact that the senior manager was only “partially” dedicated to the sub-process does not mean that he could not belong to
the company’s most senior decision-making body. Thus, the sequence of levels of maturity in this dimension becomes comprehensible. In the activities dimension, the reason for the unnatural sequence of maturity simply concerns a specific activity that the manager did not perform (i.e. to document the sub-process). This did not entail any serious consequence in successive levels of maturity nor prevented the sub-process from attaining greater maturity, which did not influence the subsequent sequence of maturity in this dimension.

Overall, despite the complexities encountered in this enabler, the model allowed for deep discussions regarding the sub-process ownership. Each of the three different dimensions left room for a detailed analysis of the sub-process and showed to be adaptable to a reasonable extent to the original context of study. Even though the sequence of maturity may have created certain confusion at first glance, it does not point towards any issue regarding the applicability of the model to the studied sub-process. Rather, it suggests that the levels of maturity partially achieved does not represent any obstacle for the sub-process to achieve greater maturity.

![Maturity analysis of the owner enabler.](image)

### 5.1.4 Infrastructure

The infrastructure enabler is broken down into the following two dimensions: information systems and human resource systems.

- **Information systems.** The sub-process was supported by three fragmented legacy IT systems (or modules) that were set up on the basis of different sub-process’s and company’s needs. This is in line with P-1 level, which is defined by Hammer (2007) as a process that is supported by fragmented legacy IT systems. The fact of having three separate IT systems, not surprisingly, created time-consuming double-registrations of part information and sometimes led employees to produce mistyping errors. IT systems, in addition, were not able to calculate automatically any metrics from the sub-process, which needed to be calculated by employees manually instead. All this inevitably did not permit the sub-process to achieve P-2 level,
which is described by Hammer (2007) as a “single” IT system supporting the process that is constructed from functional components.

- **Human resource systems.** The manager responsible for the sub-process principally rewarded employees in relation to their working time, their suggestions for improvement, and the amount and type of training they took. This, I argue, is partially in accordance to P-1 level, where Hammer (2007) points out that managers reward the attainment of functional excellence and the resolution of functional problems in a process context. While employees were not rewarded by the attainment of functional excellence (e.g. they were not rewarded for neither delivering parts on time nor for best-in-class performance), they were however rewarded by the resolution of functional problems (i.e. when they made suggestions for improvement). This, I argue, made the sub-process only partially attain P-1 level.

To reach P-2 level, Hammer (2007) stressed that the process’s design drives role definitions, job descriptions and competency profiles, and that process documentation facilitates job training. In the studied sub-process, differently, the managers used one competency profile that did not completely adjust to the sub-process design. The sub-process design was comprised of three differentiated areas with three different defined roles. However, there was just one role definition, one job description and one competency profile for the overall three areas. This consequently prevented the sub-process from attaining P-2 level.

### 5.1.4.1 Degree of applicability of PEMM

The infrastructure enabler, in each of its two dimensions, was found considerably useful for studying all the relevant issues encountered in the IT systems and human resource policies of the studied sub-process. It was possible to analyze in detail its current state of maturity, which, not surprisingly, showed serious inefficiencies that the sub-process was actually struggling with (see Figure 8 below). Despite the low level of maturity achieved in each dimension, the model clearly reflected the reasons why the sub-process could not achieve higher levels. This helped to understand the complexity of the existing situation and gave indications of how it might improve. This, I argue, made the infrastructure enabler be largely adjustable to the sub-process under study.

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![Figure 8. Maturity analysis of the infrastructure enabler.](image-url)
5.1.5 Metrics

Similar to the previous enabler, the metrics enabler is divided into two dimensions: definition and uses.

- **Definition.** The sub-process had different metrics that provided a fairly clear picture of its performance. It was principally calculated the number of carriers that were coming to the warehouse, the inflow of parts that were stored in the warehouse and the number of orders sent from R&D to pick up the parts. The manager also controlled some cost metrics with respect to warehouse expenses and personnel costs. All these metrics, I argue, led the sub-process to attain P-1 level, which Hammer (2007) described as a process that has some basic cost and quality metrics. However, these metrics did not derive from customer requirements, as claimed by Hammer (2007) at P-2 level. Rather, they derived from each sub-process area, which prevented the sub-process from attaining P-2 level.

- **Uses.** Hammer (2007) described P-1 level as a process in which managers used its metrics to track its performance, identify causes of faulty performance, and drive functional improvements. In the studied sub-process, similarly, the manager principally used the metrics to track the sub-process’s performance. By measuring volumes of handled parts, he identified temporary performance trends and recognized reasons of faulty performance, which led him to reassign, when necessary, employees from one sub-process area to another. This, I argue, made the process attain P-1 level. Nonetheless, the manager did not use the metrics for neither comparing them to customer needs nor benchmarking purposes, which prevented the sub-process from achieving P-2 level.

### 5.1.5.1 Degree of applicability of PEMM

The model in this dimension provided a clear and comprehensive analysis of the sub-process in terms of the definition and uses of its metrics. Importantly, it allowed to identify where the metrics derived from and to what extent they were used, which allowed to measure the current state of maturity of the sub-process appropriately (see Figure 9 in next page). No dimension was particularly found inapplicable to the sub-process. Rather, both of them were fairly adjustable. In the same line as the previous enabler, however, the sub-process achieved low levels of maturity in each dimension. Nonetheless, it could be easily recognized and discussed the reasons for those low levels and identified signals of potential improvements from the model.
5.1.6 Summary comments

Hammer (2007) noted that the overall maturity level concerns the process enablers with the lowest maturity levels. Therefore, based on the maturity analysis conducted above, it can be said that the overall maturity level of the sub-process was relatively poor; P-1 on Hammer’s four point scale (see a complete maturity analysis in Appendix 2). This level is described by Hammer (2007) as a process that “(…) is reliable and predictable; it is stable” (p. 114). However, despite this low level of maturity, some dimensions achieved substantially higher levels than others. Specifically, it became apparent a clear difference, in general terms, between the dimensions of the first three process enablers (i.e. design, performers and owner) and the last two (i.e. infrastructure and metrics). This pointed out existing weaknesses affecting the sub-process, which will be addressed in the next section. In summary, the model allowed to clearly identify the maturity levels of the five process enablers in each of their different dimensions. Notably, it left room for analyzing and discussing existing complexities embedded in the sub-process, and showed a reliable face of its overall maturity level. This indicates that the model was appropriate to measure the sub-process maturity, which gave rise to identify potential improvement paths.

5.2 IDENTIFICATION OF IMPROVEMENT PATHS

One of the distinguishing features of maturity models in general, and the PEMM in particular, is their twofold aim of both analyzing current levels of maturity and providing guidelines to identify potential improvement paths (Hammer, 2007; Röglinger et al., 2012). After conducting a current maturity analysis, therefore, it remains essential to discern if feasible improvements can be identified from the PEMM to examine its complete applicability to the sub-process. In this section, thus, I intend to identify reasonable improvement paths that might situate the most affected dimensions of the sub-process in a higher level of maturity on Hammer’s scale. Note that these suggestions for improvement indicate gradual and logical steps and do not pretend to be exhaustive since it is not the primary objective of this research.
5.2.1 Dimensions and potential improvements

From the maturity analysis conducted above, it can be distinguished that 6 dimensions out of a total of 13 were at P-1 level. These were the following: documentation of design, authority of owner, IT systems, HR systems, and definition and uses of metrics. Since these dimensions were at the lowest level of maturity in the sub-process, they were prioritized and accordingly subject to study (see Figure 10 summary of suggestions for improvement paths in next page).

- **Documentation and HR systems.** With respect to the documentation dimension, it was found in the analysis that a written description of the entire sub-process design was lacking, which created uncertainty and lack of visibility for engineers and coordinators about the warehouse operations. This dimension, in fact, was closely tied to the HR systems dimension in which managers solely used one competency profile for hiring and training purposes. One probable cause for this was that the lack of documentation made it difficult for managers to clearly describe roles and competencies in each of the sub-process areas, as well as facilitate training. In this context, I argue that a documentation of the sub-process clearly showing the relations between activities, employees and IT systems was needed. This would be expected to dissipate uncertainty and non-visibility to engineers and coordinators while would provide useful information to managers upon which they could describe roles and competencies and base job training. This, in essence, would represent a feasible first step towards achieving P-2 level in the two discussed dimensions.

- **Authority of the owner.** The analysis of the owner enabler revealed that the managers did not have sufficient authority to neither convene a redesign team nor have control over the technology budget. This was due to the fact that another group at the R&D department responsible for technology developments was appointed for this. Hammer (2007), in this context, suggests that the process owner must have the authority to convene a redesign team and have control over the technology budget to reach P-2 level. Nonetheless, I argue that transferring authority drastically from the technology development group at the R&D department to the managers of the sub-process might be perhaps too radical. Rather, a closer collaboration and coordination between the two groups would favor a smooth implementation of changes in the sub-process. This would represent a reasonable approach to enhance the level of maturity of this dimension towards attaining P-2 level. However, it is worth noting that P-2 level would be solely achieved partially since authority would not be completely transferred to the managers.

- **Information systems.** It was discussed in the analysis that the sub-process was supported by three fragmented legacy IT systems (or modules) that caused important difficulties to employees and the sub-process itself. The fact that information was spread across separate systems also made the business and its day-to-day operations be fragmented too. This
indicated a clear need for a single, unified IT system that could replace the three aforementioned IT systems as well as display information clearly and calculate metrics automatically. This would avoid time-consuming double-registrations and possible mistyping errors, and would ultimately lead the sub-process to achieve P-2 level in this dimension.

- **Definition and uses of metrics.** An important weakness that was found in the analysis was the absence of metrics derived from customer requirements, which obviously did not allow to compare them to customer needs. To identify customer requirements, I argue that a feasible approach would be to gather perceptions and attitudes from sub-process’s customers (i.e. engineers and test coordinators at the R&D department). This would increase the managers’ understanding of customer needs and would permit to focus metrics and internal improvement efforts on them. This suggestion would illuminate the path to the sub-process towards attaining P-2 level in these two dimensions.

<table>
<thead>
<tr>
<th>Enabler</th>
<th>Dimension</th>
<th>Current maturity</th>
<th>Improvement path</th>
<th>Expected maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Documentation</td>
<td>P-1</td>
<td>Elaborate documentation that shows the relations between activities, employees and IT systems of the sub-process.</td>
<td>P-2</td>
</tr>
<tr>
<td>Owner</td>
<td>Authority</td>
<td>P-1</td>
<td>Closer collaboration and coordination between the technology development group and managers.</td>
<td>P-2 (Partially)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Information system</td>
<td>P-1</td>
<td>Single, unified IT system displaying information clearly and calculating metrics automatically.</td>
<td>P-2</td>
</tr>
<tr>
<td>Human Resource system</td>
<td></td>
<td>P-1</td>
<td>Elaborate documentation that shows the relations between activities, employees and IT systems of the sub-process.</td>
<td>P-2</td>
</tr>
<tr>
<td>Metrics</td>
<td>Definition</td>
<td>P-1</td>
<td>Gather perceptions and attitudes from sub-process’s customers to focus metrics on customer requirements.</td>
<td>P-2</td>
</tr>
<tr>
<td></td>
<td>Uses</td>
<td>P-1</td>
<td>Use defined metrics from customer requirements to compare them to customer needs.</td>
<td>P-2</td>
</tr>
</tbody>
</table>

*Figure 10. Summary of suggestions for improvement paths*
6. CONCLUSION

6.1 CONCLUDING REMARKS AND IMPLICATIONS

This paper aimed to explore a new perspective of the Hammer’s PEMM in relation to its degree of applicability to the scale of an individual sub-process. Through the study of an organizational sub-process in its real-life conditions, it was found that the PEMM was applicable to the studied sub-process in terms of its five process enablers. By taking the sub-process as point of reference and making the different dimensions of each process enabler revolve around it, the model provided a realistic framework for gaining a rich understanding of the existing complexities observed in the actual sub-process. Importantly, the model allowed for an in-depth maturity analysis and the identification of feasible improvement paths, which offered the potential to examine the sub-process in a detailed, yet comprehensible manner. Clearly the results evidence that the PEMM, which was demonstrated to be applicable to an individual process by Parkes and Davern (2011), is equally applicable to the level of an individual sub-process.

These findings represent a step forward towards understanding the practical applicability of the PEMM in an organizational setting and suggest important implications for both researchers and practitioners in the BPM field. The application of the PEMM to the studied sub-process highlights the analytical value of the model at the level of an individual sub-process. This sheds light on the broader scope of application of the model, which encourages researchers to develop extended maturity models adaptable not only to entire processes but also to individual sub-processes. This can be especially useful if the future contexts of application of these models are large-size organizational processes since assessing maturity at a sub-process level acquires greater importance. On the other hand, this paper also provides valuable insight for managers responsible for organizational sub-processes. Specifically, the findings obtained encourage them to put the model into practice in their efforts to identify potential deficiencies and search for improvement paths in their own sub-processes.

6.2 FURTHER RESEARCH

Although the results of this study are positive with respect to the broader scope of application of the PEMM, it can be questioned if similar results would be obtained in other sub-processes with different characteristics. Thus, the limitations of studying a concrete sub-process in a specific organizational setting raise important questions for further research. I see great potential to examine if the PEMM could be similarly applicable to other sub-processes with a portfolio of process enablers with differing maturity levels. More specifically, does any other ownership structure and/or design configuration of a given sub-process represent any obstacle
for the applicability of the model? More empirical studies exploring the PEMM would certainly broaden our existing understanding of the model and help to generalize the results beyond this study. Further research is also needed to explore the scope of application of other maturity models. In other words, do other existing maturity models also represent useful frameworks for assessing the maturity of individual sub-processes? More efforts directed towards studying the practical applicability of maturity models will help to understand the usefulness and potential of these models.
REFERENCES


APPENDICES


<table>
<thead>
<tr>
<th>P-1</th>
<th>P-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessing the Maturity of Your Processes</strong></td>
<td><strong>Hammer’s PEMM process enablers (Hammer, 2007).</strong></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>The process has not been designed on an end-to-end basis. Functional managers use the legacy design primarily as a context for functional performance improvement.</td>
<td>The process has been redesigned from end to end in order to optimize its performance.</td>
</tr>
<tr>
<td><strong>Context</strong></td>
<td><strong>The process’s inputs, outputs, suppliers, and customers have been identified.</strong></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td><strong>The documentation of the process is primarily functional, but it identifies the interconnections among the organizations involved in executing the process.</strong></td>
</tr>
<tr>
<td><strong>Performers</strong></td>
<td><strong>Knowledge</strong></td>
</tr>
<tr>
<td>Performers can name the process they execute and identify the key metrics of its performance.</td>
<td>Performers can describe the process’s overall flow; how their work affects customers, other employees in the process, and the process’s performance; and the required and actual performance levels.</td>
</tr>
<tr>
<td><strong>Skills</strong></td>
<td>Performers are skilled in problem solving and process improvement techniques.</td>
</tr>
<tr>
<td><strong>Behavior</strong></td>
<td>Performers have some allegiance to the process, but owe primary allegiance to their function.</td>
</tr>
<tr>
<td><strong>Owner</strong></td>
<td><strong>Identity</strong></td>
</tr>
<tr>
<td>The process owner is an individual or a group informally charged with improving the process's performance.</td>
<td>Enterprise leadership has created an official process owner role and has filled the position with a senior manager who has clout and credibility.</td>
</tr>
<tr>
<td><strong>Activities</strong></td>
<td>The process owner identifies and documents the process, communicates it to all the performers, and sponsors small-scale change projects.</td>
</tr>
<tr>
<td><strong>Authority</strong></td>
<td>The process owner lobbies for the process but can only encourage functional managers to make changes.</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td><strong>Information Systems</strong></td>
</tr>
<tr>
<td>Fragmented legacy IT systems support the process.</td>
<td>An IT system constructed from functional components supports the process.</td>
</tr>
<tr>
<td><strong>Human Resource Systems</strong></td>
<td>Functional managers reward the attainment of functional excellence and the resolution of functional problems in a process context.</td>
</tr>
<tr>
<td>The process’s design drives role definitions, job descriptions, and competency profiles. Job training is based on process documentation.</td>
<td></td>
</tr>
<tr>
<td><strong>Metrics</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>The process has some basic cost and quality metrics.</td>
<td>The process has end-to-end process metrics derived from customer requirements.</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>Managers use the process’s metrics to track its performance, identify root causes of faulty performance, and drive functional improvements.</td>
</tr>
<tr>
<td>Managers use the process’s metrics to compare its performance to benchmarks, best-in-class performance, and customer needs and to set performance targets.</td>
<td></td>
</tr>
</tbody>
</table>
that aren’t impeding the process’s progress; the yellow ones show areas where the company has a lot of work to do; and the red cells represent obstacles to the process’s attaining greater maturity.

The colored table to the right shows the results of such an exercise at a large U.S. company. In this case, the context of the process design and the performers’ knowledge are the roadblocks to the process’s attaining the P-1 level.

At www.hbr.org, you can download a blank version of this table to assess the state of your company’s processes.

<table>
<thead>
<tr>
<th>P-3</th>
<th>P-4</th>
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</thead>
<tbody>
<tr>
<td>The process has been designed to fit with other enterprise processes and with the enterprise’s IT systems in order to optimize the enterprise’s performance.</td>
<td>The process has been designed to fit with customer and supplier processes in order to optimize interenterprise performance.</td>
</tr>
<tr>
<td>The process owner and the owners of the other processes with which the process interfaces have established mutual performance expectations.</td>
<td>The process owner and the owners of customer and supplier processes with which the process interfaces have established mutual performance expectations.</td>
</tr>
<tr>
<td>The process documentation describes the process’s interfaces with, and expectations of, other processes and links the process to the enterprise’s system and data architecture.</td>
<td>An electronic representation of the process design supports its performance and management and allows analysis of environmental changes and process reconfigurations.</td>
</tr>
<tr>
<td>Performers are familiar with fundamental business concepts and with the drivers of enterprise performance and can describe how their work affects other processes and the enterprise’s performance.</td>
<td>Performers are familiar with the enterprise’s industry and its trends and can describe how their work affects interenterprise performance.</td>
</tr>
<tr>
<td>Performers are skilled at business decision making.</td>
<td>Performers are skilled at change management and change implementation.</td>
</tr>
<tr>
<td>Performers strive to ensure that the process delivers the results needed to achieve the enterprise’s goals.</td>
<td>Performers look for signs that the process should change, and they propose improvements to the process.</td>
</tr>
<tr>
<td>The process comes first for the owner in terms of time allocation, mind share, and personal goals.</td>
<td>The process owner is a member of the enterprise’s most senior decision-making body.</td>
</tr>
<tr>
<td>The process owner works with other process owners to integrate processes to achieve the enterprise’s goals.</td>
<td>The process owner develops a rolling strategic plan for the process, participates in enterprise-level strategic planning, and collaborates with his or her counterparts working for customers and suppliers to sponsor interenterprise process redesign initiatives.</td>
</tr>
<tr>
<td>The process owner controls the IT systems that support the process and any projects that change the process and has some influence over personnel assignments and evaluations as well as the process’s budget.</td>
<td>The process owner controls the process’s budget and exerts strong influence over personnel assignments and evaluations.</td>
</tr>
<tr>
<td>An integrated IT system, designed with the process in mind and adhering to enterprise standards, supports the process.</td>
<td>An IT system with a modular architecture that adheres to industry standards for interenterprise communication supports the process.</td>
</tr>
<tr>
<td>Hiring, development, reward, and recognition systems emphasize the process’s needs and results and balance them against the enterprise’s needs.</td>
<td>Hiring, development, reward, and recognition systems reinforce the importance of inter- and interenterprise collaboration, personal learning, and organizational change.</td>
</tr>
<tr>
<td>The process’s metrics as well as cross-process metrics have been derived from the enterprise’s strategic goals.</td>
<td>The process’s metrics have been derived from interenterprise goals.</td>
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<tr>
<td>Managers present the metrics to process performers for awareness and motivation. They use dashboards based on the metrics for day-to-day management of the process.</td>
<td>Managers regularly review and refresh the process’s metrics and targets and use them in strategic planning.</td>
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APPENDIX 2. Summary of maturity analysis of the material handling process.

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<td><strong>Design</strong></td>
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<td>Purpose</td>
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<td>Context</td>
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<td>Documentation</td>
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<td>Authority</td>
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<td><strong>Infrastructure</strong></td>
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<tr>
<td>Information Systems</td>
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<tr>
<td>Human Resource Systems</td>
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<td><strong>Metrics</strong></td>
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<td>Definition</td>
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<tr>
<td>Uses</td>
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</tbody>
</table>

- Green: In line / in accordance to / *differ
- Yellow: Partially / in part
- Red: Did not permit / prevent