The Logistic Maturity Model: guidelines for logistic processes continuous improvement

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Abstract: This paper presents a Logistic Maturity Model. The goal is to provide companies with a system that allows both to assess their logistic processes current status and to outline an action plan for improvement, considering four key elements: Modeling Framework, Maturity Framework, Performance Framework and Improvement Systems.

Keywords: Maturity Model; Performance; Best Practice; Improvement System.

Introduction

A business process oriented organization (BPO) gives a great dynamism to enterprises, and consequently a better answer to any possible external change, and confers a better control on the business performance (Hammer, 1999) (CMMI Product Team, 2010).

In literature, many authors point out a clear relationship between the adoption of an *organizational structure* focused on the processes and the progressive increase of the business performance in terms, for instance, of increase of profit, increase of the customer service, decrease of delays, errors and incomprehension (McCormack, 2004) (Netland, Alfnes, & Fauske, 2007). The same studies show as the effectiveness of a BPO organizational structure results to be tightly related to the presence and interaction of three key elements:

- Process Maturity System - framework to evaluate the maturity level of the business process through the definition of true criterions of analysis and classification;
- Process Measurement System - framework for the performance monitoring of the processes through the definition of a suitable system of indicators;
- Process Improvement System - framework to define a list of optimization measures of the business processes, in order to reach a continuous improvement.

There is a plenty of examples that show how researchers and industrial managers focused, in the last ten years, on the development of a framework able to define the firm maturity level in order to help the management to identify the main solution to tune business processes.

The idea of Model of Maturity finds its bases in software engineering: in 1993 the Software Engineering Institute (Six) of Carnegie Mellon University, Pittsburgh (USA), planned the first Capability Maturity Model (CMM), developing a standard process in order to assess the level of

quality of IT organizations, through the analysis of performance levels of software development process.

This model was developed in order to give, as output, something called “improvement road map”: steps of evolution that the firm should follow to upgrade from a level of immaturity in the software processes, to a better management of them, with the consequent increase of quality service, saving time and costs.

The success of this model brought to the proliferation of many new CMMs for different business areas. A huge fragmentation that pushed SEI to start a project of synthesis of the existing models by realizing in 2002 an extensible unique framework - the Capability Maturity Model Integration (CMMI) - that is, by now, the main benchmark in the research of the Models of Maturity (Turner, 2002).

According to statistics published by SEI in 2009, the application of such methodology of analysis and optimization of the processes recorded an exponential growth in the last years with interventions from all over the world and extremely positive results: by the introduction of a CMMI project, SEI declared that the test-firms recorded a 34% average reduction of costs, an average increase in productivity around 61% and a 400% increase of the ROI.

As to these results, many authors put their own attention on the development of new models of maturity focused on specific sectors: from the Information Technology (Gibson & Nolan, 1974) (Crosby, 1979) (Radice, Harding, Munnis, & Phillips, 1985) (Software Engineering Institute, 1995) (CMMI Product Development Team, 2000) (CMMI Product Team, 2007) (CMMI Product Team, 2010) (CMMI Product Team, 2002), to the project management (PMI, 2003) (Kerzner, 1998) (Bourne, 2007), to the health (Wetering, 2009) (Staggers, et al., 2011), to the knowledge management (Klimko, 2001) (Ehms & Langen, 2002) (Kochikar, 2000), to the supply chain management (Johnson & McCormack, 2003) (McCormack & Lockamy III, 2004) (Srai & Gregory,

2005) (Hunsche, 2006) (Netland, Alfnes, & Fauske, 2007) (Bolstorff & Rosenbaum, 2007) (Kauremaa & Suzuki, 2007) (Lambert, 2008) (Supply Chain Council, 2010) (Garcia & Giachetti, 2010). Nevertheless, in some studies that praise and apply the Models of Maturity as tools of analysis and optimization of the business processes, there are some important limits that don't allow their diffused affirmation in the industrial level, especially in the logistics (Valadares, Ladeira, & McCormack, 2005):

- lack of a framework able to incorporate an identification methodology of the qualitative and quantitative relationships among the business performance indicators (KPI), the strategic objectives and the improvement actions to be undertaken in the proper area of process (Valadares, Ladeira, & McCormack, 2005);
- no easy use of the existing frameworks in industrial process, because of the low flexibility of the modeling architecture of the business logistic processes (Garcia & Giachetti, 2010);
- hard understanding by the consumers of the criterions of process modeling and of evaluation of the level of maturity (Visconti & Cook, 1998);
- lack of a holistic framework able to incorporate a global vision of the business logistic processes, caring about direct and indirect points of contact (Netland & Alfnes, 2008).

This article is about a Model of Maturity for Logistic Processes - defined LMM - with the aim to support the enterprises to understand the more critical areas of process in terms of "immaturity", improvement and the right actions to be undertaken for increasing the performances. The model is in phase of validation. A famous Italian firm of female fashion is adopting the LMM as a guide line for the management and optimization of its logistic supply chain.

The Logistic Maturity Model structure

LMM focuses on the business logistic processes, the processes useful to plan, manage and check the flow of raw materials, of finished goods and their informative flows from the place of origin to that of consumption. LMM works as a *specific maturity model*: likewise to the Capability Maturity Model, developed in development software range, LMM focuses, for instance, on the specific dominion of logistics.

In this way we have to exclude the processes of human resources management, project management or knowledge management. Processes that, crossing the different business sectors, are examined inside the *general maturity model*.

Therefore, LMM aims to appraise the maturity of inside and external logistics of an organization: the possible processes of production developed by the firm are not considered as much as the processes related to the sales management and clients assistance have been excluded. Finally it was decided not to consider, in this first version of LMM, the reverse logistics aspects: at the end of the phase of deploy, it is foreseen a further extension of the model finalized to the inclusion of such area.

Related to the main problems due to the analysis of the state of the current maturity models in logistic area, the following architecture is proposed for the LMM (Figure 1):

I. *Modeling Framework* - logistic processes reference model;

II. *Maturity Framework* - business maturity measurement system;

III. *Performance Framework* – performance measurement system;

IV. *Improvement System* - Best Practice system finalized to the processes continuous improvement.

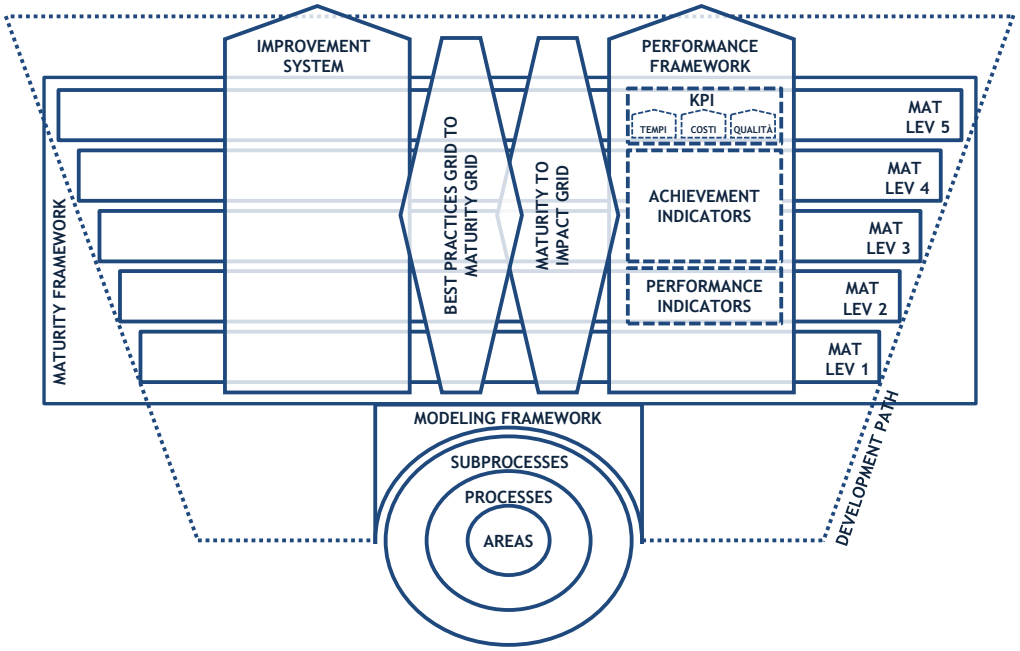


Figure 1: LMM Architecture

LMM is based on a modeling framework planned on more steps of processes aggregation. At the first level there are four Logistic Areas, each of them is split in more processes/subprocesses by a multilevel tree structure. On the first level we decided to apply a remake of the classification proposed by SCOR identifying four Logistic Area (Table 1). Every Logistic Area has been divided in processes of second and third level (Table 2).

SCOR	LMM	Description
Plan	Plan	Processes about demand planning
Source	Source	Processes about procurement planning, identification and selection of the suppliers and operative management of procurement orders
Make	Storage	Processes about stock management, in/out warehouse flow control, storage areas management and goods transportation management
Delivery	Distribution	Processes about shipment planning and transport management
Return	**N.A.**	**N.A.**

Table 1: SCOR – LMM Comparison

LA	Liv	Processes	ID Code	Relational code
LA0	2	Demand Planning	PD	P0.1
LA1	2	Suppliers management	GF	P1.1
	2	Procurement orders mgmt.	GO	P1.2
	2	Procurement planning	PA	P1.3
	3	Procurement batch setting	LA	P1.3.1/P2.1.2
	3	Procurement batch timing	TA	P1.3.2/P2.1.3
LA2	2	Inventory Management	IM	P2.1
	2	Inventory Control	IC	P2.2
	2	Warehousing	WH	P2.3
	2	Material Handling	MH	P2.4
	3	Shipment batch setting and timing	TLS	P2.1.1/P3.1.1
	3	Procurement batch setting	LA	P2.1.2/P1.3.1
	3	Procurement batch timing	TA	P2.1.3/P1.3.2
LA3	2	Shipment planning	PS	P3.1
	2	Transport mgmt.	GT	P3.2
	3	Shipment batch setting and timing	TLS	P3.1.1/P2.1.1

Table 2: LMM Modeling Framework Processes

Every process/subprocess must go with four informative elements:

- *objective* - informative element related to the description of the area of reference;
- *activity* - informative element useful to the description of the principal activities characterizing the process. Such information results to be very important in the first steps of implementation of LMM inside an organization because it helps to draw a map between the true business processes and LMM's ones;
- *correlated processes* - informative element useful to weigh up of the degree of correlation between the processes of the model. In particular, the link between the different processes is based on the number of shared Achievements (AC): the

correlation is as stronger as high is the number of shared aims. Such information can support the management in the choice, other external conditions being equal, of the process area where prioritily the attention should focuses: to improve the degree of maturity of a strongly connected process with the other ones, asks a better increase of the maturity of the whole logistic system;

- *control dashboard* – informative element useful to find the principals Control Indicators of the performance. The information can support the management in monitoring and evaluating the reached performances.

To every process is associated a maturity method assessment based on a 5-level staircase of maturity: from an initial and no-structured state - level 1 - to a standardized and optimized one - level 5 (Figures 2). The degree of maturity of the process is connected to the number of reached Achievements, that is the number of satisfied objectives for every level of maturity.

Therefore a first step of analysis is given by checking the level of maturity through the control of the Achievements that should be reached in a certain process and of those reasonably attainable in the future. The implementation of LMM in a firm will allow the management, therefore, to know the profile of maturity of every single sub-process, process, logistic area or whole logistic system. The model proposes a *maturity profile* for every planned degree of aggregation in the Framework of Modeling.

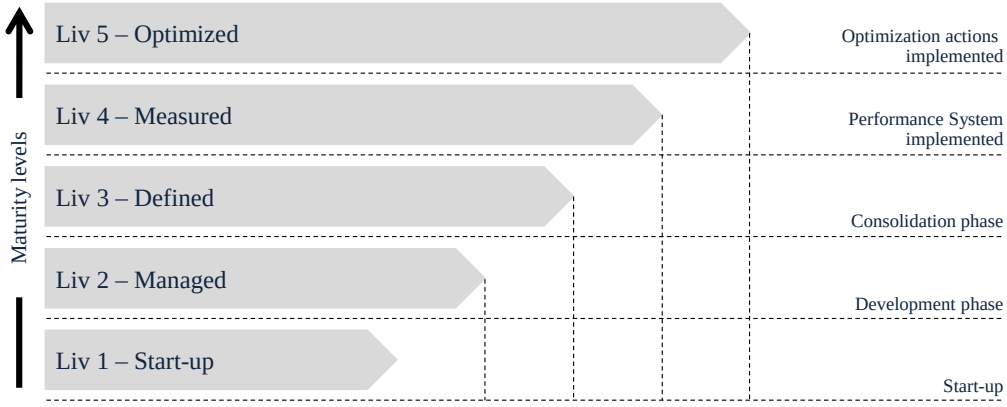


Figure 2: LMM Maturity Framework

Every Achievement, besides, is related both with specific Best Practices (Improvement System), that list the methods to achieve a particular objective, and with different Indicators of Performance categories, according to the reference maturity level. For this reason we propose three classes of indicators:

- *Performance Indicator (IP)* – Indicators connected to Achievements related to the second maturity level. The IPs show the standards that can be used to monitor the performance after reaching the goal;
- *Achievement Indicator (AI)* – Indicators connected to Achievements related to the third and fourth maturity levels. The AIs show the standards that can be used to monitor the level of attainment of the goal*;*
- *Key Performance Indicator (KPI)* – Indicators connected to Achievements related to the fifth maturity level. The KPIs show the key standards that can be used to monitor the performance after reaching the goal.

Best Practices and Indicators are therefore referable to a process, but not necessarily to only one. That is why we created a net of indicators that contributes to explain how to reach the desired performances. The integration inside the LMM of a framework of evaluation of the performance introduces three main goals:

- support the management to find out the main indicators of performance in every process;
- support the management to pick out, for every strategic/ tactical / operational objective, the right KPIs in order to measure the increase of performance in gaining the planned goal;

- support the management to single out the concerning KPIs of each Best Practice, that allow to measure the increase of performance from the implementation of a specific action of intervention.

The attainment of the three goals above listed, implicated a four level integration:

- definition and settlement of the relationships between processes/subprocesses and KPI to support the firm in a preliminary detection of the areas where, assuming an indicator to be improved, it is necessary to focus on;
- definition and settlement of the relationships between Achievements and KPI realizing some charts (Impact Grid) in order to define the positive or negative impact when an Achievement is reached according to the different identified KPIs;
- definition and settlement of the relationships between Best Practice and KPI through charts (BP List and BP Maturity Grid) with aim to associate to every KPI the relative action of intervention, in order to increase the performances;
- definition and settlement of the links among KPI with the aim to build a net and formalize the dependence between the different indicators.

We have identified six kinds of connection, four relational and two causal:

- *very strong direct/inverse bond (relational)* – by two indicators KPIi and KPIm, there's a mathematical formula like KPIi = f(x) leading to KPIm ∈ f(x). Increase/decrease of KPIm determines, being equal the other terms of f(x), an increase/decrease of KPIi. We can see, for example, two KPIis: Percentage of storage costs on turnover (KPI 2) and Value of fixed assets in stock (KPI 51). We can put KPI 2 as a function of KPI 51, and vice versa. Besides, if we increase KPI2/KPI51 we also see KPI51/KPI2 increasing. In such a way, the two KPIs show a very strong direct bond.

- *strong direct/inverse bond (relational)* – by two indicators KPIi and KPIm, such as KPIi = f(x) and KPIm = g(y) there is a variable Ω such as Ω ∈ f(x) and Ω ∈ g(y), whose variation, being equal the other terms belonging to f(x) e g(y), determines an increase/decrease both of KPIi and KPIm. We can consider, for example, two KPIs: average balance of products (KPI 39) and Value of fixed assets in stock (KPI 51). When we increase the number of units stored in the warehouse, we can observe an increase both of the average balance of products and the value of fixed assets in stock. In such a way, the two KPIs show a strong direct bond.

- *weak direct/inverse bond (causal)* – by two indicators KPIi and KPIm, such as KPIi = f(x) and KPIm = g(y) there is no mathematical formula or variable linking the two indicators. An increase/decrease of KPIi could determine an increase/decrease of KPIm only under specific conditions. We can see, for example, two KPIs: Percentage of non-conforming procurement orders (KPI 7) and Percentage of reworked procurement orders (KPI 6). An increase of the number of non-conformed orders could determine an increase of reworked orders, if the firm decides to ask the supplier a further order. In such a way, KPI 7 is bond to KPI 6 by cause-effect: the two KPIs show a weak direct bond.

From the analysis of the relationships it was fixed, for every indicator, the corresponding degree of incidence, or the degree of connection with the other indicators fixed in the model. In order to gather in this index the three typologies of links above described (very strong, strong and weak) it was attributed to every kind of relationship a different weight: weak, strong, very strong.

So, the degree of incidence of a KPIi, for instance, was calculated as a weighted average of the number of indicators linked to it. This allows to support the firm in choosing the priority tasks to

start: an improvement of an indicator of another degree of incidence involves a more rapid and consistent improvement of the whole logistic system(Appendix A).

So the LMM structure allows the firm:

- appraising its own degree of maturity on a specific process/subprocess – by comparing itself with the reached Achievements, it is possible to value the reached degree of competence, the chance of improvement and above all if the improvement really contributes to pursue the business strategic goals;
- coming down in the net of indicators - considering a KPI that the firm wants to improve, it can be determined on what further indicators it is possible to act and, finding them again in Processes/subprocesses, select areas that need a focus or which are the Best Practices to implement;
- appraising the chance to adopt/determine Practices – starting from a specific methodology suggested by external suppliers, it can be easily understood on which areas and which indicators will impact (also understanding the collateral effect on other indicators in other areas) and if it is useful to pursue the improvement of the KPIs of our interest.

Conclusion

This article proposes a Model of Maturity for Logistics Processes. It aims to support the firms in the management and optimization of the processes in order to continuous improvement of the performances. One of the greatest problems for the management is, indeed, to find the main causes of a possible low level of performance: a decrement of clients service level could be connected to an inefficient management of supply from the retailers, as to a not suitable system of distribution of

the products inside the supply chain, or could be also due to delays in the phase of the procurement of raw materials. This Logistic Maturity Model allows to:

- value the degree of maturity on one or more process Areas;
- identify the most proper actions to increase specific indicators of performance;
- value the opportunity to implement determined BP in order to increase the level of maturity reaching an AC of higher level;
- understand the direct or inverse correlations between different indicators of different Areas of process, for a complete vision of the impacts of any action of improvement.

LMM was planned with the aim to overcome the limits of the Models of Maturity proposed in literature within the Supply Chain Management. Through a critical analysis of the main Maturity Models developed since 1999 up today in fields similar to logistics one, we identified and refined the hinge elements that prevented from a suitable diffusion in business circle. LMM integrates four different systems:

- a reference model of the logistic processes (Modeling Framework);
- a business maturity measure system (Maturity Framework);
- a performance measure system (Performance Framework);
- a Best Practice system for a continuous improvement of the processes (Improvement System).

The whole business area related to logistics was planned on four Logistic Areas, each of one was actually divided in processes and subprocesses to reach the proper level of detail. Inside every process we defined specific Achievements, such as goals to reach, determining the level of maturity of the firm in the analyzed area.

So, a first step of analysis is given by the evaluation of the level of maturity through the control of the Achievements to reach in a specific area, and of those achievements that could be reached (Achievements target). In the specific case, LMM is based on a 5 level staircase of maturity: from an initial not structured level (level 1) to the optimized one (level 5), according to the most accredited standard among the Maturity Models. Every Achievement is, besides, connected both with determined Practices and with specific indicators of performance: Practices and Indicators are therefore related to a Process Area but not necessarily to one only. In this way the result is a net of indicators that contributes to explain how to reach the desired performances, and this represents an element of absolute innovation. According to the previously defined architecture we pointed out four Logistic Area:

- Procurements
- Planning
- Storage
- Distribution

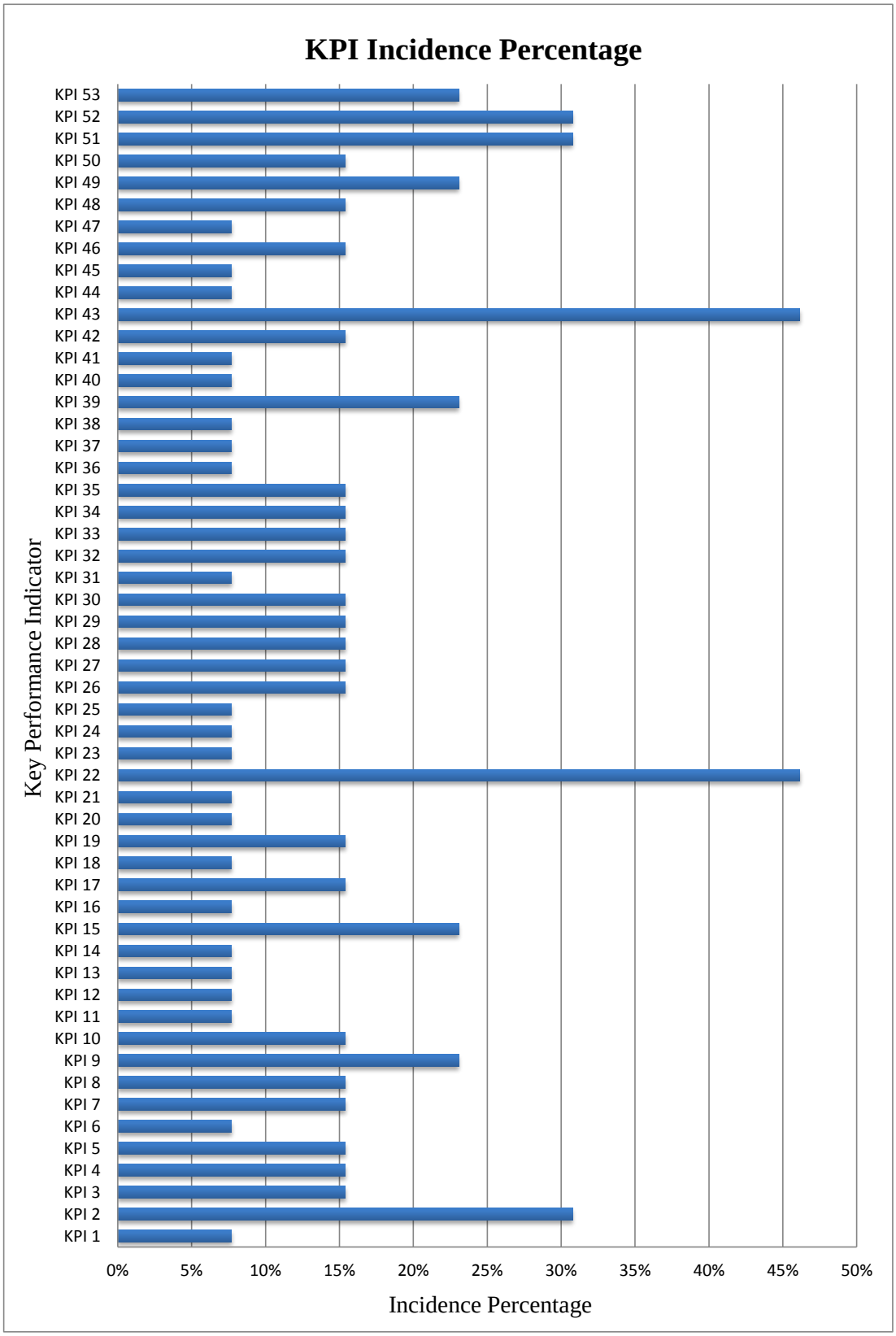
Each area was divided, according to a tree structure, in three or four processes/subprocesses. For every area / process / subprocess and for every level of maturity we have identified around 5 Achievements, with 2-3 indicative of performance and 1-2 connected Practices. The proposed LMM introduces a total of 249 Achivements, 46 Performance Indicator, 27 Achievements Indicator, 53 Key Performance Indicator and 252 Best Practice. Every KPI can be connected to more Achievements of different Process Areas so creating a deeper net of relationships. It was studied defining and formalizing three kinds of links among the KPIs (very strong, strong and weak) allowing the firms to understand the impacts in terms of performance of a specific action.

The future of the search activity on this subject could aim to three goals :

- the extension of the Modeling Framework including the reverse logistic;
- the development of a benchmark system of business performances, comparing them with the ones of the corresponding sector of activity;
- the development of a measure system of the business maturity with achievements weighted by the sector of activity.

Such extensions will allow to support the firms in a continuous and constant evaluation of their own position in comparison with the main competitors, allowing to quickly and effectively adjust strategies according to the course of markets in continuous transformation.

Appendix A


KPI Incidence Percentage
Key Performance Indicator
KPI 53
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KPI 1
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
Incidence Percentage

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