Lean Production implementation: a survey in Italy

Alberto Portioli Staudacher, Marco Tantardini

Department of Management, Economics and Industrial Engineering, Politecnico di Milano. Piazza L. da Vinci 32, 20133 Milano, Italy. alberto.portioli@polimi.it, marco.tantardini@polimi.it

Abstract

European companies can beat competition from low cost countries only through innovation, and large investments are devoted to R&D to improve products and processes. But this is not enough. Organisational and managerial innovation lever must be exploited too. Typically, some 40-70% of total activities companies carry out are waste because don't add value to the customer.
Lean production focuses on waste reduction to improve operations' performances.
Despite many firms report large benefits from lean implementation, a lot of scepticism still remains regarding attainable results and on the possibility to apply Lean approach outside high volume manufacturing. This is particularly true in Italy, where SMEs competing on high variety and customization are a dominant portion of the manufacturing industry .
Therefore a survey has been implemented to better understand Lean Production approach and implementation, because it appear to be quite an effective organisational and managerial innovation, as many Lean implementer can testify. But, Lean Production is a trick easy approach, because it appear easy to understand and implement, but it is not. And the number of companies that achieved no significant improvement is quite large. Therefore a survey has been designed and carried out, in order to deepen the knowledge and help companies that started a Lean implementation, or are considering to do so, in achieving best results. 60 Lean implementer and 45 Non Lean Implementer have been surveyed, out of companies of any manufacturing industry, with at least 100 employee.
Due to space limitation, only a small portion of the results can be presented in this paper. Future papers will present other results and comparisons with the results of other surveys. Besides, the same survey is about to be conducted in other European countries, allowing a much larger respondent sample and a comparisons among different countries.

Keywords: Lean production, survey, Italian Manufacturing firms

1. Introduction

European companies are facing the most important competitive challenge since the second world war. It is well known that they can stay ahead of low cost countries' companies only through innovation. Large investments and attention are devoted to technology innovation, but this is not enough: organisational and managerial innovation is an additional lever, that must be exploited. Most companies have 40-70 % of total activities carried out, which do not add value to the customer. These activities are waste, and competitive advantage can be achieved through waste reduction (Ohno, 1988 , Womack and Jones, 1996)

Lean Production (LP) is the approach of the Toyota Production System, and focuses on waste reduction to improve operations' performances.

Despite Toyota's amazing performances, and a number of cases reporting large benefits from lean implementation, a lot of scepticism still remains regarding results that could be really achieved and on the possibility to apply Lean approach outside high volume manufacturing. This is particularly true in Italy, where SMEs are a dominant portion of the manufacturing industry, and mainly compete on large variety and high customisation.

Moreover, even if a lot of successful Lean programmes are known, many other Lean programmes failed. So an increasing number of companies and organisations are interested in better understanding Lean Production. In particular, we found a need to deepen the knowledge on results achieved in improving different performances, on how to maximise benefits from Lean implementation, and most common difficulties faced by companies implementing LP.

In order to answer these and other questions a survey has been designed and performed, involving more than one hundred companies.

The reminder of the paper is organised as follows: in section 2 a brief literature review is presented mentioning existing surveys having similar or related objectives; section 3 describes the survey and the procedure followed to perform it. Section 4 presents main results of the survey with an interpretation and a comment. Finally, conclusions and future developments are presented in section 5.

2. Literature review and objectives of the research work

Over the last decade a number of surveys have been presented. The ones most related to our research work are briefly presented next, in chronological order, highlighting their scope and objectives.

Sohal & Egglestone (1994) present a telephone survey of 42 Lean implementers, were they investigate to what extent LP has been implemented in Australian organizations. They also seek to identify the benefits from LP implementation, and investigate the structural changes taking place as a result in the implementation. Finally they present future trends in Lean production.

Panizzolo (1998) presents 27 interviews to Lean implementers, with the main scope to understand how much firms are doing on various Lean improvement programmes and to understand which are the most used and applicable.

White et al. (1999) investigate LP implementation differences between a set of 174 U.S. small manufacturers (with less than 250 employees) and one of 280 U.S. large manufacturers (with more than 1000 employees) in order to understand to what extent LP techniques have been implemented, and the relationships between implementation status of 10 specific LP management practices and associated changes in performance in the two groups of manufacturer.

Interviewing 14 companies and deepening 3-case studies, Lewis (2000) investigates the impact of LP implementation on overall competitive position of the company and overall business performances after Lean implementation. The paper argues that lean production can underpin competitive advantage if the firm is able to appropriate the productivity savings it creates.

In their work, Shah & Ward (2002) try to understand, in a total of 1757 respondents, how firm size, age and unionization degree affect effort needed for Lean implementation and necessary effort in achieving improvements. Research goal is also to understand if Lean bundles implementation have positive effects on operative performances. Authors use Total Productive Maintenance (TPM), Human Resources Management (HRM), Just in Time (JIT) and Total Quality Management (TQM) as estimators of LP implementation. At the end of the article, differences between discrete and process productions are analyzed too.

Wu (2003) surveyed a total of 103 American first tier automotive suppliers with more than 100 millions $ in annual sales, with the aim to understand whether significant performance /

practice differences exist between lean suppliers and non-lean suppliers. In particular, he tries to understand if, even given the same organizational constraints and resources, lean suppliers gain significant competitive advantages over non-lean suppliers in production systems, distribution systems, information communications, containerization, transport systems, customer-supplier relationships, and on-time staging/delivery performance.

56 Egyptian LP implementers and 38 Egyptian firms considering LP implementation are then considered by Salaheldin (2005) to delineate the major human modifications to be undertaken prior to LP implementation in Egyptian manufacturing firms; to discern benefits obtained from Lean Production implementation; to identify the problems that Egyptian manufacturing companies typically encounter in implementing Lean philosophy; and to explore the relationship between human modifications efforts to be undertaken prior to Lean implementation and Lean success.

Achanga et al. (2006) presents the critical factors that constitute a successful implementation of LP within manufacturing SMEs. A combination of comprehensive literature review and visits to 10 SMEs based in the East of the UK were employed in the study. Companies practices were observed to highlight the degree of LP implementation within these companies. Then LP critical factors determining a successful Lean implementation within SMEs environment are captured and the authors provide SMEs with indicators and guidelines for a successful implementation of Lean principles.

Bonavia & Marin (2006) provide a view of the ceramic tile industry in Spain. In particular, main objective of the 76 visits to companies was to assess the extent to which the ceramic tile industry in Spain uses LP practices. In addition, effects that the most relevant Lean Production practices have on operational performance are other desirable objectives too. To reach the goals, they try to investigate which are the most used LP practices in this sector, if larger firms have installed LP practices to a higher degree than smaller ones and if companies that adopt a LP practice to a greater extent obtain better results in terms of quality, productivity, lead time or stocks.

Aberdeen Group, The Manufacturer and The Manufacturing Research Centre perform frequent Lean surveys in UK and USA, and present evolution of lean implementation in those countries.

The different surveys above mentioned address different issues showing that there are still many unclear points about LP implementations. Moreover, while UK and USA have some systematic survey, other countries have much less empirical evidences.

The aim of this research work is to investigate Lean implementation in Italy and set the basis for a better understanding of LP. Both at a strategic level, and at an operational level, addressing techniques and single performance.

This work also aims to build the basis for an international comparison, based on the one hand on already existing research work, on the other hand on the extension of the survey to other European countries. In particular, a comparison between Lean Implementers (LI) and Non Lean Implementers (NLI) is performed, testing whether there are differences in external perception (competitive priorities), internal perceptions (main problems), and key improvement actions / tools.

The research work also wants to understand what performances are improved by Lean implementation, and if performances improve over a number of years, or rather level after

initial success. Finally, the research work wants to uncover the main difficulties and obstacles to LP implementation.

3. Research model and methodology

Two different questionnaires have been designed: one for Lean Implementers (LI) and one for Non Lean Implementers (NLI). Each one of two surveys is divided in two parts: the first part is common, the second part is specific for LI and NLI.

Part one, analyses critical market requirements and the strategic goal so reflects strategic goals of the firm. Investigate the major problems that are limiting the firm in reaching the objectives that customers are highlighting, and tries to understand which actions are taken to overcome highlighted problems and reach the strategic objectives. It analyses as well which of the Lean techniques are currently known, which are in use, which are considered not important, and which are planned for the future. First part ends by asking the knowledge level about LP.

In the second part the main goals are to understand the maturity degree of Lean implementation, the performance level reached, the level of satisfaction and difficulty encountered in adopting Lean concepts, main advantages and barriers encountered, the time needed to gain advantages, which are the most important factors that make this implementation a success.

In addition other understanding items are the Lean organizational structure and the resources involved in the Lean implementation. Presently and in the future. In which non manufacturing areas of the company it is possible to implement the Lean approach as well as what are next steps to push forward lean implementation.

Survey ends asking an estimation of the percentage of companies that are implementing LP in the same industrial sector as the respondent, the present development trend and what are the main questions they have regarding the Lean approach.

The survey part two, addressed to NLI, tries to understand why they don't implement LP. Non-Lean firms are asked to answer 12 questions both multiple choice and open questions and are asked to answer about their opinions about LP. Why they don't adopt Lean principles, where, within the company, Lean concepts could be applicable, what are the possible advantages they relate with Lean production, what are Lean characteristics that should make easier the implementation in the firm and what are the barriers they presume they could experience when adopting Lean principles.

Firms are asked about any intention of applying LP in the future, and what will probably push them towards implementing LP (internal necessities, suppliers, customers, etc.).

At the end of questionnaire they also are requested to estimate the percentage of LI in their own industrial sector and the current trend in LP implementation (decreasing, increasing, strongly increasing). Respondents are also invited to specifically request what are the items and characteristics of Lean production they are interested to analyse further.

Having taken into consideration existing surveys, a part of the answers is easily comparable with those of other surveys (e.g. UK or USA). This will allow to analyse differences between Italian companies and companies in other countries, in terms of Lean maturity in firms, industrial sectors, knowledge and use of various techniques, etc..

The survey has been developed according to the following phases:

After the concept phase (January 2007) in which questionnaires were created, a validation phase (beginning February 2007 – mid February 2007) was conducted visiting 5 companies and discussing the questionnaire with the Operations manager. This allowed us to check that the questionnaire output would have answered most relevant questions of Operations Managers, and that the questionnaire was not ambiguous.

A lot of suggestions came out; in addition a better understanding of current situation of Lean manufacturing in Italy did arise. Taking into consideration all findings, the questionnaire has been fine tuned accordingly.

Third phase, sample creation phase, was ran simultaneously with firms' contact phase.

Firms to be contacted were selected among already existing contacts, and new ones were added searching on the web. Firms received a preliminary phone call to introduce the project and to understand who could be the best person to answer the questionnaire. A subsequent e-mail addressed such person to the web link where they could find and fill the on-line form.

Phase three and four were ran from mid February 2007 to mid April 2007. Firms could choose to answer either via online form or via fax, depending on the company most favourite means.

During questionnaire collections, a person was available over the phone and over the e-mail to clarify doubts and answer possible questions of the companies contacted.

As questionnaire arrived, they were checked and if key answers were missing, or data was suggesting an error (e.g., turnover, inventory level), the company was contacted again and clarifications made.

On the total, 72 lean firms and 111 non lean firms filled the on line forms. 183 respondents correspond to a return rate of about 3,9%.

Finally, from data collected, a subset was extracted according with the criteria of the needed analysis. For example, for the analysis presented in this paper, only companies with at least 100 employee have been considered, leading to a sample of 61 LI and 51 NLI.

4. Empirical results

Due to space limitations, only a portion of the results of the survey can be presented here. Full results, and deeper analysis will be presented in a future journal article.

Figure 1 presents, for each strategic objective, the percentage of companies that selected that objective to be one of the most important (a maximum of 5 could be selected by each company). The first 4 most selected objective are in common between LI and NLI, even if not with the same ranking. Moreover most objectives show a very similar relevance for LI and NLI (e.g. about 25% of both LI and NLI mention product innovation). But for 6 objectives the differences are very large. A much larger portion of LI select as top objectives Quality conformance, More frequent new product introduction, On time delivery, than NLI do. On the contrary, a much larger portion of NLI identify as most important Higher plan flexibility, and Higher order spec flexibility than LI do. This can be read as a will of NLI to better accommodate customer modification requests, while LI tend to focus more on meeting what has been promised, in term of quality, and time. This is strongly related to the philosophy of the Lean approach: process control is fundamental.

It forces a deeper understanding of the phenomena and leads to a much reliable system. In turn, reliability means lower perturbation, and less fire-fighting. These concepts are in common with the Six Sigma approach.

Figure 1. Main strategic objectives (LI vs. NLI)

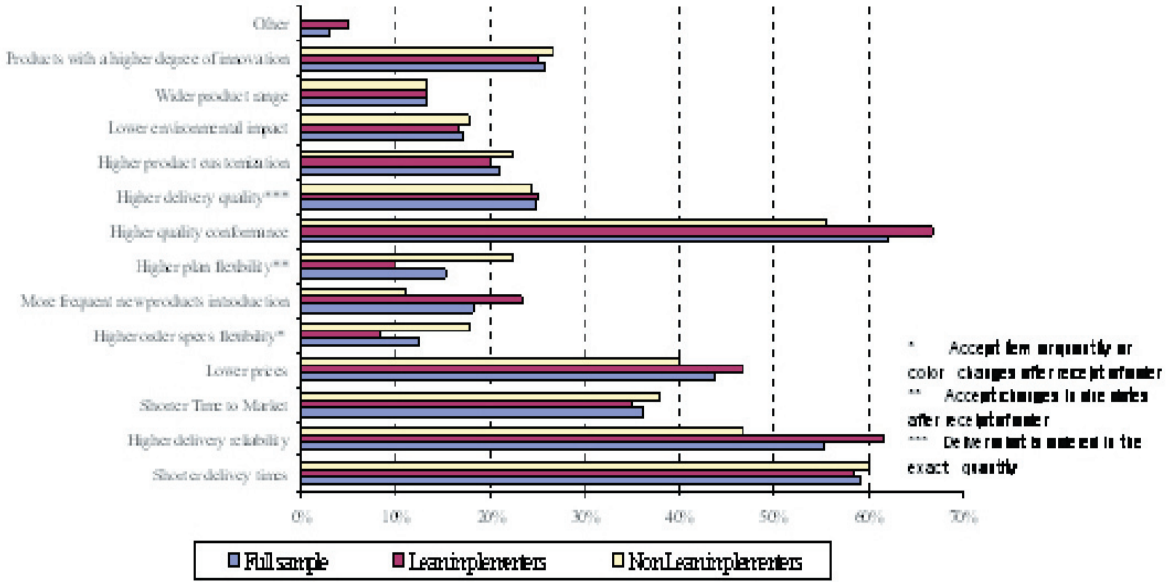
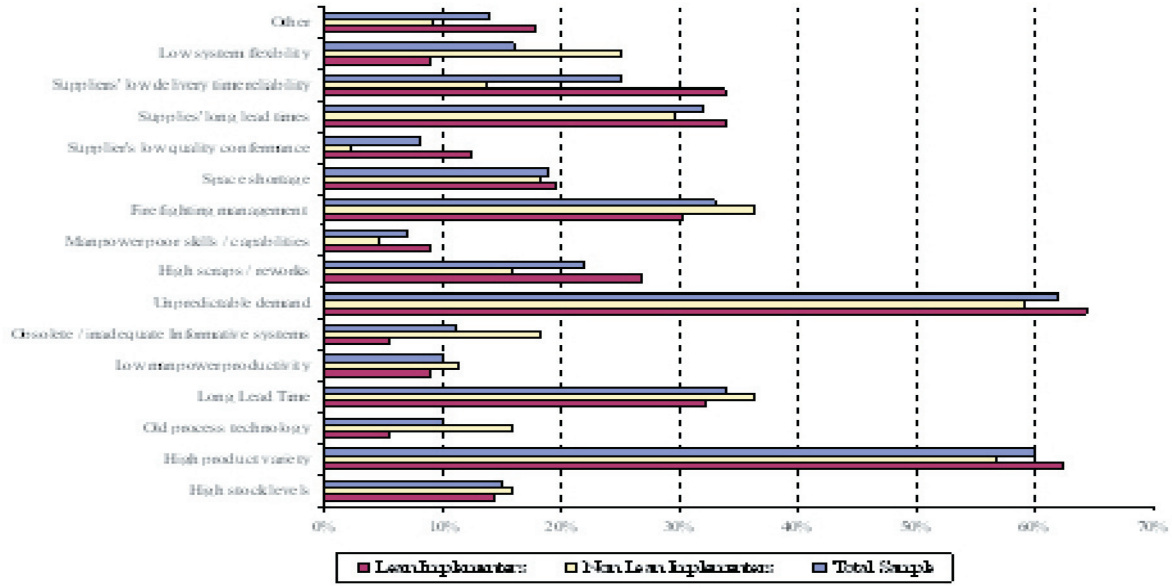


Figure 2 presents, for different possible problems limiting the achievement of strategic objectives, the percentage of companies that selected that problem to be one of the most important (a maximum of 5 could be selected by each company). Here LI and NLI present more differences: only 2 of the top 4 problems are in common. In particular, a much larger portion of LI indicate Quality conformance (from external and from internal suppliers) and suppliers' on time delivery as the key problems, compared with NLI indications. Whilst a much larger portion of NLI select Process technology, Information Technology and System flexibility, compared with LI's selections.

Figure 2. Major problems limiting the achievement of strategic objectives (LI vs. NLI)



This again makes clear how Lean approach stresses control and reliability: LI pay much more attention to suppliers' reliability than NLI.

Figure 3 presents most selected corrective actions that LI and NLI are undertaking, or are about to undertake (companies could select a maximum of 4). Both LI and NLI state a good relevance of corrective actions on Organisation/procedures and in Management techniques (more relevant for LI than for NLI). But there is a large difference for other actions. In particular LI focus on supply chain management, involving customers and suppliers (the proportion of LI selecting this is more than the double compared with the one for NLI), a larger portion of NLI selects Increase automation level, Process technology innovation, Information technology improvement.

This gives a strong confirmation that Lean approach open the way to address managerial levers to improve competitiveness, whilst NLI rely much more on technology. This is more clear if we group actions according to whether they are related to Management, Technology innovation/ automation, or Product Innovation, as in Figure 4. 70% of corrective actions selected by LI are in the management area, while only 45% for NLI's; on the contrary 45% of NLI selections are in the Technology innovation area and only 20% of LI's.

Figure 3. Corrective actions (LI vs. NLI)

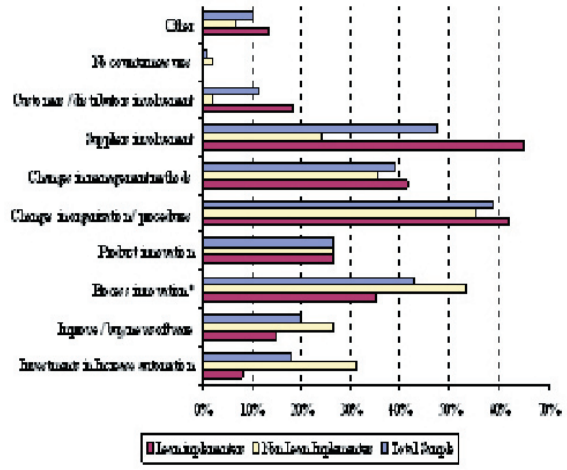


Figure 4. Corrective actions areas (LI vs NLI)

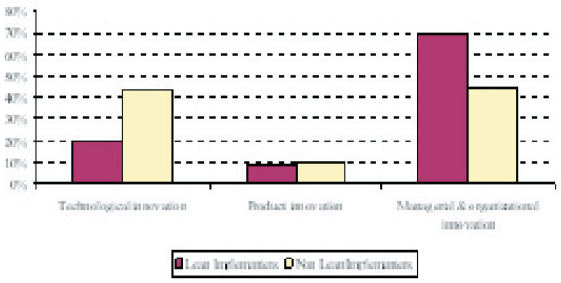
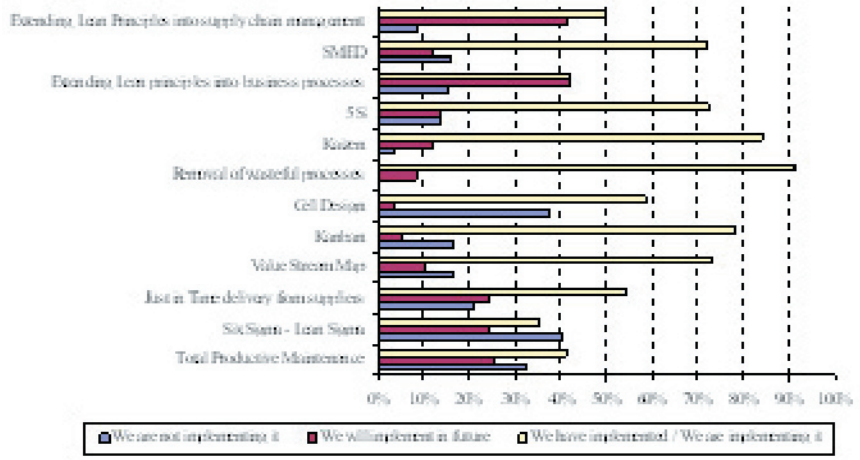


Figure 5 presents, for each technique, the percentage of LI companies that declare to implement it, not to implement it, or considering it for future implementation. SMED, 5S, Kanban and Value Stream Mapping appear to be the most commonly implemented. On the contrary, very few LI started six sigma, total productive maintenance projects, or implemented cell design. But while six sigma and TPM have a 25% of LI considering it for future implementations, cell design has almost none. This means that 40% of LI do not implement cell design and do not intend to implement it in the future, making this the less implemented technique. This suggests that the other techniques are perceived with a more general applicability. A few are sooner implemented (probably easier to implement), other later on in the lean implementation process. Cell design is implemented in certain companies and perceived as not useful / applicable in others. This point is worth a deeper investigation to understand the reasons of such a perception, because in our opinion cell design has a much broader applicability than stated by surveyed companies.

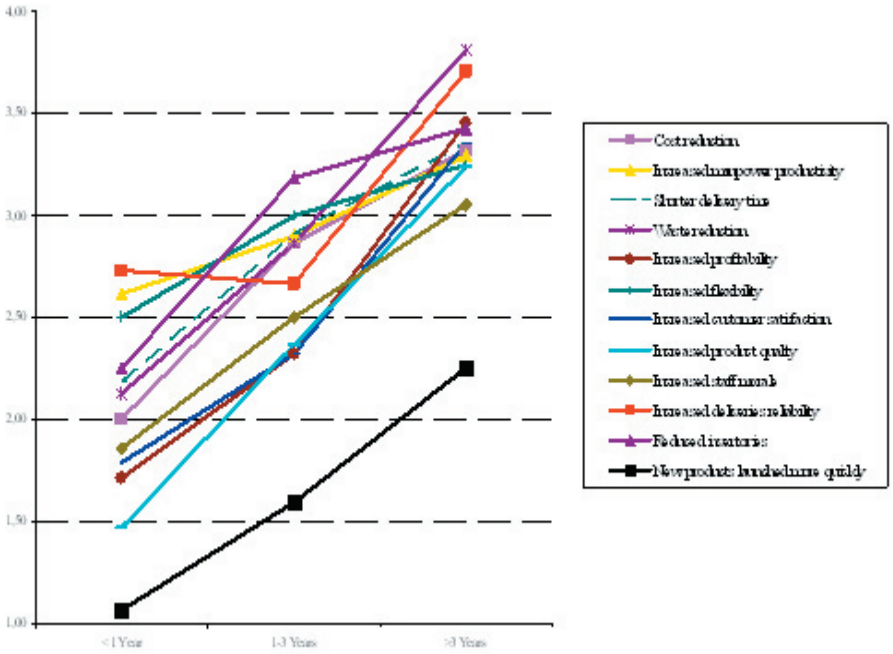
Figure 5. Lean Techniques' diffusion (LI)



At this point we wanted to understand how satisfied are LI, and what kind of improvements companies achieved implementing the Lean approach. 70% of LI stated a satisfaction level of 4 or 5 in a 0-5 scale, with an average for the whole sample just below 4. As for the improvements, we investigated many different dimensions, and the average improvement is almost 3 on a 0-5 scale.

Stratifying companies on the base of the number of years the Lean project had been running, Figure 6 shows that companies running the project for more than 3 years have much better results that companies that have been running the project for 1-3 years, and even more than companies that started the project during the last 12 months. For every performance dimension considered. Figure 6 shows that there are limited improvements during the first year, but then improvements increase a lot, and keep increasing. This means that there are additional advantages even after 4 or more years implementation. Companies running a Lean project for more than 3 years state improvements score above 3 in a 0-5 scale: for all dimensions considered.

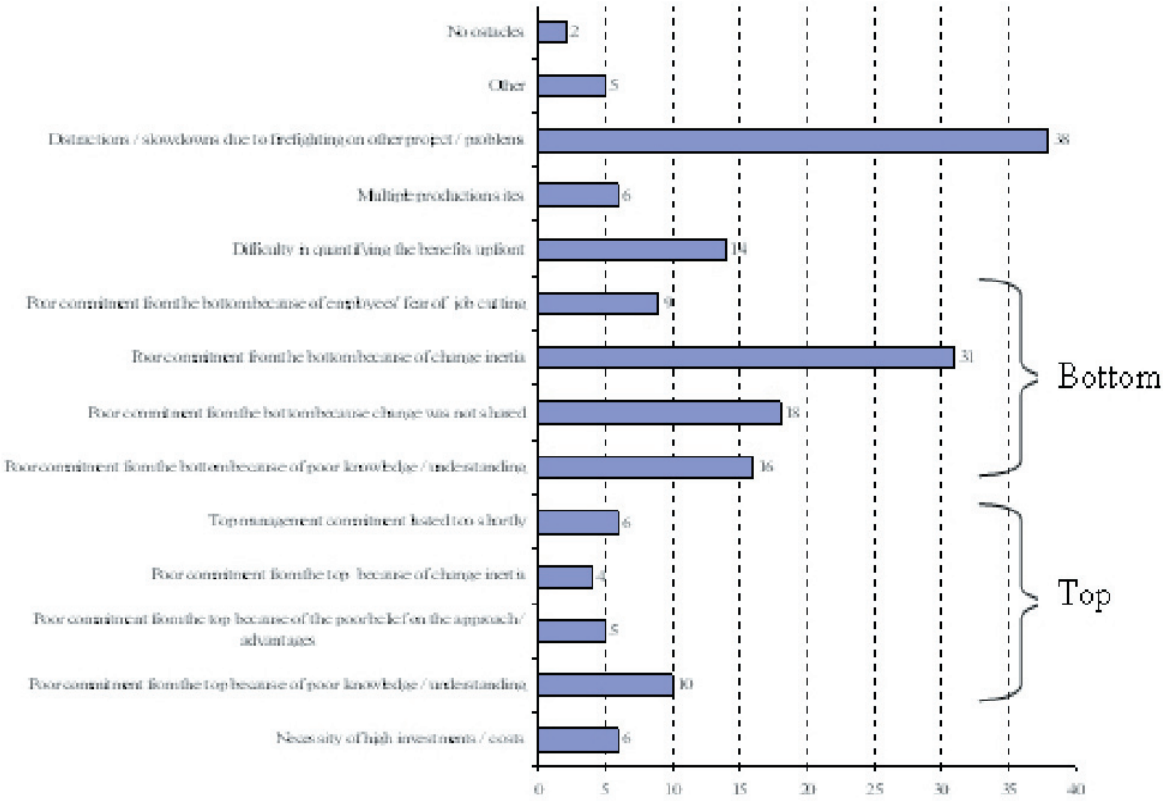
Figure 6. Results over Lean implementation time



But results are not achieved without difficulties.

Interestingly, Figure 7 shows that, when asked about the main causes (maximum 5) of difficulties in developing the Lean implementation, the area of resistance (or limited support) from top management received 15% of hits, the area of perturbation from other urgent problems 27%, the difficulty in demonstrating *a priori* an economic advantage received 12% of hits, and the area of resistance from bottom received the vast majority of hits: 45%. This highlight another big area of interest for improving Lean implementation projects, i.e. having the operators really involved, proactively participating in the development of the project, so to make the Lean approach a real part of the DNA of the company. But difficulty is not the same level for all type of companies. In particular it is interesting to compare companies producing on a repetitive base, with companies that have a low volume-high variety/customisation level. Whilst overall satisfaction level for the Lean project is basically the same (almost 4 on a 0-5 scale for both groups), difficulty level is stated at level 2.5 for low variety companies, and at 3.3 level for high variety/customisation companies.

Figure 7. Main causes of difficulties in developing the Lean Implementation (number of citations)



5. Conclusions and future developments

Empirical results of this research work show that companies implementing Lean present a different view of competitive dimensions, and rely on different improvement actions to increase competitiveness. In particular, Lean Implementers and Non Lean Implementers are aligned on considering Shorter delivery time as one of the main priorities, but LI give much more relevance to Quality conformance, and Delivery reliability is much more important do LI than for NLI. This can be related to the Lean idea (common to Six Sigma) to control processes. LI also have a different perception of what are the causes of poor performances and, as a consequence, what

are the line of action to improve. NLI are more focused on process technology, automation and Information technology as a way improve, while LI give more attention to Supply chain management, and in general to managerial aspects.

When we focus on LI we find that LI are well satisfied with the results achieved, and that results are good for all performance considered. Besides, Lean implementation gives improvements over a number of years, with all companies implementing lean form more than 3 years stating much bigger improvements than companies implementing Lean for 1-3 years.

Another very interesting result is that main difficulties in implementing the Lean approach are coming from the Operators. This at least is the perception of the respondent (top managers). This can be interpreted as the difficulty in really involving operators in a proactive way. We think the main reasons could be the need to invest more in education, or the difficulty of top managers to really delegate, increase decision scope of operators, listen to them, and set with them a different relationship. This and other issues emerging from the complete analysis of the data of the survey will be deepened through case studies in specific companies.

The survey gathered a much larger number of data than presented here, and they will be presented in a future journal paper. Moreover, the questionnaire will be the base for surveys in other European countries so that we will have a better overview about Lean implementations, and it will be possible to make comparisons between different countries.

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