

Implementation and Evolution of the Critical Chain Method: A Case Study

U. Apaolaza and A. Lizarralde

Abstract The Critical Chain Project Management (CCPM) method has been implemented in a wide variety of industries, activities and countries. This article is based on the implementation of this method in two different units of the same company which designs, develops and produces high-tech parts. Even if it is based on the implementation process and its results, the scope exceeds this context. The analysis is made with a time perspective, considering not only the implementation but also the evolution following its completion. As a result, two different sides can be highlighted: the first one concerns the outcomes achieved in each case as a consequence of the implementation of the method, and the second one is related to the key aspects identified in the implementation processes—in particular the success factors. The comparative analysis regarding the results achieved in both cases, in a time period that goes beyond the implementation timeframe, is of special interest. The findings of this work lead to some new aspects concerning the method, which require further research.

Keywords CCPM · Critical chain · Project management · TOC · Theory of constraints

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1 Introduction

Project Management (PM) is a discipline whose origin dates back to the mid-20th century (Archibald 1987), appearing to have reached maturity (Bredillet 2010). Its growth and development were particularly steep during the second half of the last century, as a result of the growing interest in projects and their management (Kloppenborg and Opfer 2002). Indeed, many authors agree with this idea due to reasons such as the fact that projects are the means by which strategies are performed (Maruchek et al. 1990), new products are developed and launched (Cook 1998), or the innovation strategy of a company is implemented and developed (Tatikonda and Rosenthal 2000). Furthermore, due to the progressive “projectification” of work, the use of projects seems to continuously grow in the future (Stoneburner 1999; Kloppenborg and Opfer 2002), confirming the relevance of PM at present.

Considering the above, together with the increasing trend towards both, the use of PM approaches and the need to address real world problems, several perspectives and patterns have arisen in recent years (Goldratt 1997; Beck et al. 2001), acquiring great relevance (Pinto 2002). The underlying idea here is that PM can be a competitive advantage for companies if it is properly implemented. This way, they could increase their chances of survival, or even reach a better competitive position.

This paper is practice-based research about the implementation of one of these methods, Critical Chain, in a company that having tried different approaches unsuccessfully, decided to implement it to solve the problems related to the management of projects and resources in two R+D+i units. In particular, it covers the results and findings achieved during a three-year period that followed the implementation process carried out in both units.

1.1 *Background of the Company*

The company analyzed in this enquiry develops and manufactures capital goods for machine automation and control. The 560 people workforce of the company is organized into two units, each one being responsible for one product line. They export more than 80 % of their production globally, and in recent years they have diversified their activity towards other sectors. But despite this international expansion effort, this company is much smaller than those leading this industry.

In this context PM performance is a key factor in achieving a competitive advantage or simply surviving, and a proper use of their capacity (resources) becomes essential. Additionally, since the market is evolving continuously they are forced to constantly upgrade their products and to broaden their catalogue by developing new products in order to remain competitive. These features lead to frequent changes and new needs such as technological developments and new trends, thereby causing the portfolio to be very dynamic, and requiring fast responses.

There were some attempts in the past so as to get an approach capable of dealing with this issue, but all of them were unsuccessful. Consequently, there was a lack of information from a managerial perspective, creating difficulties in managing the system properly. In addition, some kind of rejection against new improvement attempts turned up among the workers, as a consequence of the time and efforts wasted before. As a first step a profound reengineering of the new product development process was carried out, defining the framework for projects. Then, it became obvious again that it was necessary to manage projects efficiently. Taking all this into account, the company decided to try the Critical Chain method.

1.2 The Critical Chain Project Management Approach

CCPM is a method for managing projects developed by Goldratt (1997), founded on the principles of his Theory of Constraints—TOC (Goldratt 1992). Since it was published, it has continuously evolved on the basis of an intensive usage by practitioners in real-world environments, leading to a large number of publications including implementation methodologies and success stories, among others (Leach 2005; Srinivasan et al. 2007; Gupta 2010). The main features of this CCPM can be summarized as follows: firstly, it assumes that uncertainty exists and that it cannot be avoided, even if it can be managed. Secondly, the method takes into account the impact of human behavior on projects. Finally, it addresses both single-project and multi-project management.

According to Execution Management approach, “*the key to good execution is not detailed planning and control, but coordination of execution priorities across the organization*” (Gupta 2010). This implies implementing “Three Rules”, the Execution Management System and the Active Role of Senior Management, as briefly described below.

Implementation of the Three Rules:

The Three Rules are Buffering, Pipelining and Buffer Management. Buffering consists of creating project plans according to CCPM, so as to dampen deviations and prevent project delays by using buffers. The aim of Pipelining is to stagger the projects taking into account resource availabilities, deadlines and global priorities. Finally, through Buffer Management the system looks for a better performance in the operative level by following task priorities and preventing the waste buffers.

Execution Management System:

It means synchronizing the whole system consistently with the three rules. Key aspects:

- Operational Goals and Measurements: aggressive operational goals (schedules) and measurements so as to promote execution according to synchronized priorities and early warning signals.

- Management Policies and Processes: needed to, respectively, enforce the new rules of Critical Chain and translate these rules into understandable decisions and actions.
- Execution Oriented Project Schedules: suitable for execution and control according to CCPM.
- PM Information System: the means to integrate roles, information and decisions/actions. The software used in this case was Concerto.

Active Role of Senior Management:

The direct involvement of top management is a key success factor. As the implementation of CCPM implies a profound change, the supervision and engagement is essential, especially until the method has been interiorized by staff. In addition, only top management can proactively identify and eliminate policy obstacles. Therefore, they must be involved in the implementation.

2 Aim, Methodology and Structure of the Research

In spite of the maturity reached by PM, as stated in the introduction, some authors claim that PM research is still in its early stages (Sausser et al. 2009), and it calls for a different approach to the one provided by the traditional PM research (Ivory and Alderman 2005; Cicmil 2006). Investigation going beyond existing PM models and more focused on the practice is considered very important in order to achieve a deeper understanding of PM (Blomquist et al. 2010). Additionally, O'Neal et al. (2006) revealed that there is a gap between the professional (dominant) and the academic worlds, as most of the PM articles have been published in practitioners' journals.

Under these circumstances, real-time case studies and project organization studies are of particular interest. In this case the focus is not on the implementation and its results, but on the post-implementation period and the comparison between two similar organizations (units). Considering the above, the aim of this research is to:

1. Expound a real-world experience.
2. Draw valuable findings and conclusions for their use in practice.
3. Contribute to bridging the gap between the academic world and the practitioners' reality.

As stated earlier, the starting point for this research was given by the situation once the implementation project was completed, and this study is limited to the R+D+i units of the company, involving 115 people.

Figure 1 summarizes the process followed while carrying out the study. The methodology used is based on case study research (Gummesson 2000; Yin 2009) and combines different approaches: starting from the initial results of the implementation, the research addresses the evolution of both units during a three-year

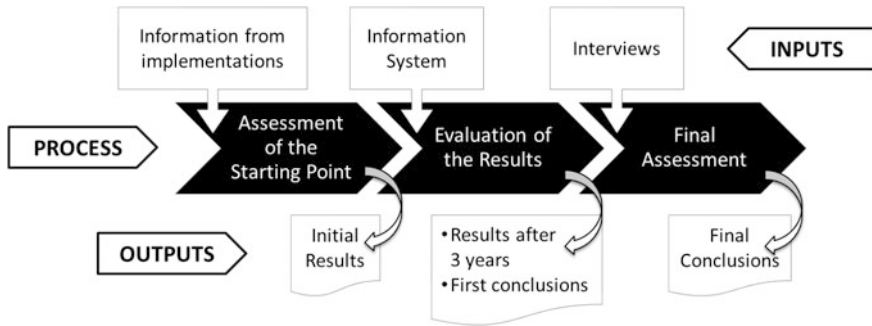


Fig. 1 Research methodology

period. This involves observation and analysis of (i) the results achieved, (ii) the evolution of the method and its performance, and (iii) the behaviour of those directly involved in the management of projects. Since different kinds of information were required for this purpose, diverse sources were used: information from the implementation process, data provided by the information system and formal and informal interviews conducted with employees involved in projects. The stages of the research are detailed in depth in Sect. 1.3.

3 Research: Stages, Results and Performance Assessment

3.1 Assessment of the Starting Point

Both researchers were directly involved as implementers in that process. So, all the information collected during the project was available for this purpose. This information included files and records, reports, working-papers, interviews, meeting minutes, etc., which is the foundation of the stage 1 of this research.

The situation at the beginning of project can be summarized as follows: inexistence of a suitable PM methodology and a perceived need for change. It also was found that CCPM was a completely unknown method to almost everybody in the company. Thus, the analysis of the system so as to understand its needs and limitations became even more important, including the features of both projects and resources (Apaolaza 2009). In this way an initial analysis was performed, and as a result valuable information regarding the business and the company was gathered. A summary of the main features of the context are provided below:

- Multi-project environment: different projects performing simultaneously, sharing (and often competing for) common and limited resources.
- Very specialized resources, low polyvalence due to the long time required to get enough experience, and extreme difficulties to get more resources within a short period of time when additional capacity is required.

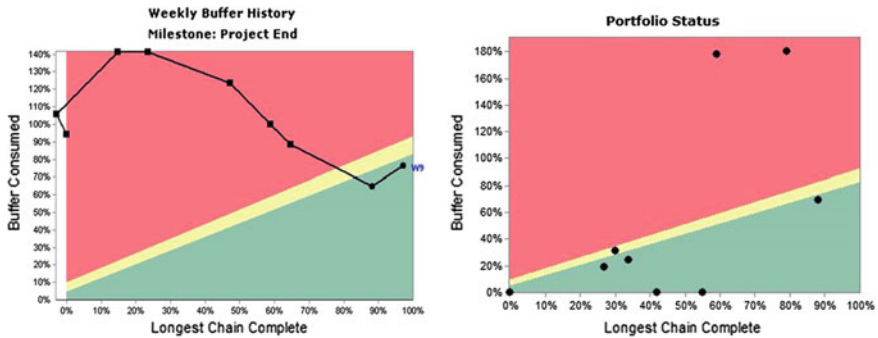


Fig. 2 Examples of results achieved during the implementation. *Left* Progress of the project during the pilot test. *Right* Project portfolio in Unit 2

- **Uncertainty:** by its very nature, uncertainty is inherent to these projects, thereby making their management more difficult (Shenhar and Dvir 1996).

The implementation plan was constructed and accepted by all the parties involved, completing the buy-in. The plan was made up of three main stages: a pilot test to be run in Unit 1 involving one project, the implementation in Unit 1 (conditioned to the results obtained in the pilot test), and the implementation in Unit 2.

The pilot test was carried out through a representative project, over a three-month period. Figure 2 (left) depicts the evolution of the project, completed on time as a consequence of the decisions made based on the visibility and information provided by the method. This brought with it the release of the second stage, involving the whole Unit 1.

The implementation of the method in Unit 1 lasted 4 months, requiring a customization and adapting the generic rules to that specific context. It resulted in the development of a suitable management model that included workload (projects), capacity (resources) and roles and responsibilities. Additionally, the integration of the model, the planning process and the execution management needed some other ingredients. Thus, two specific forums were created: the project tracking committee and the project launching committee. While the project launching committee was responsible for the management of the project portfolio, the aim of the project tracking committee was the monitoring and control of the performing projects.

Despite the success of the pilot project, the implementation in Unit 1 did not progress as expected. Even though an agreement was reached in the first stage, some reluctance to change arose as a consequence of the time and efforts wasted in previous attempts. This lack of commitment led to a misalignment between needs and behaviors, causing the results initially achieved in the pilot test not to be expanded to other projects.

Finally, the implementation in Unit 2 was performed similarly but started later than the previous stage and overlapped with it. Surprisingly, the results achieved were good, even though a pilot test was not carried out there. As shown in Fig. 2 (right), most of the projects progressed well, better than in the past, thereby creating

the impression that the method was suitable for that environment. Moreover, they were aware at all times of delays in some projects. As a result, when necessary they consciously decided which projects would be delayed, when, and for how long. Nevertheless, further research was needed so as to confirm or discard these findings and deepen in the causes and key factors that led to such different results.

In view of the very different results obtained an analysis of the whole project was carried out, covering both units. The report based on this analysis was then presented to the senior management of the company, including managers from both units. There was an agreement on the diagnostic, and the recommendations were very welcomed. In summary, the following was the content of the report:

Unit 2's success not only did show that the method was applicable to this context, but it also provided significant advantages. Likewise, there were no significant differences between both units to conclude that it could only work in Unit 2.

Daily reporting and task performance according to priorities were keys to success. The levels achieved were high in Unit 2 and low in Unit 1, which was a flaw because of its direct consequences over the PM system: lack of visibility, misalignment with priorities, low resource and project performance. Instead, this was considered to be one of the main causes of success of Unit 2.

The engagement of the managers in the project is another fundamental pillar. Their involvement was high in Unit 2, but the commitment of certain managers in Unit 1 was insufficient. This fact would probably bring negative implications over the behavior of the workers, due to the impact of the poor results over the morale of the staff. As a result, the following was recommended:

1. Correct misaligned behaviors in Unit 1, starting with managers
2. Strengthen the performance of the information system, mainly in Unit 1
3. Expand the method to other parts of the company.

3.2 Evaluation of the Results

In order to get a better understanding of the implementation and use of the method, the results must be analyzed from different points of view. As both units work in very similar contexts and conditions, their performance in this period can be compared. Thus, this section summarizes the main quantitative and qualitative achievements reached by each unit along this time frame, including a comparison between these results.

3.2.1 Quantitative Results

The results achieved once the implementation was completed in Unit 2 can be summarized as follows: more projects completed on time and by time unit, shorter lead times, and dramatic reduction of terminated or postponed projects. On the

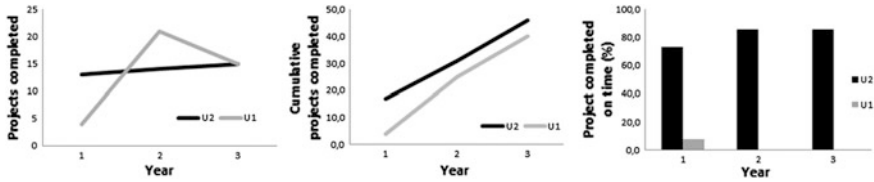


Fig. 3 Comparative results in 3 years

contrary, even if the context was very similar in both units, none of these results was achieved by Unit 1, achieving only some minor improvements.

- Amount of projects completed in the first year (Fig. 3, left): although it was expected that Unit 1 would complete more projects than Unit 2 due to the fact that it was bigger, having implemented the method before, it only completed 4 projects, while Unit 2 finished 13 projects.
- Evolution of performance for the following years (Fig. 3, center): it remained steady for Unit 2. On the other hand Unit 1 seemed to have improved its performance hugely in the second year, but it decreased again in the third year, going below the performance of Unit 2. The vast increase of completed projects happened in Unit 1 during the second year was due to the concurrence of lots of delayed that were still performing projects. This fact was proven during the third year, setting a new decreasing trend that lasted even in the first months of the fourth year.
- Amount of projects completed on time (Fig. 3, right): according to the criteria stated by the company, 90 % of the projects were completed on time in Unit 2 while almost no projects were delivered on time in Unit 1. Besides, delays regarding Unit 2 were of days or weeks at the worst, whereas in Unit 1 they reached months or even more than one year.

The results achieved by Unit 2 go beyond what Fig. 3 shows. By focusing resources in those high priority projects and according to the available capacity, the use of resources is improved, increasing efficiency and preventing resource assignment to low priority or urgency projects. Additionally, those projects terminated or postponed consume capacity which may have been necessary in other projects, implying a poor resource usage. The performance according to CCPM led Unit 2 to finish all the projects launched without any termination or postponement, thereby improving the productivity also from this perspective. Again, the results in Unit 1 were worse despite the fact that planning was done similarly in both units. The awful execution management caused some projects to be abandoned due to the delay accumulated, performing below its potential.

3.2.2 Qualitative Results: Overall Improvement of PM

This section gathers the most important results achieved regarding the qualitative side, due to their impact over the quantitative results. Although the implementation process was almost the same in both units, the maturity and results reached by them were very different. This fact led to the conclusion that only Unit 2 had properly implemented the method. Indeed, they remained very close to execution and were capable of reacting fast, making decisions aligned with the company's priorities and according to the current situation. The key for this was the coherent combination of visibility, flexibility and alignment at all levels within the organization, as explained below:

Visibility

Achieved in the early stages of the implementation, it was progressively improved as the maturity of the company was growing. It gave timely and accessible information about the different sides of the project environment, providing the company with the capacity of identifying deviations when they were happening, analyzing problems as soon as possible, and making decisions when necessary. It was the basis for decision making, and this global view was composed of different perspectives depending on the aspect to be observed (e.g. tasks, project progress, portfolio status, etc.). This was supported by the comments of some participants when asked if the method was helpful for the on-time completion of the pilot project, such as *"It helps to focus"* or *"It has forced us to react"*.

The key here is to be aware that when used properly visibility may be an advantage. But it must be underlined that even if visibility is a necessary condition for improvement, it is not sufficient to achieve good results: it allows identifying deviations early, but taking advantage of this also requires decisions and actions. Figure 4 shows an example of such an opportunity provided by early warnings. This was the main difference between Unit 1 and Unit 2: while Unit 2 used visibility to manage projects and resources from a global perspective, Unit 1 only used visibility to know what the situation of individual projects was. Thus, the quality of the information was not good enough, causing the visibility provided by the information system to be inaccurate, leading to late and bad decisions.

Flexibility and Strategy-Projects-Resources Alignment

Visibility was also the base of other improvements. For example, when taking visibility and priorities into account, decisions regarding resources became easier. This information enabled the managers to make decisions aligned with the global priorities, ensuring that resources were always working on the right tasks. In other words, the system was flexible or capable of adapting fast to the real needs given by both, global priorities and current conditions.

As projects lasted for months or even years as well as being ever-changing, fast adaptation to reality was essential. In particular, aspects such as information accuracy and updating frequency determined the potential of the system to identify problems and react fast. For instance, portfolio management required information

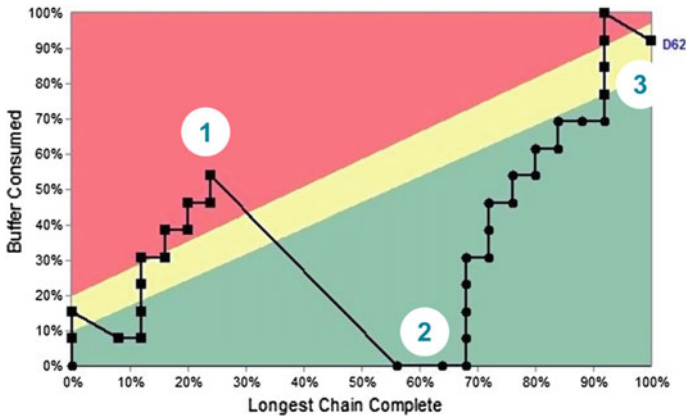


Fig. 4 Example of the evolution of one project reacting to make up the delay: the warning provided by the software (1) led to take actions to get back on track (2). As a result, the project was delivered on time (3)

related to project and resource status, and analysis and decisions related to this were normally made on a monthly basis, but it was also necessary whenever a new project was to be introduced in the system. Instead, single PM had to be closer to execution. In this context the duration of tasks could be shorter than one week. Therefore, task management was better made on a daily basis, requiring a daily task performance report according to CCPM as well. As a result, the use of resources and the project flow were improved.

Thus, the management of the planning and execution of tasks, projects and resources, both in the short and the long term became essential to manage the system consistently. The use of this information allowed planning and launching projects properly staggered, coherently with the resources available and aligned with the company's priorities. This approach was also used when new decisions were needed, for example due to changes in dates or priorities, or when new projects had to be introduced. Regarding execution, visibility was even more important, especially on the day-to-day basis where problems such as unbalanced resources, delays in programmed tasks' starting dates or variations in deadlines arose require fast responses. To this end, it was vital to have timely (daily) and updated information about the status of projects and tasks so as to allow the resource managers to keep their resources focused in the right tasks.

Other Results

The implementation led to partial outcomes that, even if they weren't initially set as objectives, were a part of the solution and also welcomed as they were progressively achieved. Similarly, some other improvements were reached, despite the fact that they were not what the company was initially looking for, as the aim was to manage projects reliably. In fact, while the usual procedure was to launch projects as they were being sold, launching projects staggered according to the global

priorities and the existing capacity not only led to shorter lead times and better use of resources, but to a considerable reduction of the work in process (WIP).

The implications of this fact, achieved in Unit 2, were diverse. Firstly, the management of the system became easier: there were fewer tasks to pay attention to, thereby enabling crystal-clear visibility and simplifying the decision making process. Secondly, the staggering of projects caused the project expenses to be staggered too. As in the new situation projects were launched according to capacity and priorities, the expenses were incurred later, according to the needs and not just as soon as possible. Thirdly, the lead time reduction of projects entailed that the incomes came in sooner, as these incomes are often subject to compliance with certain conditions and/or deliveries. Finally, considering both the staggering of expenses and the acceleration of incomes, it is concluded that the cash flow of the unit was also improved.

3.3 Performance Assessment

The Performance Assessment stage aimed to evaluate the results achieved by the method from the company's perspective and, therefore, focusing especially on Unit 2. To this end, several interviews were conducted individually. In particular, the outcomes of four of these interviews are shown below because they synthesize the findings. Two of them were structured because the information to collect was considered deep and technical—held with the Technical Manager of Unit 2 (TM), responsible for the management of the projects, and the Master Scheduler (MS), responsible for the global planning and information system in both units—, and the other 2 interviews were not structured, as it was searched for a more general view—Business Manager of Unit 2 (BM) and a Technical Developer (TD) from Unit 1—. The key conclusions drawn are the following:

- (TM) The company knows what the situation is at all times. Therefore, the unit is managed according to the general priorities and results are better.
- (MS) CCPM works and priorities are clear. The only reason for the different results between Unit 1 and Unit 2 is the involvement, not the method or the context.
- (BM) The method works. The results have been improved. Now it is known what the situation is. The key is the personal involvement.
- (TD) The rationale behind the method makes sense and is suitable for the context. The underlying idea has probably been forgotten.

4 Conclusions and Future Research

When applying the method to the performing organization, the main issues were two: its applicability and its appropriateness. This research, performed in two similar units of the same company, provides results and conclusions valuable for diverse purposes, as outlined below. It may be helpful guidance for future implementations. It also gives a different perspective of the method, addressing not only its implementation, but its evolution over time too. Finally, some issues that require further research in order to increase the knowledge regarding the real-world use of the method are identified.

4.1 Conclusions

It is important to note that CCPM is a holistic method that aims to manage the projects and resources involved consistent with the particular strategy and the environment considered. The underlying idea is that when the amount of tasks performing simultaneously is smaller and priorities are clear, it is likely that the finished task and completed project rates will be increased. As in the case of Unit 2, the key for this is to focus on certain aspects stated by the method, such as clear and stable priorities, suitable WIP levels and reduction of multitasking, among others. This enabled a global management of the system, resulting in a better global performance. Thus, the general conclusion derived from the results and findings reached in the three-year period after the implementation of the method can be stated as follows: the implementation of the Critical Chain method in the R+D+i context of the company was suitable, sustainable, and provided a competitive edge if compared to the previous situation. This conclusion is based on the results achieved by Unit 2, which gives a clear and direct response to the concerns of the company regarding the applicability and appropriateness of the method.

The implementation process and the results achieved in Unit 2 showed that the method can not only be adapted to the particular features of these contexts, but can also be promptly implemented. In addition, it was demonstrated that it is sustainable from a usability point of view, as a balance between the information given by the information system and the work required to maintain it updated was reached. Moreover, on one hand the information provided by the system was far better than the one formerly available, enabling the organization to react faster and to make more and better decisions. On the other hand, the work required to keep the information system updated wasn't unreasonable. Indeed, Critical Chain advocates for low WIP levels, leading to more economical reporting needs.

In fact, if the situation of both units after their implementation projects is compared, it is concluded that the proper implementation and use of the method entailed a competitive advantage for the company. As for the comparison between the results achieved by both units analyzed if they were competing in the same

market, those PM capabilities acquired and developed by Unit 2 would have led the unit to a better competitive position. But it would also be a major mistake if these outcomes were considered as single improvements. These quantitative results were caused by the qualitative improvements attained in Unit 2. Likewise, the main factors under this perspective and several relevant reasons are summarized below.

Visibility:

It is not an advantage itself, but it is a key contributor to success. It shows the current reality and is therefore the foundation for better decision making regarding the quality and timeliness of the decision—i.e. early decisions based on more accurate and updated information. Hence, it is important to understand that it gives an opportunity. For instance, if one company achieves visibility but does not act accordingly, it will not take full advantage of its potential. Furthermore, this will be especially harmful if visibility is only locally observed, for example, from a single project perspective, not considering resource status, priorities among projects, etc.

Flexibility:

The simplicity of the planning and execution management processes given by CCPM are essential for this purpose. It facilitates decisions to be close to the current reality, enabling the connection between the needs and the decisions and/or actions.

Alignment:

The holistic nature of Critical Chain facilitates the consistent alignment of strategies and actions, projects and resources, and planning and execution at all the organizational layers of the system. All these contexts are provided with the information needed to individually perform but connected with the rest of the system. This also implies clear priorities, and prevents problems arising from a lack of view, information or coherency between those parts integrating the system, or mitigates their impact. Thus, the positive impact of the individual improvements is enhanced through a global perspective.

Project Flow:

The increase of the project flow is also a major contributor to the enhancement of the competitive positioning for different reasons: firstly, the time to market for new developments was shortened. Secondly, a substantial reduction of the reaction time was achieved to address tough situations. Thirdly, the increase of the project flow also entailed an increase of the project completion rate. Finally, the combination of flow increase and project staggering caused the cash flow to be improved, impacting positively on the company's economic performance.

In short, all these aspects individually contribute to enhance the competitive position of a company, but the biggest potential comes from the quantitative-qualitative combined contribution. When achieved together and consistently with the strategy and priorities of the company, they can certainly bring it to a better competitive position.

The last conclusion of the research refers to the key success factors for the implementation of CCPM. The pilot test was performed in Unit 1, achieving tangible results that showed the potential and applicability of the method in that context. Nevertheless, the changes needed inside the unit to successfully expand the method were not materialized. While Unit 2 was driven aligned with global priorities, Unit 1 lacked visibility and priorities, causing a misalignment between projects, resources and goals. The main reason for that was a lack of engagement and even resistance to change from some people. In particular, the attitude of certain managers, that initially agreed to perform in accordance with the method, was very harmful for the implementation: not having assumed their responsibilities regarding the method, their staff was not forced to comply with the requirements of the method. Thus, the method never worked properly in this unit.

It is concluded that there are two essential components necessary in an implementation: the adaptation of the method to the context, and the acceptance of the method inside the organization. The adaptation rests on the comprehension of the context and the method, so that a suitable model is created. The acceptance, instead, is related to other factors such as the culture and maturity of the company, its willingness to change and the commitment towards rigor as required by the method. Therefore, it is also concluded that the engagement of all the parties involved is an absolute prerequisite for a successful implementation.

Finally, it must be asserted that there is no reason to conclude that the particular features of this R+D+i context may recommend not to implement CCPM. In fact, it is not a method designed for a specific industry, and aspects addressed by the method such as lead time reduction, higher productivity or better cash flow are of general interest for companies. Therefore, this approach seems to be particularly interesting for those contexts where multiple projects are performing simultaneously and share resources, due to the difficulty of managing them.

4.2 Future Research

The results achieved by both units and the different behaviors arisen in such similar contexts confirmed that the human factor is a key success component when implementing CCPM. It is clear that the involvement of the senior management is essential, but even this may be not enough. Thus, further research is needed so as to identify those fundamental aspects that can cause such an implementation to fail, even if a success case is being achieved in another unit of the same company at the same time, and to find appropriate ways of addressing them.

Another issue that, even if it was not a real problem in the period observed, might have been a drawback was the management of resources shared by Unit 1 and Unit 2. Because of the low saturation of these resources, both units were considered to be independent. However, in a different scenario where saturations were higher this could be a major problem: as units were arranged and managed as independent systems, they would not be capable of managing these resources

properly, resulting in an internal misalignment of both units and in worse results. Similar situations where parts of a company are managed independently but share certain resources are not unusual. Therefore, it would be worth to develop further research about this issue in order to identify appropriate approaches to deal with such situations.

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