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Lean monitoring: action research in manufacturing

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Abstract

Purpose – This study aims to study the implementation of lean thinking at the strategic level of an Italian manufacturing company. Companies implementing continuous improvement (CI) projects in their production processes often take the monitoring phase for granted. This research deploys an A3 lean thinking project in the monitoring phase of strategic KPIs upon completion of several ongoing improvement projects.

Design/methodology/approach – The research methodology is action research aiming at disseminating the problems that the company is facing. The study relies on the lean action plan developed by Womack and Jones (2003): Planning for lean and Lean action. Lean planning consists of the following steps: find a change agent; get the knowledge; find a lever. Lean action uses the A3 lean approach.

Findings – The company reached high-performance improvements due to the proposed lean action plan.

Research limitations/implications – This study contributes by presenting a lean action plan in the monitoring phase, highlighting the importance of the lean thinking-monitoring continuum in reducing time waste for faster diagnosis and using action research to analyze and instill reflective learning.

Originality/value – The research relies on the A3 methodology to showcase the benefits that a mature paradigm, often coined to production, still has unexplored potentials.

Keywords Monitoring, Lean, KPI generation, Action research, Continuous improvement

Paper type Research paper

1. Introduction

Lean management (LM) has proven to improve companies' operational performances, whether in the automotive sector, where it was born, or in other sectors, where it expanded on all levels of the organization (Womack *et al.*, 1990). It is a people-based paradigm where people are committed to continuous improvement (CI) (Chiarini, 2013).

Notwithstanding the benefits of LM and CI, many firms struggle to integrate, harmonize, and sustain lean principles within the different lines of the organization (Dorval and Jobin, 2021). Most studies addressing CI projects dedicate small efforts to monitoring and are mainly concerned with the upstream steps. This results in a slow pace of lean growth and an unexploited range of opportunities and benefits that lean at strategic levels can provide (Rossini *et al.*, 2020; Sousa and Dinis-Carvalho, 2021). The immediate results-oriented mindset prioritizes the early stages of CI projects over the monitoring stage (Bourne *et al.*, 2003; Sanchez-Ruiz *et al.*, 2020). Kaplan and Norton (1996) recommended using the balanced scorecard design process to overcome these challenges.

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In addition, managers' skills and knowledge of CI tools may vary and often be scarce; therefore, it is important to stress further the monitoring phase (Kumar *et al.*, 2008). Moreover, the cumbersome data collection and analysis process and the lack of data management tools might exacerbate the issue and deter managers from delving into the monitoring phase. Furthermore, allocating enough resources and time for the monitoring phase becomes challenging without top management support (Sanchez-Ruiz *et al.*, 2020; Schroeder *et al.*, 2008).

The CI cycle, by default, requires a complete and meticulous conducting of the monitoring phase to ensure alignment with expected results and actual ones. This phase is evidence of the degree of success of any CI cycle (Bessant *et al.*, 2001).

Finally, monitoring any CI cycle spreads the culture of learning and self-reflection that would benefit the project and the professional growth of any stakeholder involved (Bannister, 2001).

To the best of the authors' knowledge, studies concerning CI projects tackled common performance-oriented problems. Still, so far, no study tried to enter the loop of CI by conducting a CI approach in one of its most important phases.

Henceforth, this article contributes to filling this gap by introducing a lean action plan incorporating the A3 thinking and applying it as a new CI loop within a CI project. Such a plan could be extended and implemented for any CI project. The research focuses on the deployment of lean methodology in the monitoring phase following the implementation of several CI projects in a service offering business side of a manufacturing company. This article aims to illustrate how an Italian company's journey, applying a lean methodology, could become closer to developing a just-in-time monitoring process. This action research represents the applicability of LM in the context of KPI monitoring activities, leading the company to just-in-time responses. It would significantly improve customer relationships (Kassem *et al.*, 2021).

The remainder of the article is organized as follows. Section 2 discusses the theoretical background, followed by the methodology in Section 3. Section 4 explains the project steps and results, whereas Section 5 discusses findings, and Section 6 concludes the research.

2. Theoretical background

2.1 Continuous improvement

Lean is an organizational and human-oriented corporate philosophy that pursues the main objectives of creating customer value and transparency along all processes. Even though it was born in production (Ohno, 1988), it expanded its applications to other areas of the value chain, from logistics to business processes and supply chains (Shah and Ward, 2003). It also expanded horizontally across all sectors and industries, from manufacturing to the service industry (Dibia and Onuh, 2010). This expansion is mainly due to its increasing contribution to improving the company's performance (Holweg, 2007). Applying lean is done through CI projects and is primarily focused on solving problems pertinent to internal operations and production in the case of manufacturing, for example, or improving service delivery for the service sectors (Sousa and Alves, 2012).

The lean philosophy could be a way to solve any problem pertinent to internal processes and decision-making processes. However, lean's applicability is not strictly related to operative procedures that literature and researchers focus on (Lamming, 2005; Sousa and Alves, 2012). People and CI are at the heart of the house of lean (Holweg, 2007). CI initiatives have started at Toyota to uphold the company's competitiveness in the challenging environment (Bortolotti *et al.*, 2015).

The notion of CI evolved over the years from a principle-driven mechanism based on improvement efforts in the workplace to a holistic approach comprehensive of methodologies embedded in a work culture where the organization is committed to continuously improving (Mclachlin, 1997). In a CI environment, the top management's role consists of training, educating and coaching employees on the importance of CI projects and how to maintain them (Netland and Ferdows, 2016; Powell and Coughlan, 2020).

CI encompasses a range of tools that could achieve business excellence. Companies could customize them to fit specific needs. However, it is essential to note that when these tools are combined, they can produce even more significant results (Alhuraish *et al.*, 2016; Dombrowski and Mielke, 2014).

The available tools include Just-in-Time, Kanban, Kaizen, Value Stream Mapping, 5S, Takt-Time, Poka-Yoke, Waste Elimination, Standardization of Work, Autonomation, PCDA, and Total Production Maintenance (Durakovic *et al.*, 2018).

The A3 lean methodology stems from the Toyota Production System and relies on the Plan Do Check and Act (PDCA) cycle. It follows a structured approach with delineated logical, sequential steps that allow solving any problem, an AS-IS to develop the desired TO-BE (Sobek, 2008). Researchers tackled the deployment of the A3 in CI projects and proved to be successful. Successful implementations of A3 in Toyota affected other companies in several industries, such as service, manufacturing and health care. Torri *et al.* (2021) applied the A3 for a confirmatory case study of lean application in IT companies, which reduced non-value-added activities and increased productivity while including the various stakeholders in change creation. Sobek and Jimmerson (2006) applied the A3 model to develop a CI project in a hospital that also yielded increased satisfaction levels among all employees and patients. The importance of the A3 lies in its broad applicability across various sectors and levels of the organization (Rother and Shook, 2003). Prioritization matrices are employed to assess each cause systematically. A helpful element of the Root Cause Analysis section of the A3 is prioritizing the causes. This activity aims at defining the most significant reasons in terms of impact on the project target.

One of the characteristics of a successful CI project is the "Gemba walk." The core idea of the "Gemba walk" is that when a problem arises, stakeholders should remove its root causes. Therefore, it is necessary to go to the Gemba, where things happen and observe closely (Ohno, 1988).

2.2 Monitoring phase in continuous improvement projects

The underlying benefit of CI projects lies in their holistic perspective (Rijnders and Boer, 2004), with organizational learning as the foundation (Hilton and Sohal, 2012). They usher a learning cycle through problem-solving with collaborative spirits from employees and a clear awareness of the sense of responsibility (Struckman and Yammarino, 2003). Finally, CI also affects both operational and financial performance. Some studies show that companies can reduce costs and improve quality performance (Kumar and Sosnoski, 2009; Powell and Coughlan, 2020). However, studies showcasing CI projects emphasize the steps of the project and show the final results but leave a small room for discussion about the monitoring of results. Companies must adequately monitor the CI project's results; otherwise, they risk overturning the benefits (Costa *et al.*, 2019).

Monitoring and tracking the system is instrumental in spotting whether introducing improvements and countermeasures was influential in nurturing lean sustainability. In this phase, the project's effectiveness unfolds, enabling the team to track the process changes (Marksberry *et al.*, 2011). Furthermore, the monitoring phase allows for spotting any further problems or issues that may arise while implementing the countermeasures, which adds the learning aspect in a CI context. Allowing the time and space for tracking changes ensures that the project stays on track and achieves its intended goal (Powell and Coughlan, 2020). Managers may not stress the monitoring phase due to time constraints, as the data collection and implementation phases are usually the densest phases in projects. However, this should not reduce the importance of such a step (Kerzner and Saladis, 2009). Juran (1992) argued that follow-up meetings and measures to track and monitor results are essential to designing, managing, and improving kaizen event programs. Also, using systematic performance analysis increases the likelihood of event success.

To this date and to the best of the authors' knowledge, no study tackled the monitoring phase by considering it a project worthy of CI. This study aims to contribute to filling this gap and enriching the literature.

3. Research methodology

Action research is a collaborative process in which employees, managers, and practitioners generally come together with researchers to analyze and solve company problems. It is a repetitive learning process in which both parties collaborate and learn from the corrective actions applied (Coughlan and Coghlan, 2002). Action research relies on collaborative efforts to advance a company's performance and quality of operations and processes. The company's stakeholders will gain problem-solving experience while researchers play a double-agent role, actively partaking in the project while concurrently developing the research (Greenwood and Levin, 1998). Though action research might be viewed as a methodology that somehow lacks objectivity, it is greatly valued for integrating the researcher's experience into problem-solving, unlike other methodologies (Mcintyre, 2008). For this project, a team of researchers and the article's authors actively participated in every phase of CI.

The study relies on Womack and Jones's (2003) lean action plan with two phases: planning for lean and lean action. Lean planning consists of the following steps: find a change agent, get the knowledge, find a lever. Lean action uses the A3 lean approach, followed by reflective learning.

3.1 Planning for lean

3.1.1 Find a change agent. The operations manager, who has been conducting successful CI projects with the researchers, wanted to see the exact changes happening at all levels of the organization. Having to work closely with the team responsible for monitoring KPIs on the strategic level, he stepped up to actively partake in the project as he expected to have a streamlined process with higher reactive capability.

3.1.2 Get the knowledge. The researchers inducted a meeting with all stakeholders to introduce the lean thinking process and invited the operations manager to speak about his experience with CI projects.

3.1.3 Find a lever. The researchers explained to the team the benefit this project would bring them personally, as they would no longer have to deal with the stress and spend time on numerous calculations. The researchers showed the team the consequences of delaying KPI calculation and formulation on the company's ability to understand the current situation regarding customer experience and feedback. The team was ready and on board to start the journey.

3.2 Lean action

The researchers conducted initial interviews before process exploration to understand the company's current status, business philosophy, and strategic objectives. Indeed, it involved management levels to get a sense of the pervasiveness of the lean culture inside the company. The company recognizes the importance of lean in driving CI and has been applying it in its manufacturing processes, but it also needs to spread the culture in other parts. On an operative level, data utilized to describe the current condition have been collected through interviews with employees involved in the investigated activities.

Once we collected preliminary data, we applied the A3 methodology (Figure 1).

Eight steps define the A3 model in the PDCA Cycle (Figure 1):

The plan phase is composed of the following:

- problem background and definition according to the company's context and strategy;
- problem breakdown that highlights the AS-IS situation upon data collection;
- a target definition measuring the success of the project;
- root cause analysis using Ishikawa and five whys; and
- countermeasures development or the solutions.

The Do phase implements the proposed countermeasures, while the Check phase monitors the results. Finally, the Act phase is the eighth step in which the new TO-BE will be standardized and success is shared.

3.3 Research validity and reliability

To ensure the validity and reliability of the research, the researchers resorted to direct observations and Gemba, company reports, company employees' participation and interviews (Yin, 2014). The researchers triangulated the takeaways from the interviews with the Gemba observations and company reports about the KPI monitoring process. The researchers' team sat down with the company team while working on the KPI formulation process and observed the steps they carried from the beginning to the end. The mapping activity started with a written description provided by the company that represented the basis for the first draft of the process. After observing several cycles of the process in a period spanned over two weeks daily, the researchers defined with a very high level of detail the process that the company followed when performing field service activities. According to Coughlan and Coghlan (2002), interviews in action research generate feelings of "anxiety,

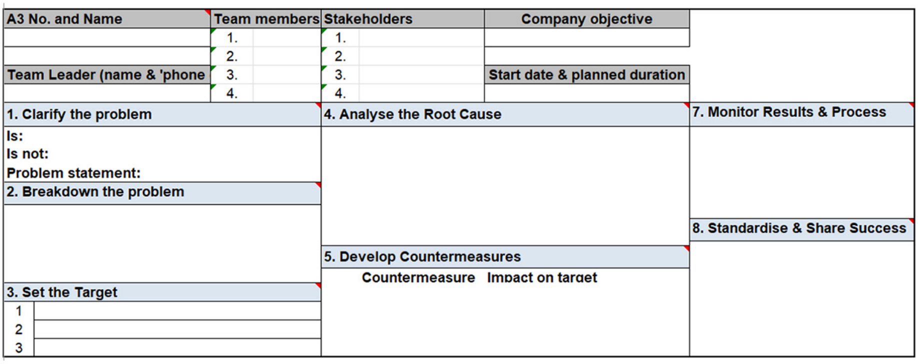


Figure 1.
A3 model

Source: Rushe (2020)

suspicion, apathy and hostility or create expectations in a workforce", and if not attended to, they might lead to incomplete data collection. Therefore, the researchers made sure to have friendly welcoming semi-structured interviews lasting maximum 60 min focusing on understanding the employees' role in each step, the struggles they are facing, in addition to hearing their ideas and proposals on how to improve the process.

4. The company ABC

ABC is an Italian company that has been a leader in producing innovative industrial printers and equipment for the textile industry for 70 years. The company started implementing CI projects in several areas and departments, creating a knowledge base for lean principles.

Part of the company's business is selling services linked to its products. Some of these services require a presence on customers' sites, called Field Services (F.S.). These services encompass not only field activities but also some back-office activities. In the last years, F.S. has been facing changes introducing SAP and customer relationship management Salesforce to support the management.

Salesforce records all the information regarding customers, assets, human resources, standard types of interventions, and skills (necessary for a kind of intervention and owned by human resources).

ABC was using Salesforce as a support of the activities carried out by the After Sales department. When an intervention following a customer request was necessary, the operator would open a case and store the primary information in the system. Then, he would insert data regarding the technicians' activities into the system. Considering the current situation of the KPIs' computation, closing Salesforce cases represented a mandatory activity that allowed the collection of all the needed data. Afterwards, the operator would transfer the data to Excel files.

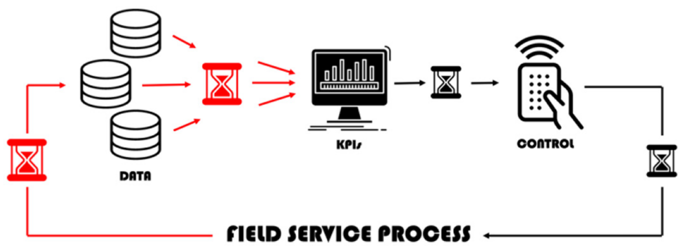
F.S. directly affects relationships with customers and their overall company experience. Therefore, it is of primary importance for the company to monitor its F.S. activities.

4.1 The problem

The first step is understanding the problem and the definition of the problem statement. While defining the problem, the team must refer to something the company cares about; hence, they must connect the problem under investigation to its mission and goals. After some analysis and confrontations among the team, the identified problem has been the following:

> "The long time to calculate the KPIs necessary to monitor the Field Service Process."

Figure 2 shows the traditional feedback and control cycle applied to the Field Service process. It plays a fundamental role in managing the company's activities, monitoring their



Source: Authors' own work

Figure 2.
Field Service process

effectiveness and making conscious decisions. However, the long time necessary to obtain the KPIs (highlighted in the picture by the two red hourglasses) made maintaining a constant overview of the situation difficult.

The company could increase the KPIs calculation frequency once every quarter by shortening the time necessary to store raw data and transform them into information. In this way, the firm would be able to have a more customary overview of the process, resulting in higher control. The main benefit would be the possibility to design timely and more effective corrective actions in case of arising problems. The overall positive impact of this reduction would boost the company's performance toward their customers.

As we have previously mentioned, customers' happiness is and must be at the center of ABC's strategy, and therefore the identified problem is crucial for that objective.

4.2 Current situation

The planning phase of the A3 model proceeds with the description of the current condition, whose goal is to describe the company's current situation relative to the problem statement.

In this phase, we had to identify quantitative data to describe the time needed by ABC to compute the KPIs. KPIs include, for example, Customer satisfaction on installation, Time on the field, Install service days and Days to solve remote requests.

However, before collecting those data, we agreed with the After Sales department to map the Field Service Process. We used Business Process Mapping Notation to perform this analysis, which gave us insights into the difficulties of monitoring the process.

The mapping activity started with a written description provided by the company that represented the basis for the first draft of the process. Then, following a cyclical approach, we were able to increase the precision of our map. After several cycles, we defined with a very high level of detail the process that the company followed when performing Field Service activities, from the customer request to the issue of the invoice. During the interviews, we asked direct questions about the software used to support each process step.

The Field Service process was supported by: SAP to manage sales orders and billing activities; Concur to keep track of travel expenses; Microsoft Word, used by technicians to prepare intervention reports; Microsoft Excel to store and process data; Outlook to communicate with customers; and, finally, Salesforce Classic, which was used to store other data. The team used the last four mentioned programs in KPIs' computation activities.

To understand the current situation, the team considered two different measures: the lead time (L.T.) and the workload (W.L.). The L.T. represents the time necessary to obtain the KPIs from the top management's request when the report is delivered. The W.L. considers the man-hour dedicated to the activities related to KPIs' computation during the whole quarter. Even if the L.T. and the W.L. are correlated, monitoring both parameters would make it possible to highlight the company's improvements better. The computation of the KPIs relates to three macro-activities: data storage, pre-computation, and actual computation. These activities allowed the calculation of the L.T. and W.L. The results for the current situation were a L.T. of 4.1 working days and a W.L. value of 15.8 working days (1 working day equal to 8 h).

4.3 Target definition

The team followed a standard procedure to set each target. It included a brainstorming session between team members and then a discussion with some company representatives to review the team's perspective.

Must-have targets have been set based on the indicators considered: L.T. from 4.1 to 1.6 working days; W.L. from 15.8 to 9.5 working days. They represented the minimum objective to be reached at the end of the project, and the team would assume this responsibility.

Besides, Nice-to-Have targets have been set in both cases: L.T. from 4.1 to 0.8 working days and workload from 15.8 to 6.3 working days. They highlight the willingness of the team to go beyond the achievement of the must-have ones.

4.4 Root cause analysis

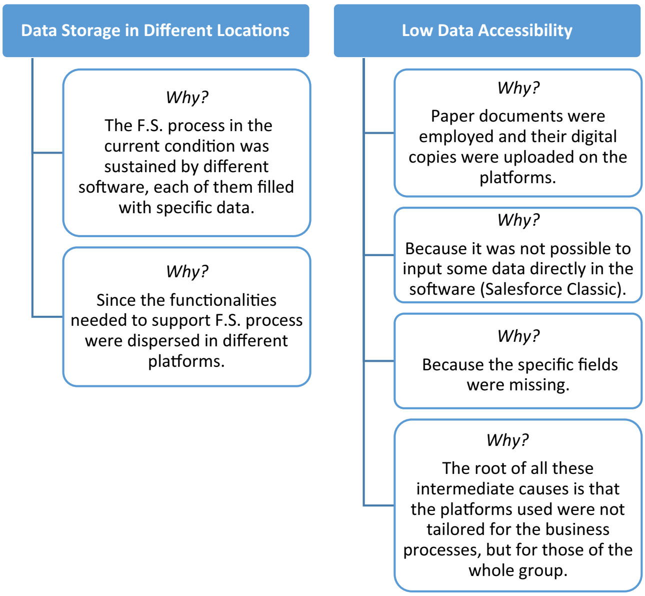
To solve the problem, however, it is critical to understand the primary cause (Figure 3 and 4).

The researchers concluded the root cause analysis in the following graphical representations.

A prioritization matrix was employed to assess each cause systematically. The scale decided by the team and applied in this procedure was 5,3,1. This type of scale drastically differentiates high from low-scoring causes. The high score is attributed to the root cause with a significant impact on the negative characteristic under evaluation. The scores were assigned based on the information gathered throughout the project. The result was later presented to the team lead to validate the coherence of the scores. The final output of this procedure is a priority ranking of the primary causes. The project team designed it by defining relevant elements (data characteristics) that negatively impacted the KPIs' computation time.

Then, each root cause has been evaluated based on its contribution to each specific characteristic (Figure 5). These characteristics are as follows:

- Data Inaccuracy: If data stored are not entirely reliable, check procedures for the accuracy of the data stored in the platforms are necessary, increasing the overall KPIs' calculation time.



Source: Authors' own work

Figure 3.
5 Whys Part 1

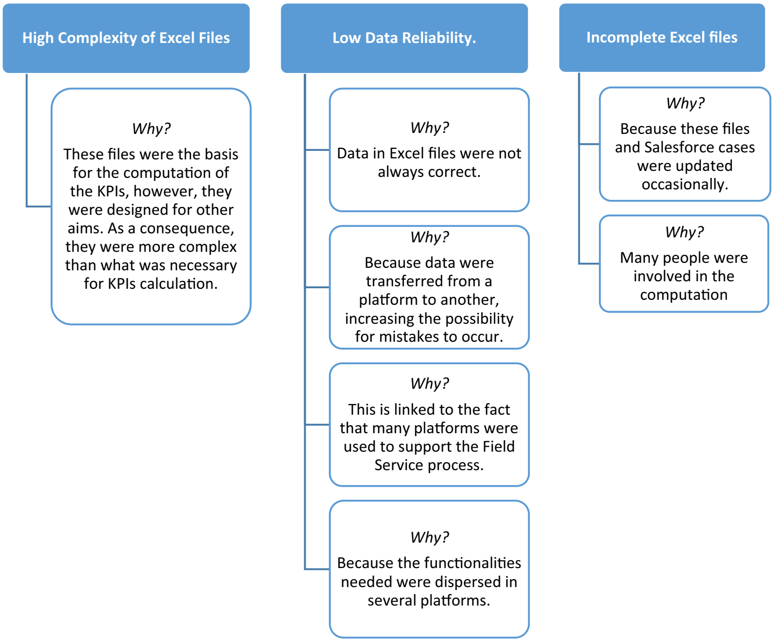


Figure 4.
5 Whys Part 2

Source: Authors' own work

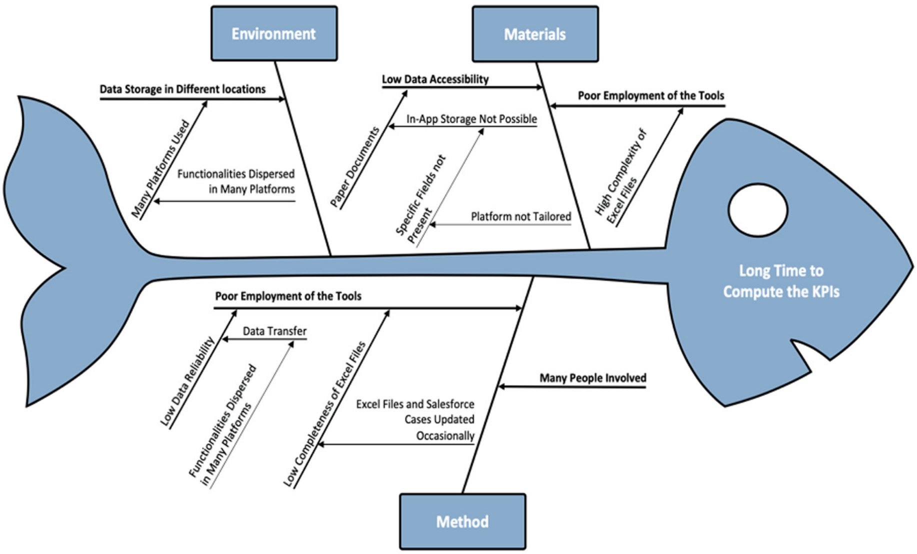


Figure 5.
Ishikawa diagram integrated with five WHYs

Source: Authors' own work

- Data Incompleteness: If data stored are not complete, it is necessary to retrieve those that are missing before calculating the KPIs, increasing the time needed to perform the task.
- Difficulty acting on data: The KPIs' computation process would be negatively affected if operators cannot easily manipulate data.

The scale decided by the team and applied in this procedure was 9,3,1. This type of scale is intended to differentiate high from low-scoring causes. The higher the impact, the higher the score a root cause receives. The scores were assigned based on the information gathered throughout the project. The result was later presented to the team lead to validate the coherence of the scores. In this way, we were able to achieve a better evaluation. The Priority Number for each root cause was calculated as the average of the scores of the three characteristics. Finally, a Pareto analysis with the marginal increase method was applied to derive the classes of the different causes.

Then, it is possible to calculate the average priority number considering all the causes not in the A class and apply the same line of reasoning previously used to assign the causes to the B class. All remaining items are assigned to the C class (Table 1).

4.5 Countermeasures

A brainstorming session involved all researchers and company employees where they discussed the root cause analysis results and possible solutions for each root cause. The researchers guided the meeting and shared the various suggestions given anonymously by other employees in aggregate forms. After a full day of discussion, the team finalized the countermeasures based on the ease of applicability and the investment involved.

The implementation of these actions requires a commitment of resources by the company. Consequently, it is necessary to perform a careful analysis to estimate the efforts (in terms of time, financial resources, and managerial and organizational effort) and the benefits; the latter comprise the expected impact on the addressed performances:

- KPI dashboard: The team created a digitally enabled KPI dashboard to receive as inputs the figures obtained by manipulating the data performed directly in Salesforce and to calculate the KPIs automatically. By exploiting all the possible functionalities provided by implementing the new platform, the system can store all the data needed for the KPIs calculation. The action affected the A class root cause: *The high Complexity of Excel Files* since it allows dedicated, easier-to-use files for KPIs computation.

Criteria/root cause	Data accuracy	Data implementation	Difficulty to act on data	Priority no.	Class
Functionalities dispersed in many platforms	3	9	3	5	A
Excel files and occasional updates of Salesforce cases	9	1	3	4.3	A
High complexity of Excel files	3	1	9	4.3	A
Platform not tailored	1	3	3	2.3	B
Many people involved	3	1	1	1.7	C

Source: Authors' own work

Table 1. Prioritization matrix of the root causes

- Even if the reporting functionalities offered by Salesforce Lightning are very effective, the last steps still need to be performed in an Excel spreadsheet. Therefore, the team designed simplified versions of Excel files that include most KPIs to execute those final activities.
- Salesforce Reports: A new reporting system, Salesforce Lightning, that can be used to pre-aggregate data present in the platform;
- Good Practice for Constant Case Closure: Office personnel every week should check all opened cases on F.S. Lightning. This procedure would allow having in the platform all the data needed to compute the six KPIs at the moment of top management request.
- Dashboard to Monitor Open Cases: It is a visual tool to have a complete overview of the open case interventions at the time of the control. It is connected to the KPI dashboard.

It helps to understand the situation: for instance, if a service case remained open for several quarters, there would probably be something to investigate. Having the cases up to date allows the company team to keep all the data ready to be processed when there is a request for the KPIs, leading to a lower lead time.

4.6 Results monitoring

The Check phase consists of a quantitative analysis that compares the current condition measured in the first part of the project with that after implementing the countermeasures relative to the defined problem. Hence, it is helpful to test the effectiveness of the countermeasures and potentially take corrective actions before the end of the project. Besides, it is used to understand whether the team met targets set previously within the due date.

The strategy applied by the team to perform the check phase of this project was a test trial. The test trial was carried out in the test environment of F.S. Lightning. However, before its execution, the team had to populate the system with specific data. In particular, based on the firm's actual data, the operator created more than 20 service cases and more than 5 installations (with related work orders and service appointments). The trial process has been designed to collect data about the times for each of the three macro activities considered to describe the current condition:

(1) data storage;

(2) pre-computation; and

(3) actual computation.

The data about the times for installation cases have been estimated based on the collected data on service cases, considering that one single case of installation contains, on average, three work orders and three service appointments (one for each work order). Concerning pre-computation activities, the people had to simulate the calculation of the KPIs, following the guidelines of the new process and using the tools designed by the team: reports and dashboard. In the test trials for the actual computation phase, people had to create a table in PowerPoint and insert in it the KPIs obtained following the new process.

Having all the data from the test trials, we could estimate the total L.T. and the total W.L. after applying the countermeasures.

An important aspect is a reduction achieved in both measures: *−96%* in the lead time and *−48%* in the workload.

The first result brings the company very close to having real-time KPIs, meaning that in less than two hours from the request, it would be possible to have them. The second one highlights a relevant saving in terms of time. Specifically, workload reduction can be translated into more than *240 man-hours annually*, which can be reallocated to other activities.

Considering the workload reduction, the team assessed the economic impact in terms of the cost of the man-hours that the company saved from monitoring activities.

The starting point has been a yearly cost of an employee in Italy of 35,700 €. This number has been divided by 2032 h of work a year (8 h a day for 254 working days per year), resulting in a cost of 17.6 €/h per employee.

The 242 h of work saved from monitoring activities yearly correspond to about 4,250 €/year of savings from field service process monitoring. Furthermore, the team is confident that this estimate will increase in the long term as the operators' skills in using F.S. Lightning will grow.

A fundamental aspect that cannot be neglected is the project's impact on the employees involved in the field service process. Their average satisfaction rate was 4.5 out of 5. The positive perception of the methodology will undoubtedly play a vital role in implementing F.S. Lightning and applying the whole procedure to KPIs computation after the Go-Live phase.

4.7 Standardize and share success

The final step of the A3 model is identifying actions aimed at standardizing the new procedures to make the achieved results last in the long term and possible further improvements.

The team devised a few actions to sustain the employees in applying the new KPIs computation process.

The first is a document shared with all employees detailing the new process. The second is a series of video tutorials that show how to insert the information in Salesforce Field Service Lightning, following the main steps: the creation of the case and work order, management of the service appointment, input of the time sheets (time spent by technicians on travel and service activities); work order closure; case closure.

As previously stated, the team exploited the survey submitted to the employees to identify possible further improvements. Thanks to this, it was possible to define the training for the staff as one of the most essential follow-up actions. Moreover, the team is confident that within a few months, when the company's experience with F.S. Lightning increases, it will be possible to optimize the data input phase. This way, the workload would be further reduced, and the Nice-to-Have target set in this project would be achieved.

5. Discussion

This research deploys a customized lean plan and implements it for the monitoring phase downstream of several successful CI projects. Vlachos (2015) developed another lean action plan based on Womack and Jones's (2003) lean plan and discussed the importance of expanding the scope of the projects as soon as momentum follows immediate results. Though this constituted a valid point and was later adopted by other researchers (Vlachos, 2015), this research adds to the extant works by integrating a CI cycle within the monitoring phase. The entire project spanned over several months and was dedicated solely to improving the improvement phase to show managers that each step of a CI project should be considered a standalone project. The stages of CI enter a loop upon starting a new phase; this is the essence of the culture. Unlike van Assen (2018), who rejected the hypothesis that "communicating the meaning of Lean positively moderates the relationship between encouraging continuous improvement and Lean," this action research highlights that managers' support is once again proven necessary for the success of the project, similarly to what other researchers postulated (Bessant *et al.*, 2001; Powell and Coughlan, 2020; Sanchez-Ruiz *et al.*, 2020; Schroeder *et al.*, 2008 Vlachos,2015). This research shows that momentaneous support is not enough; the support is needed before and during the implementation and monitoring phases. It also uses lean thinking to accelerate one of the PDCA cycle phases that other researchers do not often discuss.

6. Conclusion

6.1 Concluding remarks

Companies and organizations often seek performance improvement through various means. CI projects are to advance operations throughout all levels of the organization. They have been applied in manufacturing as well as service companies and have proven to be successful.

However, the established culture demanding instantaneous results might hinder the project's success by investing in the early stages at the expense of the monitoring stage (Bourne *et al.*, 2003; Kaplan and Norton, 1996; Sanchez-Ruiz *et al.*, 2020).

This culture could be attributed to managers' lack of skills and knowledge of the CI tools phase (Kumar *et al.*, 2008) and the lengthy process of data collection and management. Furthermore, the top management must dedicate time and resources to track the project's progress and sustain its success (Sanchez-Ruiz *et al.*, 2020; Schroeder *et al.*, 2008).

In conclusion, the monitoring phase is a critical aspect of a CI project, as it allows teams to track progress, measure the effectiveness of changes, and identify and address any issues that arise. However, managers may take the monitoring phase for granted due to a lack of understanding, time constraints, overconfidence or lack of tools and resources. Ensuring a project stays on track and achieves its goals can be challenging without proper monitoring.

To ensure the success of a CI project, managers should focus on the monitoring phase as much as they focus on other phases. This includes dedicating the necessary resources, developing effective metrics and measurement techniques, and motivating the team. By giving the monitoring phase the required attention, managers can ensure that their projects stay on track and achieve long-term success.

Lean thinking is a culture that should be diffused across all levels of the company, and sometimes, even those who apply it in their operations tend to forget its holistic nature. ABC company was caught up in the small batches of CI projects that eventually neglected other departments in the improvement process. Lean thinking should be taught to all employees, and the researchers wanted to demonstrate to the company that the learning should be reflective. Learning about the success or failures of the projects should lead to more spread of the culture. Even though Lean is recognized as a successful management paradigm, the focus of the literature remains on its applicability within the place it was born in the production and service industries. There is ample room for showcasing lean as successful in improving decision-making processes and accelerating problem emergence and problem-related analysis.

In this sense, the present article intends to focus on the applicability of the lean framework within this area and contribute to the knowledge field through this study.

6.2 Research contributions

This study contributes to the extant research. Through action research, this study showcases the importance of dedicating time and effort to a CI cycle inside the monitoring phase. . Furthermore, it relies on action research to demonstrate that knowledge and lean awareness should not be restricted to where CI occurs in a company. This research adopted a new version of the lean action plan of Womack and Jones (2003). It incorporates its two stages, Planning for Lean and Lean action with the A3 thinking approach, and applies it in a CI loop of a CI project inside a manufacturing company. The company has achieved an impressive reduction in lead time in the KPI formulation process by applying lean principles in this improvement project. It allowed the company to reduce the reaction time to the minimum, and real-time action is now possible. The A3 problem-solving tool proved to be an effective lean methodology that would completely grasp the problem to solve it. Moreover, the direct actors in the monitoring activities were satisfied as well.

6.3 Managerial implications

Lean provides a sane methodology that enables accelerated learning for good decision-making processes. It shows that lean could be applied to any problem and does not exclude decision-making processes. Hence, this paper can help managers and area leaders visualize how to successfully implement the lean approach in their organization and understand the advantages and synergies this could bring to the customer relationship. Managers could benefit from this research by replicating the same steps in any CI project, specifically in the monitoring phase. Furthermore, we introduced the KPI dashboard, a lean digital tool inside their operations. We showed the successful implementation and the usefulness of a simple digital tool to make the process leaner by reducing non-value-added activities. Companies tend to apply digital solutions in their operations with the risk of digitalizing waste. ABC company could have implemented the KPI dashboard from the beginning.

This research provides more empirical evidence of the importance of lean, which adds to the extant literature a case in which lean is applied inside a manufacturing company, but not necessarily in production or logistics or even in between departments but rather as a means to accelerate KPI formulation and calculation to enhance decision-making.

6.4 Limitations

This study presents several limitations. The first limitation of the action research methodology is the challenge of generalizing the findings, specifically when it involves the analysis of one case. It is not easy to generalize the findings and approach to every manufacturing company. However, since Womack and Jones's lean plan and the A3 approach have proven successful in manufacturing and service companies, the proposed lean action plan could also be helpful to companies across both sectors. The second limitation is the need for external consultants and academics that are strange to the company culture. However, companies could greatly benefit from experts who would give unbiased opinions about the company's operations and contribute to advancing the performance. This is achieved after clearly delineating roles and responsibilities for all the stakeholders involved and, most importantly, being willing to work together for project success. Future research could apply our lean action model to other sectors to fully grasp the benefit of CI projects.

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