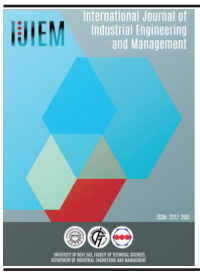
ISSN 2683-345X



journal homepage: http://ijiemjournal.uns.ac.rs/

International Journal of Industrial Engineering and Management

Volume 14 / No 4 / December 2023 / 336 - 348

Original research article

Lean Management in the Banking Industry: A Case Study

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ABSTRACT

The purpose of this paper is to discuss the application of lean principles in the banking industry. The difference between AS-IS and TO-BE process parameters represented the main effects of the improved process using lean tools such as value stream mapping, as well as lean techniques such as centralization, rearranging, elimination, and automation of the process activities. The results showed that lean implementation leads to better overall process performance expressed by various parameters, such as lead time, waiting time, processing time, and process efficiency. Additionally, the Wilcoxon signed-rank test results confirmed that the banking process improved by lean (TO-BE), compared to the existing process (AS-IS), has a shorter duration, and that the positive difference between AS-IS and TO-BE process duration is statistically significant. Also, the effect size based on the mean comparison showed that this statistically significant difference is not trivial. The study demonstrates how banks, relying on the lean paradigm, can improve operational efficiency, but also cope with intense competition, maintain market share, save operating costs, and attract new clients.

ARTICLE INFO

Article history:

Received July 3, 2023
Revised September 29, 2023
Accepted November 28, 2023
Published online December 5, 2023

Keywords:
Banking efficiency;
Lean management;
Process mining;
Value stream mapping;
Change management

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1. Introduction

The banking industry's complexity, customer-centric focus, and the need for cost-effective and efficient operations make it a compelling arena for applying lean management principles. The use of lean principles in the banking industry dates back to the early 2000s, when financial institutions started to understand the importance of operational excellence in a setting where competition was on the rise. Early initiatives centered on process simplification, lowering paper-based transactions, and improving back-office operations. Significant advantages including shortened processing times and increased cost effectiveness were produced by these activities. Lean principles were initially only partially implemented in banking operations that dealt directly with customers. Lean management has advanced within the banking industry in more recent years, expanding its application to include customer service, digital transformation, and product innovation. By removing bottlenecks, automating repetitive procedures, and utilizing data analytics, banking institutions have attempted to provide a seamless and customer-centric experience. This transition to a more comprehensive view of lean management has the potential to increase both operational effectiveness and customer satisfaction.

Lean management in banking is a methodical approach that aims to optimize processes, eliminate waste, and maximize efficiency in order to improve

Published by the University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia.

http://doi.org/10.24867/IJIEM-2023-4-343

customer satisfaction and accomplish sustainable growth. Most banks have slowed, open to error processes, which limit their ability to be flexible, efficient, effective, and responsive to these difficulties [1], [2]. In order to maintain sustainable profitability and strengthen their competitive position, they must seek new strategies and alternative management models that allow them to create value, decrease risk, and minimize resource consumption without compromising quality [3]. The banking sector is undergoing several changes right now, and banks, like other corporate entities, must enhance the efficacy and effectiveness of their procedures in order to be profitable and satisfy customers' expectations. As global financial markets become more integrated, banks are compelled to establish operations, physical branches, and subsidiaries abroad [4]. Additionally, as a result of economic shifts and crises, financial deregulation, globalization, economic liberalization, and digitization, the competitiveness of the financial sector has greatly increased [5]-[7]. On the other hand, although banking industry is strictly regulated, banks have been working continuously to reinvent their products and services in order to meet changing client expectations, maintain their competitive advantage, and take advantage of opportunities brought about by technology advancements and innovations [8]. Inefficiencies related to low productivity, poor planning, poor coordination and communication, mistakes made during training, inadequate processes, tools, and workflows, excessive bureaucracy, errors and rework, and employee annoyance affect almost all financial organizations [9]. Due to regulatory pressure, competition from FinTechs, and the development of new technologies, banks were forced to update or change their business models and provide cutting-edge goods and services [8]. Therefore, banks must develop operational efficiency to face intense competition, protect their market share, lower operational costs, and draw in new customers. This is done by speeding up and improving the quality of banking services, increasing flexibility, and better responding to changing customer expectations [10]. Fortunately, an excellent solution exists and lies in the lean paradigm, since "lean applies to any type of work, in any industry, non-profit or government organization, in any country, and any economic and political system" [9].

While there is a growing body of literature on lean management in the banking industry, several knowledge gaps remain unaddressed. The literature often lacks in-depth insights into the unique challenges and adaptations required when applying lean principles to the intricacies of banking operations. As the banking industry undergoes digital transformation, there is a notable lack of research examining how lean management can be effectively applied in the context of evolving technology and customer expectations. Moreover, universally accepted performance metrics for lean management in banking are yet to be established. As an extension of the existing literature on lean management, this study also enriches the discourse by highlighting the potential benefits derived from integrating cutting-edge approaches such as process mining and advanced project management. According to Van Der Aalst: "process mining aims to discover, monitor, and improve real processes by extracting knowledge from event logs readily available in today's information systems" [11]. By employing process mining, with a focus on real-time data, organizations can gain immediate insights into operational workflows, enabling the timely identification of inefficiencies and facilitating ongoing performance enhancement, and aligning seamlessly with the principles of lean management. The integration of advanced project management tools, such as rigorous cost-benefit analysis, emerges as a strategic avenue for unlocking further potential benefits. The incorporation of comprehensive cost-benefit analysis and its modules [12] could provide a quantitative framework for evaluating the economic feasibility and long-term advantages of lean initiatives within the dynamic and complex landscape of the banking industry. Additionally, by employing advanced risk analysis and simulation techniques, such as Monte Carlo simulation [13], we can develop digital twins, analyze process metrics under different scenarios, and enhance risk assessment and decision-making precision, enabling data-driven continuous improvement and streamlined implementation of lean principles. Acknowledging the pivotal role of advanced change management practices in navigating organizational shifts, we also recognize the potential benefits of examining the effects of change management to enhance the results of the research on lean management, fostering a culture of adaptability and ensuring sustainable improvements within the banking sector. This paper aims to address the critical gap in establishing clear and universally accepted performance metrics for the corporate clients' term deposit process within the banking sector, thereby providing a comprehensive framework for benchmarking and assessing the success of lean initiatives in this specific domain. The novelty of this research lies in its specific application of lean principles in the corporate clients' term deposits process within the banking sector. This process is of critical importance within

the banking industry as it directly impacts bank's financial stability, profitability, and customer relationships. This paper offers a case study that examines the before-and-after effects of lean implementation, quantifying improvements in process efficiency.

2. Literature review

The current literature can be classified into several meaningful streams, each providing insights into the application of lean principles in various industries, including services like banking. Evolution and adaptation of lean thinking stream explores the historical evolution of lean thinking, tracing its origins from Toyota's automotive manufacturing to its rapid adoption in various industries. Toyota's automotive manufacturing is where lean first appeared. Oppenheim and Felbur [9] stated that it first arrived in the 1990s in the United States and other Western countries, where it quickly established itself as the new paradigm in manufacturing before spreading to a variety of other industries, some of which had nothing to do with manufacturing, like administration and government [14], government finance [15], healthcare delivery [16], supply chain management [17], education [18], project management [19], product development [20], engineering [21], customer experience [22], and defense work [23].

Researchers in the case studies and practical applications stream present real-world case studies that demonstrate the practical impact of lean and lean six sigma (LSS) methodologies on improving production capacity, reducing costs, streamlining processes, and enhancing quality across diverse industries. Pickrell et al. [24] provided two case studies that had been completed at a global manufacturer of integrated motion systems and precise slip rings for high-performance requirements in military and commercial airplanes, satellites and spacecraft, missiles, and automated industrial machinery. The findings demonstrated that the lean and six sigma methodologies may enhance production capacity while lowering costs, cycle times, customer returns, and inventory. According to Atkinson [25], organizations need to implement a culture of thinking and listening among staff members and teams in charge of delivering the product or service if they want to develop and apply lean in the service sector. Furterer and Elshennawy [26] presented a case study of applying lean and six sigma tools and principles to improve the quality and timeliness of a city's finance department. The processing times for payroll, purchases, and accounts payable were decreased by 60%, 40%, and 87%, respectively, after deploying an LSS program. According to Heuvel et al. [27], hospitals have significant difficulties because both patients and health insurance companies require that the quality of care be continuously improved. To assist healthcare practitioners in achieving these competing objectives, they used the LSS program. In order to establish an effective framework for systematic innovation initiatives in healthcare, Koning et al. [28] demonstrated how to combine lean thinking principles with six sigma methodology. This allows service businesses to be competitive, cost-efficient, and modern. Bader et al. [29] found: 1) stakeholders salience criteria are considered more often than lean thinking's waste variants in decision-making by managers as a whole and in particular by middle-level managers and senior managers. However, lean thinking's waste variants are considered as often as stakeholder salience criteria by first-line managers; 2) the ranking of stakeholder salience in making decisions is not affected by organization type, respondent position, organization size, perceived lean experience, or geographic location; 3) stakeholder salience criteria have a significantly higher ranking than lean thinking variants in making decisions for all organization types: manufacturing and nonmanufacturing.

Lean in financial services stream explores the application of lean principles within the financial services sector, particularly in banking, emphasizing the unique aspects of lean thinking when applied to services. According to Womack and Jones [30], lean thinking "provides a way to achieve more and more with less and less...while growing closer and closer to delivering customers with exactly what they want". They contend that lean has a significant impact on the service sector. Instead of "Lean Management," "Lean Methods," or "Lean Tools," they used the label "Lean Thinking" since, in the services industry, lean is a way of thinking that integrates people, processes, and tools. Also, they claimed in their 1996 book "Lean Thinking" that "value", as defined and acknowledged by the final customer in terms of a good or service that satisfies its needs and expectations, is the beginning point for effectively applying lean thinking. Introducing lean management is an effective way to achieve maximal quality in all sectors [31]. The phrase "lean service" was coined when Bowen and Youngdahl [32] released their essay "Lean service: in defense of a production-line approach". It quickly gained popularity and significance. It is regarded as one of the earliest lean models to emphasize services. According to these authors, the main point of convergence between lean service and the Womack

model is the creation of "production flow processes" in services and the usage of "pull mechanisms" by customers [10]. In their book, Oppenheim and Felbur [9] addressed this issue, arguing that lean is defined as "striving to meet customer needs at minimum cost as rapidly as feasible while ensuring high-quality work and defect-free products" in the context of financial services. These authors list the eight areas of processing waste that banks can address and reduce by implementing lean principles, including waiting, defects and rework, over-production of information, unnecessary movement of people and information, over-processing of information, inventory of information, and finally, expertise and enthusiasm when staff members are confined to specialized and repetitive tasks. Also, authors define high executive resistance to its application as another challenge in implementing lean in banking services. Swank [33] documented manager resistance to lean implementation among executives of an insurance company. Similar to this study, Delgado et al. [34] claimed that management commitment is the most crucial critical success factor (CSF) for lean solutions. They investigated the service provider GE Consumer Finance, a division of the General Electric Company. Leyer and Moormann [35] explored the adoption of lean in German financial sector organizations using a large-scale study based on 38 questions to examine eight principles that serve as the basic tenets of the lean service philosophy. This highlighted the need of a lean culture (customer need, VSM, flow, pull, perfect creation, leadership style, individual responsibility, continuous improvement). The findings demonstrated that employees assume they are leaner than their actual conduct reveals. Xavier dos Santos and Cabrita [2] examined how lean principles were applied to financial services (CSF). By defining and evaluating the application of lean principles and technologies at one of the biggest Portuguese banks, they carried out case study research. More than two million people use the bank under consideration. The front office of the financial operation was the target. The goal was to increase the process's effectiveness and operational performance. The authors found that integrating lean has improved banking operations to their fullest potential and contend that lean methods must be modified and ingrained into bank culture. Kovacs [36] investigated the case of the second-largest bank in Hungary, KandH Bank, a subsidiary of the Belgian conglomerate KBC with more than 4000 workers. The bank developed a new lean approach with three main focuses: 1) putting customers first, in line with Womack and Jones' [30] thesis of "what consumers want"; 2) streamlining bank operations using VSM mapping; and 3) fostering a positive work environment for all workers. Abinaya and Sureh [37] inferred that the general management leanness (level 1) in commercial banking is the most important driver, it has to be given more importance and enhancements should be made so that they contribute to the overall operational excellence. The other drivers are distributed at various levels in the following order: process management leanness and continuous improvement leanness (level 2); planning leanness (level 3); communication and coordination leanness (level 4). Secchi and Camuffo [38] suggested that the banking lean implementations are less likely to fail when they are characterized by the appropriate level of codification, which is contingent upon the following variables: the performance challenge to be addressed, the sense of urgency of the required improvements, the vertical and horizontal articulation of the target organization, and the organizational units' absorptive capabilities. Li et al. [39], using data from a community bank case study, focused on how service providers can meet rising customer value expectations through service process designs that are not only lean but also with high service quality. The authors consider two design approaches: one with separate (decoupled) front-office and back-office operations and one that integrates the front-office and back-office operations with a combined workforce. Their simulation results over various scenarios confirmed that the integrated design achieves better performance than the decoupled design over a wide range of parameters found in services with both front-office and back-office operations, although the decoupled design is better for some settings. Riva and Piltti [40] found that the main strategy elements of lean management in banking industry are: a) culture base on a set of principles (customer first, improve the processes, cooperate and connect, managing risk, focus on execution); b) importance on both cost reductions and customers satisfaction; c) the use of process management; d) avoid waste in bank and financial service; e) strong integration between lean and six sigma methodologies. According to Bakri [10], small and medium-sized banks may fight fierce competition, protect their market share, lower their operating costs, and ultimately draw in new clients by using lean processes and culture. Finally, Khan et al. [41] found that banks are not implementing lean practices in the true spirit, and to implement lean practices holistically, bank employees should, first of all, understand the philosophy of lean.

Our study on the application of lean principles in the banking industry, focusing on the corporate clients' term deposits process, aims to bridge the gap in the literature by providing a comprehensive framework for benchmarking and assessing the success of lean initiatives in this specific domain. The critical gap addressed by this study lies in the establishment of clear and universally accepted performance metrics for the corporate clients' term deposit process within the banking sector. These metrics are essential for both academic research and practical implementation, enabling banks to optimize their operations, enhance customer satisfaction, and remain competitive in an ever-evolving landscape. This study aims to contribute valuable insights and practical guidance to the ongoing discourse on lean management in the banking industry.

3. Research methodology

The improvement project, used as a research case study, followed to a certain degree the DMAIC approach, which stands for Define, Measure, Analyze, Improve, Control, and generally begins by defining the problem and assembling a project team. The project team was specifically designed to ensure that those most familiar with the process under analysis were involved in all aspects of the improvement project. Next, the process under investigation was mapped, and data were collected and analyzed to establish a baseline measurement of the current process performance. The measure phase started by observing how the process was performed and interviewing the employees responsible for the process activities. In other words, it is observed what the employees were doing and how the employees move from one step to the next and how all the various parts fit together to create the process as a whole. Also, during this phase, time measurement with accompanying notes of each process activity performed by the responsible employee was conducted. This chronometric approach was conducted according to three basic steps: the preparation of the time study based on the previous two phases which included process mapping and observing how the process was actually performed, time measurement of each activity of the mapped process, and the examination of these records. Process duration measurement was performed using a stopwatch to measure the average time it takes to complete process activity. In accordance with employee availability, process activities were measured once or several times. The analysis phase also involved examining each process activity to determine the potential waste and evaluate the impact that waste would have on the process. The process activities identified with the highest waste potential become the focus of the improvement project. To improve the process, ideas regarding how to reduce or eliminate the identified waste were generated, evaluated, and implemented in TO-BE proposal. Since process improvement usually involves changing the way work is done, a control (action) plan was also developed to ensure the sustainability of the improved process. This action plan included consultations regarding changes in process documents, development of detailed IT specification, IT solution development, selection of employees who will be in charge for the process, selection and preparation of working space, making changes in all relevant process documents, providing training in order to develop necessary skillset for employees, and full deployment phase with close supervision.

Additionally, due to the fact that hypothesis testing is widely used in lean six sigma to determine if there is any significant difference in average performance before and after certain action, we used Wilcoxon signed-rank test to test the hypothesis that difference between AS-IS and TO-BE process duration is statistically significant. This test works by ranking the absolute differences between paired observations and assessing whether these ranks collectively deviate significantly from an expected distribution, helping researchers draw conclusions about differences in related data sets. As the Wilcoxon signed-rank test does not assume normality in the data, it can be used to determine whether the mean of a dependent variable is the same in two related groups (e.g., two groups of participants that are measured at two different time points or who undergo two different conditions) when this assumption is violated [42]. This design assumes difference analysis between two conditions, which means that there is a control group (AS-IS) and an experimental group (TO-BE). In our example, we are interested in whether a new TO-BE process (i.e., the experimental group) leads to a difference in performance compared to an existing AS-IS process (i.e., the control group, since this reflects the status-quo), after lean implementation. This way, any positive differences reflect an improvement in the performance of the TO-BE process compared to the AS-IS process and vice-versa for negative differences. Therefore, AS-IS process is acting as a control group and the new TO-BE process is acting as the experimental group.

Moreover, the lean tool used for this analysis was VSM (value stream mapping), which is a detailed

process mapping technique that helps identify the value-adding and non-value-adding activities in the process. VSM typically involves creating current and future state map of the process [43], [44], and can include all the activities, people, and resources involved, as well as information on the time taken to complete each activity in the process. Moreover, VSM can involve determination of activities regarding the value they add from the customer point of view (Figure 1), which is very important because lean management principles emphasize delivering value to the customer as a central objective. This customer-centric approach aligns with the core philosophy of lean, which is to maximize value while minimizing waste from the customer's perspective. Figure 1 (a) shows the main process times in lean approach:

- Lead Time - time that elapses between an item enters and exits the process
- Wait (W) Time - time when an item waits for the next activity (when the process is stopped)
- Process(ing) Time - time during which any activity is being performed
- Value Add (VA) Time - time needed for performing activities that increase value for the client by transforming the good or service (client is willing to pay for them)
- Non-Value Add (NVA) Time - time needed for performing activities that do not provide any value for the client (these activities should be eliminated, simplified or reduced)
- Business Non-Value Add (BNVA) Time - time needed for performing activities that are non-value add but required

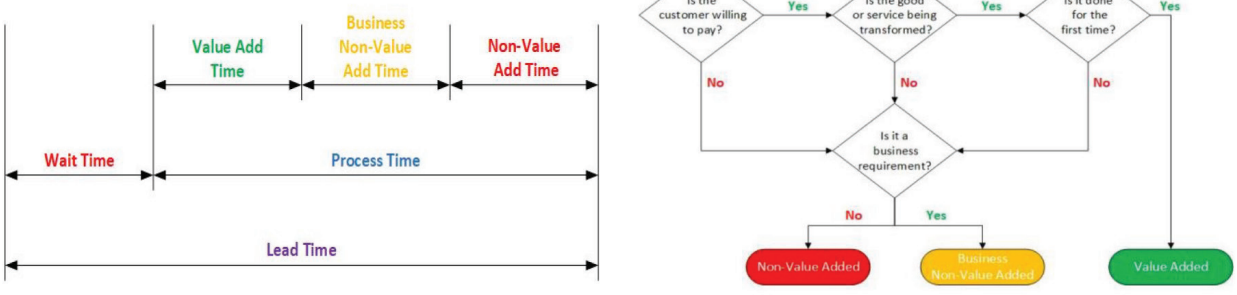
On the other side, Figure 1(b) shows the flow for determining the value of activities from the customer's point of view. According to Trizma [45]: "When we map the customer journey and those moments of truth we can see where the value is being created and how that value is being delivered to our customer. That is why we also need to design value stream mapping for our customer touchpoint processes to reduce non-value activities to a minimum, and remove waste". If the customer is willing to pay for the activity, if the good/service is not transformed, and if it is done for the first time, the activity is value added activity. On contrary, if the customer is not willing to pay for the activity and if it is not a business requirement, the activity is a non-value-added activity.

Finally, if the customer is not willing to pay for an activity, but it is a business requirement, the activity is a business non-value-added activity. For the purpose of this study, the corporate term deposit process has been chosen as a case study to show how lean can be implemented in the banking industry and lead to process improvement. To summarize, the methodology involved the following steps:

(1) Identification of the process to be optimized
(2) Creation of a current state map (AS-IS)
(3) Identification of the value stream - the sequence of activities that create value for the customer
(4) Identification of inefficiencies in the process
(5) Creation of a future state map (TO-BE)
(6) Comparison of AS-IS and TO-BE process
(7) Testing the statistical significance of the difference between the AS-IS and TO-BE process duration.

4. Results and Discussion

Branches have to improve their operational performance and become capable of reaching their sales targets. They must be considered as organizational units mainly in charge of sales of products and services, as well as interaction with clients. The less time employ-



a) b)

Figure 1. a) Wait, Process and Lead Time. Source: Authors, b) Defining the value of an activity [45]

ees in branches spend on performing routine back-office transactional activities, the more time they will have to focus on sales activities, which should eventually lead to more sales resulting in increased revenue. All back office transactional activities (or at least the majority of them) performed within branches should be transferred to back-office personnel. Accordingly, corporate clients' term deposits process (with and without promissory notes as collateral) is recognized as a target for centralization. The results regarding VSM process mapping, including system used for performing activity, responsible employee, chronometric (process activity durations), and activity type for AS-IS and TO-BE process are presented in Table 1 and Table 2, Appendix 1, respectively. The results regarding AS-IS and TO-BE process analysis comparison are presented in Table 3, while the Wilcoxon signed-rank test results are presented in Table 4.

Table 1, Appendix 1, presents AS-IS process overview, where we can see that this process has 23 activities, performed through different systems and by certain responsible employee. We can also see that this process has 6 value add activities, 1 business non-value add activity, as well as 16 non-value add activities. Interestingly, this process has 27% value add activities, which is not surprising since "lean six sigma international research from 2013 identified only 5 to 7% of company's activities to be value added" [45].

On the other hand, Table 2, Appendix 1, presents TO-BE process overview, where we can see that now this process, after lean implementation, has actually 20 activities (without 3 eliminated activities), performed through different systems and by certain responsible employee. TO-BE process is a result of centralization of back-office transactional activities performed within branches, elimination of a certain activities, development of an automatic solution for making a term deposit contract and accompanying promissory note documentation for corporate clients, as well as of rearranging process activities. We can also see that the improved process has 6 value add activities, 1 business non-value add activity, as well as 13 non-value add activities (without 3 eliminated activities).

The results regarding AS-IS and TO-BE process analysis comparison are presented in Table 3. Parameters in Table 3 include: lead time (hrs), waiting time (hrs), processing time (hrs), value-added time (hrs), PCE (%), average monthly frequency, time needed to process average monthly frequency (hrs), FTEs, total needed number of employees (FTEs adjusted for the 1,2 coefficient), needed number of employees in the Network (adjusted FTEs), and needed number of employees in the HO (adjusted FTEs). The difference between AS-IS and TO-BE parameters represents the main effects of the improved process using lean techniques, such as centralization, rearranging, elimination, and automation of process activities. In Table 3 we can see that lean implementation has improved process efficiency by comparing various parameters. Compared to the AS-IS process, the lead time of improved (TO-BE) process is shorter by 50%. Also, the waiting and processing time of TO-BE process are shorter by 49% and 64%, respectively. Accordingly, the process efficiency (PCE) of TO-BE process is higher by 150%. Additionally, compared to the AS-IS process, the time needed to process the average monthly frequency in TO-BE process is shorter by 64%. All of this resulted in a smaller number of needed employees (FTEs) by 64% in TO-BE process. Moreover, the total needed number of employees (FTEs adjusted for the 1,2 co-

Table 3. AS-IS vs. TO-BE process analysis

Parameters	AS-IS	TO-BE	Diff	Diff (%)
Lead time (hrs)	101.1	50.9	50.2	-50%
Waiting time (hrs)	98.6	50	48.6	-49%
Processing time (hrs)	2.5	0.9	1.6	-64%
Value-added time (hrs)	0.5	0.5	/	/
PCE (%)	0.2	0.5	0.3	+150%
Average monthly frequency	250	250	/	/
Time needed to process average monthly frequency (hrs)	625	225	400	-64%
FTEs	3.7	1.3	2.4	-64%
Total needed number of employees (FTEs adjusted for the 1,2 coefficient)	4.5	1.6	2.9	-64%
Needed number of employees in the Network (adjusted FTEs)	4.5	0.2	4.3	-95%
Needed number of employees in the HO (adjusted FTEs)	0	1.4	1.4	/

Note: PCE (process efficiency) = Value-added time / Processing time; FTE - Full Time Equivalent; HO - Head Office. Source:Authors.

efficient) and the needed number of employees in the Network division (adjusted FTEs) are smaller by 64% and 95% for TO-BE process, respectively. Also, the needed number of employees in the Head Office (adjusted FTEs) is 1,4 for TO-BE process, meaning that two employees should be transferred/added from the Network division to the Head Office and be responsible for the corporate clients' term deposits process. Similarly, AS-IS vs. TO-BE processing and waiting time are presented in Figure 2, where we can easily see the above-mentioned differences in processing and waiting time, as well as the portion of activities' values, comparing AS-IS and TO-BE (improved) process.

On the other side, since the assumption on normality in data has been violated, Wilcoxon signed-rank test (Table 4) was run on a sample of 23 process activities to examine whether there is a statistically significant mean difference between the matched durations in two related groups (AS-IS and TO-BE). More precisely, Wilcoxon signed-rank test was performed to determine if there was a statistically significant difference in the mean process duration before and after lean implementation. The null hypothesis is that both distributions are the same (the treatment had no effect). All durations from Table 1 and 2, Appendix 1, are converted in hours for statistical analysis. The summary in Table 4, where var1 is AS-IS process duration and var2 is TO-BE process duration, tells us that there are seven comparisons for which var1 was greater than var2, one comparison where var1 was less than var2, and fifteen comparisons where the two were equal. This again shows that AS-IS process (var1) has a longer time duration compared to TO-BE process (var2). Near the bottom of the output, we can see that the null hypothesis we tested was Ho:

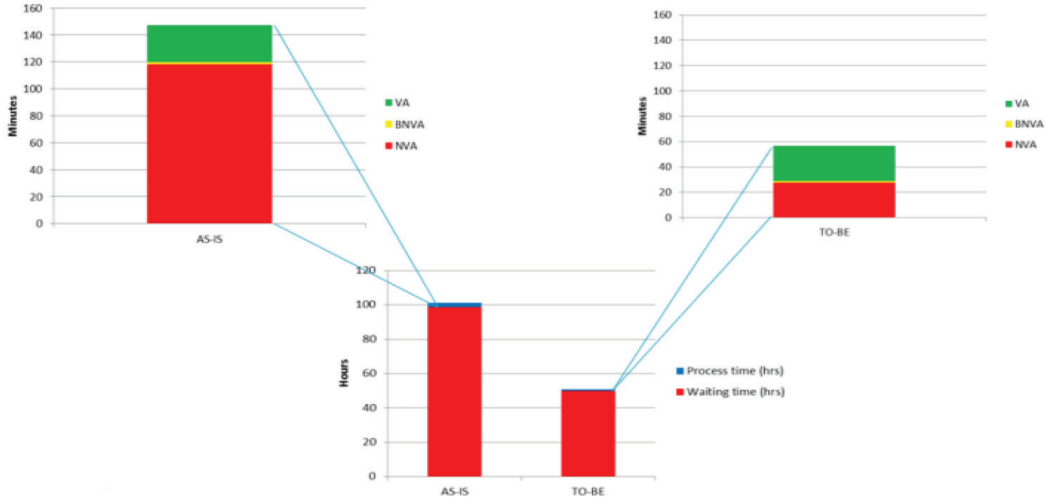


Figure 2. AS-IS vs. TO-BE processing and waiting time. Source: Authors

Table 4. Wilcoxon signed-rank test

Sign	Obs	Sum Ranks	Expected
Positive	7	139	78
Negative	1	17	78
Zero	15	120	120
All	23	276	276
Cohen's d	0.27		
Unadjusted variance	1081.00		
Adjustment for ties	0.00		
Adjustment for zeros	-310.00		
Adjusted variance	771.00		
Ho: var1 = var2; z = 2.197; Prob > |z| = 0.028			

Note: AS-IS and TO-BE duration variables are represented as var1 and var2, respectively. In the data set, the duration of each eliminated and automated activity in TO-BE variable is zero. Source: Statistical software output.

var1 = var2. The z test statistic turned out to be 2.197 and the corresponding p-value was 0.028. Since this value is less than 0.05, we reject the null hypothesis and conclude that there is a statistically significant difference between the mean durations of the two groups. Additionally, the effect size (Cohen's d) is 0.27, which confirms that this positive and statistically significant difference is not trivial, since the effect size is not smaller than 0.2 [46], [47].

These results, which show that TO-BE process duration is shorter than AS-IS process duration with statistical significance, actually reflect an improvement in the performance of the TO-BE process compared to the AS-IS process after lean implementation. Also, the results of this study in certain way support and complement the findings from researchers such as Moyano-Fuentes and Macarena [3], Cetorelli and Goldberg [4], Zafar [5], Akhisar et al. [8], Bakri [10], who examined the benefits of lean principles' implementation in banking and financial sector. Moreover, while this research aligns with the broader lean management literature, it distinguishes itself by focusing on the banking industry and corporate clients' term deposits process. It complements prior research by providing specific insights into the application of lean principles within this context. Finally, as mentioned earlier, to increase the quality of banking services and flexibility, and to respond better to evolving customer expectations, banks have to create an operational efficiency to face extreme competition, protect their market share, reduce their operational cost and attract new customers, which can be done by relying on the lean paradigm since "lean applies to any type of work, in any industry, non-profit or government organization, in any country, and any economic and political system" [9], [10].

Conclusion

Using a case study, this paper showed what lean implementation looks like in a real banking environment. The results of this study showed the benefit of lean management as a tool to improve the efficiency of banking processes. The difference between AS-IS and TO-BE process parameters represented the main effects of the improved process using lean tools such as VSM (value stream mapping), as well as lean techniques such as centralization, rearranging, elimination, and automation of the process activities. It has been proven that lean implementation leads to better overall process performance expressed by various parameters, such as lead time, waiting time, processing time, and process efficiency (PCE). More precisely, the results showed that TO-BE process duration is shorter than AS-IS process duration and that the positive difference between AS-IS and TO-BE process duration is statistically significant and not trivial. These findings can contribute to the benefit of different organizations, since by removing as much of the waste recognized by lean, organizations can experience many benefits, such as increased profits, more satisfied customers, improved operational performance, and lower risks. Lower overhead and better utilization of time and resources will increase profit. Ability to deliver higher quality products more quickly and affordably will increase customer satisfaction. Streamlining and automating business processes will improve overall operational performance. Also, better traceability and compliance to regulations achieved by lean practice will certainly reduce risks. Furthermore, as indicated in prior research, successfully adopting lean methodology can be challenging, necessitating a dedicated and well-defined strategy [48], with the understanding that for these practices to yield sustainable and enduring benefits, they must be adapted and integrated into the organization's culture over time.

This study sets a benchmark for lean management practices in the banking sector, particularly regarding the corporate clients' term deposits process, which can serve as a reference point for other banks looking to implement lean methodologies to enhance operational efficiency in similar processes. The research contributes to the current understanding of lean management by offering empirical evidence of its application in the banking sector, using quantitative analysis, and adopting a customer-centric approach. While it builds upon prior lean management literature, its novelty lies in its industry-specific focus and the case study of the corporate clients' term deposits process, providing valuable insights for both academics and practitioners in the field. This research can serve as a valuable reference for replicating and extending similar studies in other banking institutions and potentially across various industries. The lean methodology can be adapted to assess and improve operational efficiency in different organizational settings, but the extent of applicability to other industries may require adjustments and considerations of industry-specific challenges and processes.

However, there are some limitations of this analysis, such as the lack of multiple process time measurements for certain activities, or different process time measurements supported by certain IT systems, which would certainly lead to the greater

statistical power of the study. Future studies could focus on implementing real-time monitoring systems or integrating advanced data analytics and process mining tools to gather more granular process time measurements. This would provide a more accurate representation of the efficiency gains achieved through lean management practices. Exploring the benefits of the effects of advanced project management and cost-benefit analysis, advanced risk analysis and simulation techniques, within the framework of lean management, not only offers insights into optimizing operational processes but also paves the way for innovative future research directions. Understanding how these methodologies complement and reinforce lean principles can provide a holistic perspective on efficiency improvements, resource utilization, and risk mitigation, thereby contributing to the development of sophisticated strategies for lean implementation. Future research endeavors in this domain can delve into refining integrated frameworks, exploring emerging technologies, and establishing best practices to guide organizations toward sustainable and resilient lean management practices in dynamic and evolving business landscapes. The limitations of this analysis may also extend to organizational factors, such as the varying levels of lean adoption and cultural integration across different banks, which could impact the uniformity of results. Future research could delve into understanding the determinants of successful lean adoption within banking organizations. This could involve examining leadership styles, change management strategies, and organizational culture to identify best practices that contribute to a more seamless integration of lean principles across diverse banking institutions. Also, future studies could aim to compare and contrast the effectiveness of lean practices in various banking segments. This could shed light on sector-specific challenges and opportunities, providing more nuanced insights for practitioners and policymakers. Addressing these limitations through future research endeavors will not only enhance the robustness of the current analysis, but also contribute to a more comprehensive understanding of the intricacies involved in implementing lean management practices in the dynamic context of the banking industry.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Appendix 1. AS-IS and TO-BE process overview

Table 1. AS-IS process overview (current state map)

No.	Activity	System	Responsible	Average duration	Type of activity
1	Reading received request for term deposit	E-mail	BE	0.5 min	**VA**
2	Checking if the client has an open account	Bank core system	BE	1.5 min	**NVA**
3	Sending request to Corporate/Treasury Division or Retail/ Network Division (SBC) for providing intrest rate and approving issuance of promissory note of the Bank	E-mail	BE	2 min	**NVA**
4	Waiting for approval by E-mail from the Corporate/ Treasury or Retail/Network Division	/	BE	2 hrs	**W**
5	Sending offer to the client	E-mail	BE	10 min	**VA**
6	Waiting for offer acceptance by E-mail from the client	/	BE	1 day	**W**
7	Sending request for deposit reference to Corporate Division or Network Division (SBC), if not according to regular terms	E-mail	BE	1.5 min	**NVA**
8	Waiting for deposit reference to be inputted in core system	/	BE	18.5 min	**W**
9	Term deposits (forming deposit party)	Bank core system	BE	2 min	**NVA**
10	Making the contract based on predefined template	Intranet	BE	11 min	**NVA**
11	Collecting signatures for the contract (and insurance statement if needed) from A and B signees and the client	E-mail/ Manually	BE	5 min	**VA**
12	Authorization of deposit party	Bank core system	AU	1.5 min	**BNVA**
13	Filling out promissory note (if needed)	Manually	BE	6 min	**VA**
14	Preparation and sending of promissory note's documentation to Corporate Division for review	E-mail	BE	54 min	**NVA**
15	Waiting for confirmation by E-mail that the documentation is correctly completed	/	BE	20 min	**W**
16	Preparation and sending of promissory note documentation to Corporate Division for signature	Post Express	BE	30 min	**NVA**
17	Waiting for documentation by Post Express from Corporate Division	/	BE	2.5 days	**W**
18	Registration of promissory notes in application	Bank application	BE	5 min	**NVA**
19	Entry of promissory notes into the collateral database	Bank application	BE	5 min	**NVA**
20	Contacting the client to come to the branch and pick up promissory note	Telephone/ E-mail	BE	3 min	**VA**
21	Archiving of documentation	Manually	BE	4 min	**NVA**
22	Checking term deposits expiration date	Bank core system	BE	2 min	**NVA**
23	Sending e-mail to the client with notification for closing or extending term deposit	Telephone/ E-mail	BE	3 min	**VA**

Note: SBC - small business clients; HO - Head Office; BE - branch employee; AU - authorizer. Type of activity: VA - value add; NVA - non-value add; BNVA - business non-value add. Source: Authors.

Table 2. TO-BE process overview (future state map)

No.	Activity	System	Responsible	Average duration	Type of activity
1	Reading received request for term deposit	E-mail	HE	0.5 min	**VA**
2	Checking if the client has an open account	Bank core system	HE	1.5 min	**NVA**
3	Sending request to Corporate/Treasury Division or Retail/ Network (SBC) for providing intrest rate, deposit reference (if not according to regular terms) and issuance of promissory note of the Bank	E-mail	HE	2 min	**NVA**
4	Waiting for approval by E-mail from the Corporate/Treasury or Retail/Network Division	/	HE	2 hrs	**W**
5	Sending offer to the client	E-mail	HE	10 min	**VA**
6	Waiting for offer acceptance from the client	/	HE	1 day	**W**
7	Sending request for deposit reference to Corporate Division or Network Division (SBC), if not according to regular terms	E-mail	Eliminated	/	**NVA**
8	Contract data entry	Bank core system	HE	1 min	**NVA**
9	Making the contract based on predefined template	Bank application	Automatic solution	/	**NVA**
10	Filling out promissory note (if needed) and collecting signatures	Manually	HE	6 min	**VA**
11	Preparation of other promisory note documentation	Bank application	Automatic solution	/	**NVA**
12	Waiting for confirmation by E-mail that the documentation is correctly completed	/	Eliminated	/	**NVA**
13	Preparation and sending of promissory note documentation to Corporate Division for signature	Post Express	Eliminated	/	**NVA**
14	Registration of promissory notes in application	Bank application	HE	5 min	**NVA**
15	Entry of promissory note into the collateral database and sending the documentation (promissory note and contract) to the Branch	Bank application / Post Express	HE	10 min	**NVA**
16	Waiting the documentation by Post Express (promissory note and contract) from the HO	/	BE	1 day	**W**
17	Sending information to the HO Office that the documentation is received, printing the contract, collecting signatures for the contract (and insurance statement if needed) from A and B signees and the client	E-mail/ Manually	BE	5 min	**VA**
18	Term deposits (forming deposit party)	Bank core system	HE	2 min	**NVA**
19	Authorization of deposit party	Bank core system	HE	1.5 min	**BNVA**
20	Contacting the client to come to the Branch and pick up promissory note, copy of contract documentation and insurance statement	Telephone/ E-mail	HE	3 min	**VA**
21	Archiving of documentation	Manually	HE	4 min	**NVA**
22	Checking term deposits expiration date	Bank core system	HE	2 min	**NVA**
23	Sending e-mail to the client with notification for closing or extending term deposit	Telephone/ E-mail	HE	3 min	**VA**

Note: SBC - small business clients; HO - Head Office; HE - Head Office employee ; BE - branch employee. Type of activity: VA - value add; NVA - non-value add; BNVA - business non-value add. Source: Authors.