From Complaint to Continuous Improvement: A Six Sigma Approach to Post-Deployment Software Quality

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***Abstract*—Software quality in large enterprise software contracts is both a corporate performance concern and a scientific process optimization challenge. The Directorate of Quality Management applies a Six Sigma framework—rooted in industrial engineering and quality science—to systematically improve software quality across the contract lifecycle. One of the important phases of this lifecycle is the post-deployment and this study focuses on the post-deployment phase, a stage where corporate client relationships, contractual obligations, and scientific quality metrics converge. This paper proposes an approach based on six-sigma to customer complaint management in post-deployment phase. The approach operationalizes six-sigma's "Define, Measure, Analyze, Improve, and Control (DMAIC)" cycle, integrating quantitative metrics, process reviews, and continuous feedback loops. For this purpose, a web-based visualization tool is developed to monitor complaint management to make sure the eradication of complaints with customer satisfaction with a learning outcome and improved quality process for the company. The paper outlines the proposed process of customer complaint management, which includes reviews and metrics, ensuring the quality of the contracted software. The data indicates that the complaint management cycle is shortened because of this process, which leads to increased customer satisfaction, management belief, and team morale.**

Keywords-software quality management; software post-deployment; software complaint management; six-sigma.

I. INTRODUCTION

A large enterprise software contract is a set of binding documents between a client organization—typically a large corporation or public-sector institution—and a software development partner to deliver software [1]. However, the service does not end with the delivery. The post-deployment phase is a critical component of such contracts. These contracts are characterized by their magnitude, strategic significance, duration, and substantial impact on operations and finances. The magnitude of large corporate software contracts makes software quality strategically important, affecting business results in such agreements. In this context, managing customer complaints and ensuring satisfaction becomes challenging.

Customer satisfaction and contractual compliance are corporate necessities in large enterprise software contracts. Post-deployment complaint management provides an opportunity to apply and validate scientifically grounded quality improvement methods like Six Sigma. The Six Sigma technique has been shown to be crucial and effective in software quality management [2]. This results from a systematic approach to managing and improving software quality. To adopt the DMAIC cycle of Six Sigma [3] in our customer complaint resolution process, we converted each operation into a controlled, quantifiable, and continuously improving workflow. By integrating structured and systematic complaint handling into the software contract lifecycle we ensured continuous quality improvement.

Our company, Aselsan, leverages its extensive experience in military and public safety communications, satellite and space technologies, and information technology. It delivers secure, advanced, and dependable solutions through an efficient methodology in system design, engineering, production, marketing, project management, and customer support for devices and systems. These solutions have been created to compete with the foremost communication system makers globally and domestically.

Our company engages in extensive operations in satellite and space technologies, military communication systems across land, air, and sea, satellite communication user systems, identification and data link systems, public safety and mission-critical communication systems, mobile broadband communication systems, cybersecurity, and information technologies.

Our company's objective is to assess and enhance client satisfaction for all types of services, products, or activities that are planned, manufactured, subcontracted, or procured, and provided to the client following inspections or testing. Activities related to gathering consumer feedback, assessing complaints, and disseminating customer information are conducted for this aim.

This paper aims to propose a Six Sigma-based method to customer complaint management and corrective process in the post-deployment phase, with the goal of improving support services for customers and ultimately benefiting our organization. By applying the DMAIC cycle to a real-world contractual context, this study creates quantifiable

commercial results and transferable scientific information, thus bridging the gap between academic research and corporate practice. The proposed process is executed with precision to guarantee client satisfaction and to maintain the ongoing safe and efficient operation of our systems during the post-deployment phase. The paper also explains the developed web-based tool used for this purpose and presents some data indicating that the proposed process and tool improve customer satisfaction as well as efficient and effective operation. We demonstrate that scientific methods can directly affect and improve corporate quality management strategies by lining up organizational success metrics with rigorous process improvement theory.

This study makes three key contributions to the field of software quality management in large enterprise contracts:
1) Methodological Integration: It extends the utilization of Six Sigma's DMAIC cycle beyond manufacturing and general service industries to the unique, underexamined area of post-deployment software quality in contractual contexts.
2) Operationalization via a Web-based Tool: It presents a web-based visualization portal that monitors and tracks customer complaints while integrating process improvement metrics into daily operational procedures, so establishing a continuous improvement feedback loop.
3) Empirical Validation in a Corporate Context: It offers practitioner-based evidence of the tool's efficacy, showcasing quantifiable decreases in complaint resolution time and enhancements in transparency and priority.

The paper is organized as follows: Section II presents the related work. Section III explains the proposed approach. Section IV presents the result and discussion, and the last section concludes the paper.

II. Related Work

Hong and Goh discussed the applicability of the Six Sigma framework to software [4]. They addressed some common misconceptions on the potential of Six Sigma in software, as well as some actual practical challenges. A framework is suggested for practitioners and managers interested in exploiting the benefits. Redzic and Baik presented the six sigma DMAIC approach to be used for software quality improvement. Their goal was to identify and establish tactical changes that substantially increase the software quality of all software products [5].

The DMAIC framework can be efficiently utilized to mitigate the fundamental causes of customer complaints in large corporate software by methodically addressing quality concerns. This systematic method not only identifies the sources of complaints but also implements sustainable improvements to enhance customer satisfaction [6].

The Define phase identifies the specific customer complaints related to software functionality and quality. It also establishes a clear objective for the company, such as reducing complaints by a certain percentage within a defined timeframe [7].

The Measure phase collects data on the frequency and types of complaints received. It also utilizes metrics to quantify the impact of these complaints on customer satisfaction and business performance [8].

The Analyze phase investigates the root causes of complaints through techniques like cause-and-effect diagrams and Pareto analysis. It also classifies production bugs and identifies critical quality aspects that contribute to customer dissatisfaction [9] [10].

The Improve phase implements targeted solutions to address identified root causes, such as enhancing software testing processes or improving user documentation. The effectiveness of these solutions should be monitored through pilot testing and feedback loops [11].

The Control phase establishes control measures to sustain improvements, including regular reviews of complaint data and continuous training for the development and quality team. It also ensures that the improvements are integrated into the organization's quality management system [7]. The Control phase of the DMAIC framework in Six Sigma is crucial for ensuring that improvements in customer complaint resolution are sustained over the long term [12]. This phase focuses on standardizing processes [13], training employees [14], and establishing monitoring systems to maintain the gains achieved during the Improve phase. Effective implementation of the Control phase can be achieved through several best practices [15].

In addition to DMAIC, there are other frameworks for continuous improvement. One of them is MAPE, which stands for Monitor, Analyze, Plan, and Execute. Rouf et al. [16] adapted it to support DevOps for applications running on a multi-cloud environment and named it MAPE-K. It is built with existing Components-off-the-Shelf (COTS) that interacts with each other to perform self-adaptive actions on multi-cloud environments. Another one is data-driven continuous planning, delivery, and evaluation framework. Barcellos [17] applied this framework to Continuous Software Engineering (CSE), of which roadmap is defined by Fitzgerald and Stol [18], and proposed CSE processes. A similar framework is composed of do, plan, act, and check cycle. Based on this cycle, Carrozza et al. [19] developed SVEVIA, a framework for software quality assessment and strategic decisions support for large-scale mission-critical systems engineering, and its application in a three years long industry-academy cooperation.

III. Proposed Approach

To use Six Sigma's DMAIC framework to solve customer complaints in larger enterprise software, we turned each phase in the workflow into a controlled, measurable process. The proposed workflow is given in Figure 1. It also shows the mapping of our workflow into DMAIC cycle. In the following subsections, we will describe each phase of DMAIC cycle with corresponding tasks.

The organizational chart related to the proposed workflow is as follows. At the top, there is an executive board that oversees all the workflow and organization. Beneath, there is the quality management department. Within the department there is a designated individual, who communicates with the customer. Each complaint is assigned to a responsible person that collects all the necessary information related to the complaint and tracks all the activities related to the complaint. The team that measures,

analyzes, and improves the complaint with respect to DMAIC framework is composed of development team and quality management team. In the quality management team, there is a process quality officer who manages activities related to process complaints, while the project quality officer oversees those related to project complaints.

A. Define

Upon identification or notification of a customer complaint or potential dissatisfaction, corrective action is initiated in the project quality portal (PROKAP) by the quality management, adhering to the corrective and remedial action policy, to resolve the issue. This process is overseen by the designated individual from the quality management in accordance with the respected policy. Once the complaint is entered into the PROKAP, a responsible for the complaint is assigned according to the characteristics of the complaint.

The responsible person for the complaint collects all pertinent information concerning the issue and enters them into the PROKAP. The subsequent tasks in Table I must be initiated for the complaint notice arising from client complaints. The order of these tasks is shown in Figure 1.

TABLE I. TASKS WITH LATEST PLANNED COMPLETION DATE

Task	***Latest Planned Completion Date***
1 Meeting	First 5 working days as of the notification date
2 Analysis	10 calendar days as of the notification date
3 Correction	20 calendar days as of the notification date
4 Root Cause Analysis	30 calendar days as of the notification date
5 Permanent Solution	120 calendar days as of the notification date
6 Activity Tracking	180 calendar days as of the notification date

B. Measure

After collecting information on the client complaint, the individual responsible for the complaint generates a Z7 notification. Z7 alerts refer to the notification category assigned for systematic nonconformities within the PROKAP.

Upon notification creation, the quality officer in the process team manages activities related to process complaints, while the project quality officer oversees those related to project complaints, utilizing Z7 notifications. The customer satisfaction process mandates the prompt establishment of an action plan and the planning and implementation of temporary urgent measures following notification, to be completed within 20 days and coordinated by the project quality manager or process team quality officer, with closure occurring within 6 months.

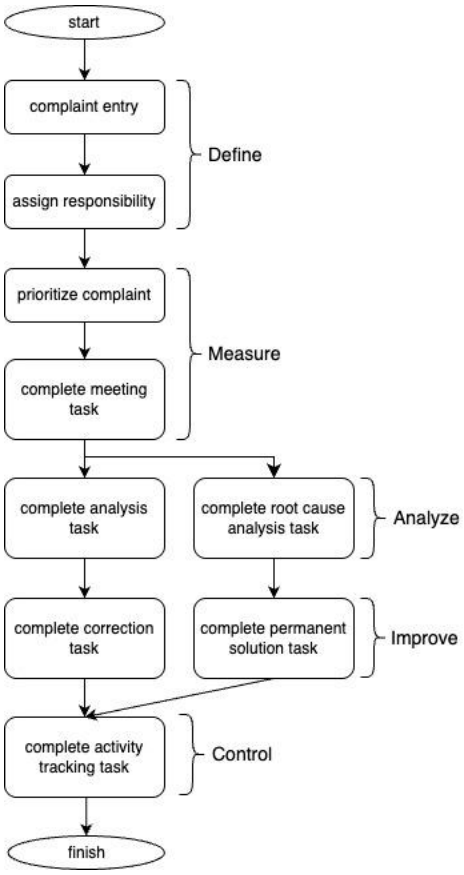

Figure 1. The Proposed Workflow.

Each complaint undergoes an initial evaluation that considers factors such as severity, security implications, complexity, impact, and the necessity or feasibility of a prompt response. Prioritization is carried out based on this evaluation, which encompasses relevant product, consumer, and political-economic-sociological-technological factors. A complaint may be categorized according to one of the priority levels specified in Table I.

TABLE II. COMPLAINT SEVERITY LEVELS

Priority Level	***Explanation***
Low	improvement suggestion
Medium	feedback
High	failure notification
Very High	Health, Safety, Privacy, Security, Customer Urgency Request, Loss of Critical Function

C. Analyze

In this phase, two analysis tasks are executed. The first one is directly related the complaint, and the development team tries to understand what causes the complaint. The second analysis performed by the quality team to understand why the problem that causes the complaint has occurred. For that purpose, the root causes of complaint are investigated through techniques like 5 Whys method and Pareto analysis.

D. *Improve*

The corrective and remedial action policy is overseen within the PROKAP. The person responsible for the complaint ensures necessary monitoring, remedial actions, and resolution of the issue through the development team and quality management team. While the development team corrects the problem, the quality management team develops and implements targeted solutions to address identified root causes, such as enhancing software testing processes.

E. *Control*

The person responsible for the complaint presents unresolvable issues to the executive board for assessment. Notifications that are initiated are monitored by quality management team and subsequently addressed. The designated individual who initiated the complaint notice must inform the customer of the progress with respect to the proposed workflow. Following the resolution of the issue and the establishment of an agreement with the customer, the relevant quality notification is closed. The Customer Satisfaction Index is assessed biannually by the customer satisfaction process measurement officer through the weighted average of survey assessment results. The assessment results are inputted into the PROKAP.

IV. TOOL SUPPORT

The screenshot in Figure 2 shows our Project Quality Portal, which is a web-based software system used to monitor, manage, and report on quality-related tasks and issues in large enterprise software projects. The screenshot is part of the Customer Complaints module for the chosen project "P123" and offers a structured and visual way to manage complaints throughout the lifespan of the project. The tool supports project governance, transparency, and quality improvement in post-deployment operations.

In the upper right corner, the system presents a vital performance indicator: the Average Notification Closing Time, calculated at 312 days. The prolonged cycle time typically signifies systemic inefficiencies or complexities in complaint resolution. The adjacent pie chart illustrates the distribution of Notification Status, indicating that 4 complaints have been resolved while 1 remains unresolved. This dashboard visualization provides immediate insights for managers and quality leads, assisting them in prioritizing follow-ups and ensuring compliance with service levels.

The table part shows each complaint record, with categories that can be sorted by Notification Number, Status, Opening and Closing Dates, Customer Complaint Text, and Coordinator. This enables each issue to be tracked and checked from the time it is made until it is resolved. Structured fields suggest connecting to back-end systems (like ERP or CRM) to make sure data is consistent and to automate processes. It also allows filtering and analysis based on status, time period, or responsible personnel.

The left-hand menu displays the complete structure of the quality portal, providing access to modules for Notifications, Meetings, Acceptances, Modifications, Subcontractor Activities, and more features. This modular architecture indicates that the site extends beyond complaints, serving as a holistic quality control solution for company projects. The "Project Risks" and "Quality Reports" sections indicate a correlation between complaint trends and risk indicators, facilitating proactive risk mitigation.

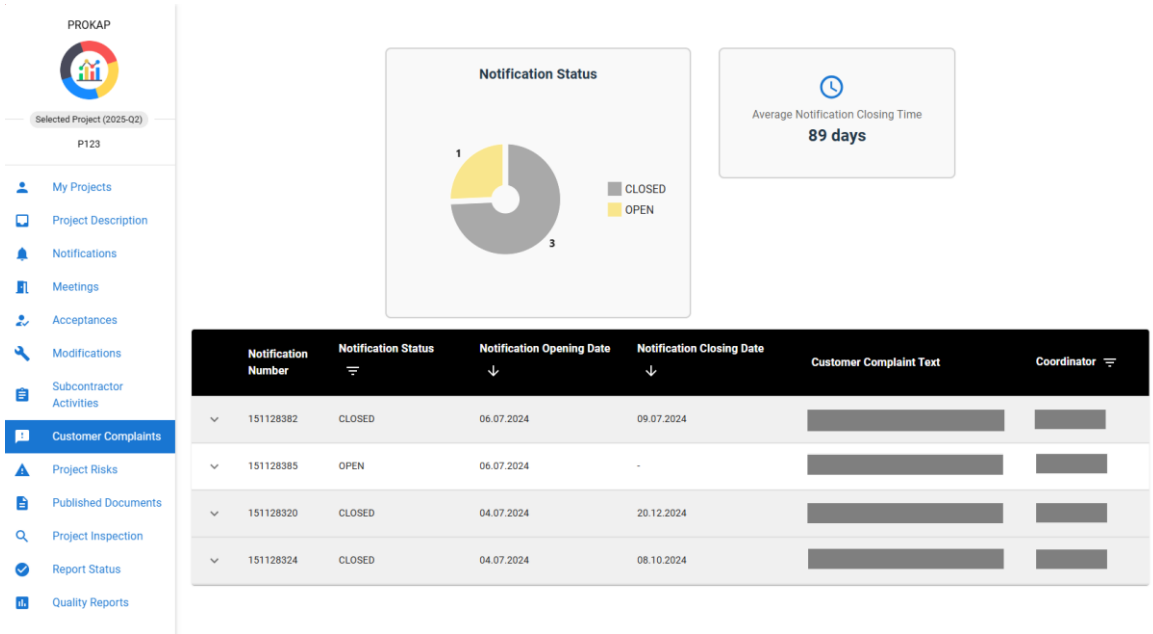

Figure 2. A PROKAP screenshot showing notification status for a selected project.

The quality management portal is multi-project capable, with user-specific role-based access control and provides project-specific views such as “My Projects”, “Project Description”, and “Report Status”. Users can switch between projects depending on their responsibilities. This is especially important in complex multi-stakeholder environments where different develop teams and quality coordinators operate across various domains of the project.

In conclusion, the quality management portal serves as a central hub that unifies all complaint-related activities into a single, easily accessible platform. By converting complaint data into user-friendly dashboards, our visual analytics tool helps managers spot bottlenecks fast, track resolution patterns, and evaluate process effectiveness in real time. From the first complaint logging to the last closure, the integrated comprehensive records module makes sure that every action is completely traceable, enhancing accountability and enabling teams to monitor adherence to specified process steps. Six Sigma's data-driven decision-making principles are directly supported by this mix of analytics and traceability, which speeds up resolution cycles, lowers process variability, and increases departmental transparency. The portal creates a strong operational basis for ongoing enhancement by integrating these features into the post-deployment stage of big software contracts.

V. Results and Discussion

Customer satisfaction is maybe the most important part of large enterprise software delivery. One dimension in customer satisfaction is the number of days it takes to close customer complaints. The average number of days required to resolve customer complaints had increased significantly—from 192 days in 2022 to 294 days in 2023, as depicted in Figure 3—signifying a considerable deterioration in post-deployment service responsiveness. This increased tendency was due to factors including increasing software complexity, disjointed communication among departments, and the lack of a cohesive tracking and accountability mechanism. Recognizing that these delays were compromising customer happiness, contractual adherence, and overall team morale, top management launched a focused quality enhancement initiative. This initiative implemented a Six Sigma-based complaint management strategy, complemented by a newly developed web-based visualization portal, at the beginning of 2024, aiming to reverse the trend, decrease resolution time, and integrate continuous improvement practices into daily operations. Data from 2024 indicates a 32% decrease in average resolution time relative to 2023, along with an increase in timely closures and favorable practitioner feedback, suggesting effectiveness of the adopted strategy.

Monitoring, tracking, and visualization has caused an important impact in the average number of days for closing customer complaints, although the project numbers are risen to 66 in 2024 from 27 in 2023, as shown in Figure 4. Another decision in the initiative is that if a complaint cannot be closed in 180 days, then a deal has been taken with the customer either the customer accepts living with the problem or a penalty is paid. This way, both the customers and the teams in the company can foresee the future and plan accordingly. This has also risen customer satisfaction.

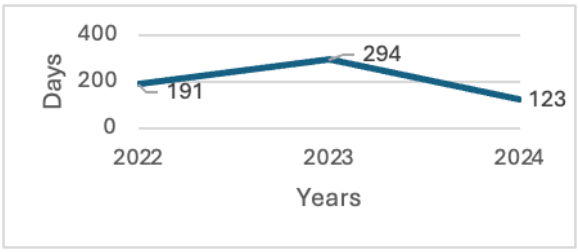

Figure 3. Average Number of Days for Closing Customer Complaints

With the availability of PROKAP portal, all complaint data has become not only visible but also exportable. In this manner, quality officers can conduct analytics on the data. The dataset provides a meaningful baseline for assessing the Six Sigma–based approach's applicability by covering a variety of contract types and organizational contexts. Only 9 projects (7% of the total) in this dataset produced multiple formal complaints; these cases were usually related to the most intricate multi-stakeholder projects, where lengthy deployment phases and integration dependencies raised the possibility of post-deployment problems. This result emphasizes two key points: first, that most projects benefit from reasonably strong project and quality management procedures; and second, that the suggested method works best for high-risk, high-complexity projects where the current systems are not adequate to effectively handle complaints. As a result, the 7% number serves as both a standard for evaluating present efficacy and a benchmark for directing efforts toward ongoing progress in 2025 and beyond.

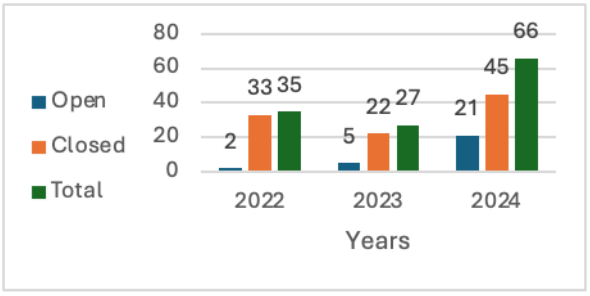

Figure 4. Customer Complaints by Year.

Another analytics obtained is shown in Figure 5. It provides evidence that the closing percentage has increased over the course from 60 days to 90 days. In the year 2024, the closing percentage goes from 31% in sixty days to 60% in ninety days, whereas in the years prior to that, the increase of the percentage has been consistent.

Feedback from five practitioners, including a quality manager, a project lead, and three software quality engineers, who used the portal for a three-month period, indicated strong perceived value in day-to-day operations. The tool's clear visualization of complaint status, according to users, reduced resolution times, and improved transparency. The

integrated measures were viewed particularly effective for prioritizing high-impact complaints and matching operational choices with contractual quality objectives.

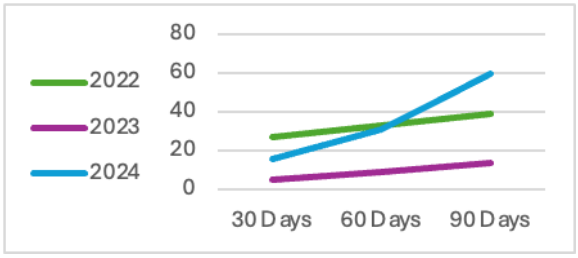

Figure 5. Percentage of Closed Compaints within 30, 60, and 90 days.

A few practitioners suggested that predictive analytics can be incorporated to estimate the amount of time required to resolve complaints. Furthermore, some proposed to add customizable dashboards that are targeted to individual roles. Others suggested a more robust integration with the corporate systems that were already in place to reduce the amount of redundant data entry.

This paper's contribution is primarily empirical and process-oriented, with novelty arising from the application and integration of established quality management methods—such as DMAIC, root cause analysis, and dashboard-based monitoring—into the relatively underexplored context of post-deployment software quality in large enterprise contracts. The theoretical innovation is limited; however, the practical value is evident in the demonstration of how these methods can be operationalized via a centralized web-based portal. This approach is validated through real-world practitioner feedback and is directly connected to measurable outcomes, including reduced resolution times and enhanced accountability.

We analyzed past complaint management processes inside the organization to provide a comparative baseline. Before the introduction of the suggested strategy, complaint management was disjointed among departments, lacked a cohesive monitoring system, and depended significantly on ad hoc reporting, resulting in prolonged resolution periods (averaging 294 days in 2023). The Six Sigma-driven portal-based method has decreased average resolution time by 32% in the first two quarters of 2024, concurrently enhancing practitioner-reported transparency and satisfaction. Despite the dataset's limitations in size and statistical significance, these enhancements indicate a distinct superiority above previous methodologies and establish a basis for more comprehensive empirical research in the future.

The proposed approach offers several advantages. First, a structured, repeatable framework for post-deployment complaint management through the integration of the Six Sigma DMAIC cycle, brought enhanced transparency and accountability via the web-based visualization portal. Second, measurable operational improvements in average resolution time and better prioritization of high-impact issues are achieved. Third, the study demonstrated how a well-known quality improvement methodology can be applied and demonstrated to be useful in a big enterprise software contract environment.

There are also limitations of the study. First, the effectiveness of the proposed approach depends on the accuracy of complaint data entry. Second, there is an initial learning curve when adopting the portal. Moreover, the results of this research cannot be generalized due to the following reasons: i) the implementation of proposed approach is limited to a single organization, ii) the study uses a small sample size, and the results are not statistically significant enough to represent the larger population, iii) the study sample might not be representative of the whole population, iv) the study uses a tool, developed by the authors, that might have some inaccuracies or limitations.

VI. Conclusion and Future Work

In this paper, we proposed a customized DMAIC framework for customer complaint management in large enterprise software. We utilized the Six Sigma's DMAIC framework's customized version to reduce the root causes of customer complaints in large enterprise software by systematically addressing quality issues. This structured approach not only identifies the sources of complaints but also implements sustainable improvements to enhance customer satisfaction.

In addition to the proposed framework, we presented our project quality portal, which is a web-based tool for managing and monitoring large-scale business software projects' quality processes. It keeps thorough sortable records of every complaint and helps with quality management across the whole project with modules like Reports, Notifications, and Risks. The portal makes it possible for multiple projects and parties to be tracked. The proposed framework along with the project quality portal helped us to improve our complaint management not only in terms of resolution time but also for continuous improvement.

The contributions of this study bridge the gap between corporate practice and academic research by showing how a scientifically grounded quality improvement methodology can be adapted, implemented, and validated in a high-stakes enterprise software environment.

For future work we want to enhance the proposed framework by workflow automation, with Service Level Agreements (SLAs), and by incorporating structured root cause analysis tools, such as the 5 Whys and Fishbone diagrams, and associating them with each complaint. Furthermore, we intend to work on a stronger empirical foundation.

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