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A NEW AUTOMATED SYSTEM FOR RFI PROCESSING: LEAD TIME REDUCTIONS AND STAFF PERCEPTION

Oliver Pitman[1], Kasun Wijayaratna[2] and Cecilia G. da Rocha[3]

ABSTRACT

This paper presents the results of a New Automated System for managing the Request for Information (RFI) process for a Tier 1 Contractor in Australia. A before and after case study entailing two projects was carried out: one using a traditional system based on manual email exchanges (Project S) and one using the new proposed system (Project P). The results show considerable reduction in the standard deviation and average time for completing the requests for information, suggesting a streamlined and more reliable RFI process. Survey results also presented favorable outcomes, with staff noting that Project P encounters fewer delays or instances of unanswered requests. Staff also expressed greater confidence in the accuracy and reliability of responses, along with increased satisfaction regarding collaboration, communication, and the overall performance of the new system. This paper illustrates how lean principles such as “simplify” and “reduce lead time” in combination with a relatively simple innovation can create objective and subjective benefits. Furthermore, it provides practical example showcasing that such innovations do not need to be top-to-bottom driven but can be created and implemented by junior/entering level staff.

KEYWORDS

Request for Information (RFI), Lead Time, Automated system, Collaboration.

INTRODUCTION

Request for Information (RFI) processes are instrumental in guaranteeing the precision and comprehensiveness of construction documents, playing a pivotal role in project success. They are indispensable for averting delays and cost overruns, ultimately elevating the overall project performance. Al-keim (2017) underscores the vital role of RFI processes in project management, emphasizing their substantial influence on the efficiency and success of construction projects. The significance of this research extends beyond individual projects, resonating with the broader construction industry and its stakeholders.

The inspiration for this research stems from the tangible, real-world experiences acquired by the primary author during an internship program. To be precise, these experiences unfolded while actively contributing to a tender team overseeing Project S. Within this setting, the RFI process revealed several inefficiencies, such as delayed responses to technical queries and

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internal disorganization leading to unanswered questions. These observations highlight the pivotal need for acquiring precise and timely information from vendors, a fundamental prerequisite for well-informed decision-making in the construction industry (Mostafa et al., 2020).

The following research paper, based on the final year undergraduate thesis developed by the first author of this manuscript, examines the impact of a newly developed automated system for RFIs processing within a major Tier 1 Construction Contractor in Australia. The system, crafted by the primary author was grounded in lean construction principles, particularly in reducing the number of steps and non-value adding activities (waste). The proposed system aims to consolidate all pertinent RFI data into a unified, easily accessible repository, simplifying workflows and significantly reducing the time dedicated to RFI coordination. The outcome was a notable improvement in efficiency and a substantial reduction in the time invested in RFIs management, leading to heightened productivity and the smooth execution of construction projects. This research thus contributes to the ongoing conversation about integrating automation technologies to enhance construction processes, aligning closely with lean construction principles, and echoing the sentiments expressed by Dowsett (2019).

LITERATURE REVIEW

In an ideal world, building designs would precise and complete with no ambiguities. Yet, this is rarely the case with documents most often being incomplete, having erroneous or conflicting information (Tilley 1997). Revisions and clarifications are thus required in the form of RFI, defined by Hanna et al. (2012) as a formal written request prompted by the contractor to acquire further information or clarification regarding matters concerning design, construction, or other contractual documents. RFIs are commonly utilized within the architecture, engineering, construction industry to address uncertainties and discrepancies, as well as to seek supplementary information (Morales et al. 2022).

From a lean viewpoint, RFI and its associated process can be viewed as a form of waste, more specifically as re-work, especially when related to incomplete, incorrect, or ambiguous information on the original design documentation (meaning this was not done right the first time). However, RFI is still a standard communication process used by companies (Gordon et al. 2023). Existing studies on this topic have mainly focused on this flow of information between architects/consultants and contractors/sub-contractors during construction (e.g. Tilley 1997, Hanna 2012, Chin 2009a, Aibinu et al. 2020). However, RFI also applies to the tender phase as examined on this paper.

RFIs are often pointed out in the literature as key performance metrics (e.g. Hanna et al. 2012, Aboseif et al. 2022). Hanna et al. (2012) develop benchmarks metrics for the assessment of transportation infrastructure projects and propose the following two quantitative metrics: (i) RFIs per million dollars of award contract and (ii) percentage of RFIs answered within the requested time period. Similarly, Aboseif et al. (2022) set out to define successful construction projects and suggest six metrics in four areas (cost, time, quality, and communication). For the last area, two of three metrics are: (i) RFI per million of dollars, and (ii) RFI processing time, with successful projects being defined by having less than 8.6 RFIs per million of dollars and of 7 days or less.

Existing investigations tend to examine RFI and its related process from a “value” lens (i.e. what are the types of RFIs, the impact they have, how to minimize/avoid them), etc but not a “flow” lens, with Chin (2009b) being one of few studies. The emphasis on the former lens is clearly justified and reasonable as we should first and foremost seek to eliminate this re-work waste, and secondly aim to reduce it to. Whitin the first lens, Tilley (1997) proposes RFIs to be classified in terms of types (alternative design solutions, approval, info clarifications, information, confirmation, others) and causes (conflicting info, incorrect info, insufficient info, and questionable info). Filho et al. (2016) organize RFIs types with regards to building systems (architecture, plumbing, fire protection and gas, electricity, etc) and/or interface between these systems. They also propose four general categories for RFIs (correction, omission, verification, and divergence) and five categories for RFIs in structural projects (poor alignment, conflicts, level difference, impracticable celling height, and structure absence), as well as ways to reduce these nine types of RFIs. Lastly, Morales et al. (2002) organizes RFIs in three categories: (i) impact (cost, time, scope, and quality), type (alternative solutions, approvals, clarification of information, others) and cause (conflict, incorrect, insufficient, questionable).

The recognition of these two lenses (value and flow) is also observed by Tilley (1997) in arguing that designs need be "effective" (i.e. serve the purpose for which they were intended) but also "efficiently" conveyed. This entails (Tilley 1997): (i) timeliness (information being supplied when required without delays), (ii) accuracy (free of errors and inconsistencies); and (iii) completeness (provision all the data required). Looking at ways to reduce such waste and increase the efficiency of RFIs processing falls under the "flow" lens. Chin (2009b) is a study example adopting this perspective. The refereed author uses Little's Law to examine Work-in-Progress levels (i.e. number of open RFIs request on a system on any given days) and its impact on delays (i.e. RFIs answered after the time frame required by the contractor, leading to delays in construction). It was found that (i) on-time response rates are low (around 50%) and processing times are unnecessarily long and (ii) delays are correlated to WIP levels, suggesting that a high WIP levels is a major cause of delays in RFI processing times (Chin 2009b).

The research carried out here also adopts a "flow" perspective and proposes a new automated system for RFIs processing. It recognizes that RFIs should be avoided in the first place by ensuring that design documentation is correct, complete, and unambiguous. However, given documentation is fail prone, this additional communication process is most often required. Thus, it becomes necessary to have it as efficient and streamlined as possible. The automated system presented was designed considering the lean principles (Koskela 2000) of (i) reducing the number of steps and (ii) reducing waste (particularly transportation, manifested here as numerous e-mail exchanges until the RFI reaches the recipient who can answer it). The main metric for assessing the success of the new system is the reduction in the cycle time (Koskela 2000), or in other words, the time required for RFI processing to be completed.

RESEARCH METHOD

This study analyzed data from Projects S and L, which utilized the traditional RFI via email and a proposed automated system, respectively. Project S focused on a major transportation initiative, aiming to establish an extensive, high-capacity rail network. The examined package included tasks such as excavating twin bored tunnels, constructing station boxes, creating cross passages, implementing viaduct underpinning for active rail lines, and installing a sewer protection structure. Project L was similar in nature to allow for comparison between the RFI methodologies. During a two-month period in 2023, staff encountered frustration due to delayed responses to vendors, leading to the collection of data tracking question timings and responses. An after-action review was conducted post-tender to evaluate perceptions of the current RFI process and assess potential enhancements for future systems.

The introduction of the new system occurred during the tender phase of a project focused on front-end engineering and design studies for the upstream production facilities of Project L (Battersby, 2023). These studies involved the development of two fields, including well pads and a central processing facility, along with the implementation of a carbon capture and sequestration scheme. Notably, the team was entirely composed of new members unfamiliar with the previous system, limiting the potential for bias. The new system collected RFI data stored in the bid directory folder within the company. The study spanned four weeks in 2023, strategically chosen to align with the busy mid-phase of the tender process, characterized by the highest number of supplier questions. This timing ensured a comprehensive dataset for thorough analysis.

Two main sources of evidence were used to assess the impact of the automated system for RFIs. First, a time delta comparison (differences between the moment an RFI is asked and when it is answered) was undertaken. In Project S this was carried out using the collected emails received and sent by procurement, then manually entering the information into an excel document. For Project P, this data was collected in the automated system. A total of 22 data points (or RFIs) for Project S (5 months, from September 2022 to February 2023) and 74 data points or (RFIs) or Project P (3 months, from August to October 2023) were collected. The RFI peak was during the middle of the tender for both projects. By examining these time intervals, insights were gained into the efficiency of the RFI process.

Furthermore, a survey with staff was carried out to gather subjective data and insights on the traditional and the automated system. Fourteen people from the infrastructure bidding team were interviewed. The survey for Project S focused on the delays and quality of responses to vendor. Eight people from Project P were interviewed were interviewed with the same questions to provide a direct comparison. The questionnaire entails a total of ten closed ended questions focused on: the average answer time of RFI, occurrence of RFI left unanswered or experiencing delays, confidence in the reliability of the RFIs process, etc. The findings for the eight core questions are summarized in Figure 6.

THE REQUEST FOR INFORMATION PROCESSES

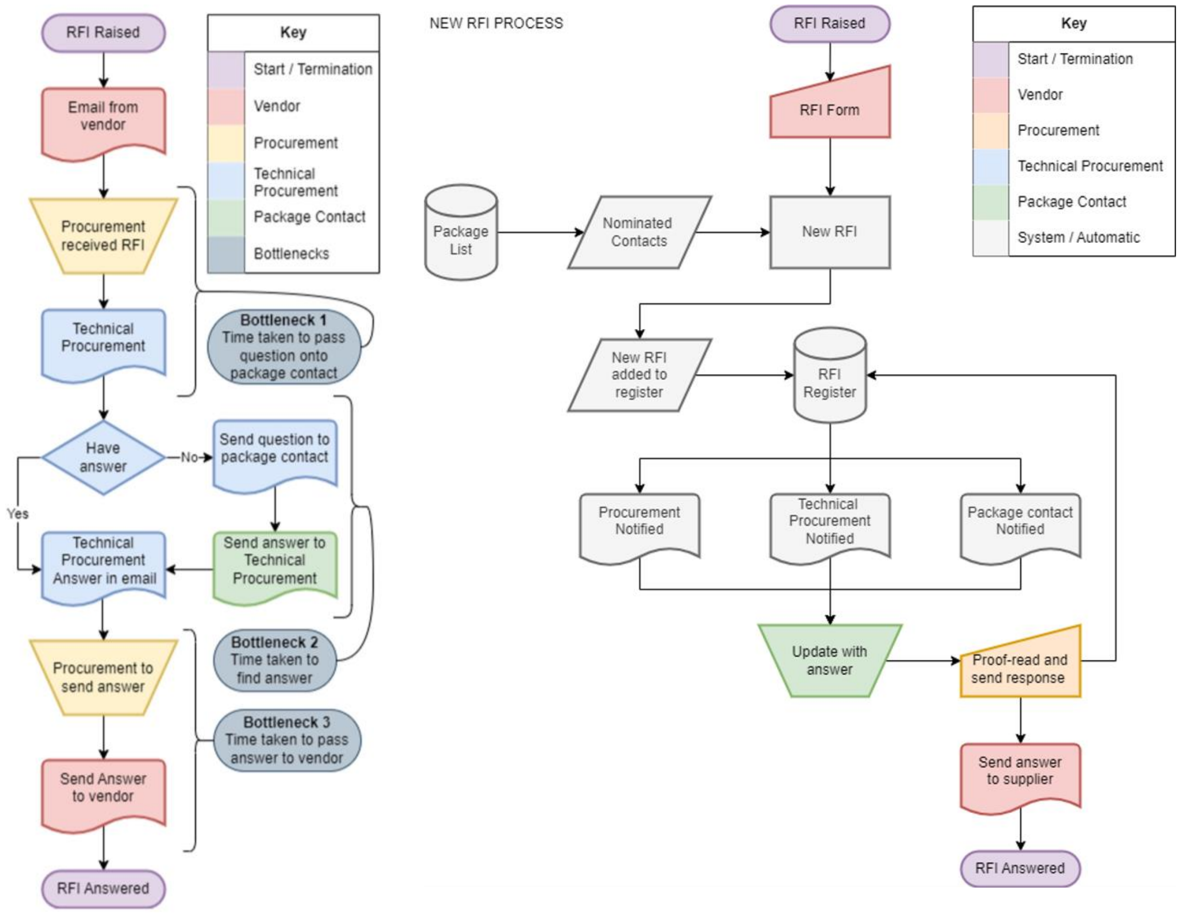
Figure 1 depicts the linear process in the Project S Tender, revealing potential bottlenecks. An RFI may go through up to four handovers before a response, necessitating relay through the same chain. Figure 2 proposes a streamlined solution with automated notifications, centralizing RFI information in a single repository. The top-to-bottom flowchart design aligns with standard principles in software development (Zen Flowchart, 2023).

BEFORE: MANUAL E-MAILS

The sequence commences with the vendor initiating contact through an email to the procurement department. Recognizing the need for a technical response, the procurement contact receives the RFI, either forwarding the request or completing an RFI document, which is then sent to the Technical Procurement team (depicted as bottleneck 1 in Figure 1a). Subsequently, the Technical Procurement team provides an answer or, if unavailable, collaborates with relevant sources like the package scope writer or other members of the construction team to acquire necessary information (indicated as bottleneck 2 in Figure 1a). Once the response is prepared, it is relayed to the procurement contact. Upon receiving the response, the procurement department promptly communicates with the vendor, indicating that the RFI has been addressed and answered (represented as bottleneck 3 in Figure 1a). All communication in this process occurs via e-mails.

AFTER: AUTOMATED SYSTEM

The system was designed using Microsoft Forms, SharePoint Lists, Microsoft Teams, Power Automate, Power BI, and PowerApps. The supplier initiates the RFI by completing a Microsoft Form (Figure 1b), which requires them to enter their details, specify the package of interest, and pose their query. Once this form is submitted, it triggers the generation of an RFI entry within the SharePoint and the request is cross-referenced with the corresponding package number to identify the designated contacts for that package. With every new entry in this list, an automated notification process is initiated, guiding the package contacts on how to maintain and update the RFI information within the list. Once the new RFI is added to the register, three simultaneous notification activities occur (Figure 1) and the RFI is directed to the procurement team for thorough review. Such team then collaborates with technical counterparts for a resolution. Once a suitable response is obtained, the procurement approves the RFI, they select the ‘send’ option, thereby dispatching the response to the suppliers, while simultaneously updating the RFI status to ‘closed’, signifying the completion of this process and marking the response time. Several challenges arise during the implementation of the system, notably the adherence of suppliers to the intended usage of the system, alongside the internal maintenance of up-to-date information within the system.



(a) (b)

Figure 1: Traditional RFI Manual Email (a) and Automated RFI (b) processes

RESULTS

PROBLEM DIAGNOSIS WITHIN PROJECT S (E-MAILS SYSTEM)

Figure 1b highlights the three bottlenecks in the former RFI process, specifically: transferring the RFI to technical procurement (1), the time to find the RFI answer (2), and the time taken to relay the answer to vendors (3). Figure 2 presents the distributions of time delays for each bottleneck type in Project S. The "X" denotes the median of the data, and the blue dot (Bottleneck 1) is classified as an outlier in the dataset. Notably, Bottleneck 2 constitutes 66% of the time required to answer an RFI. This extended duration is attributed to technical procurement, when lacking the answer, having to identify the responsible package owner and gather necessary information within the team. This often led to delays and unnecessary distractions for team members without the required information. Consequently, the automated system was developed to eliminate Bottlenecks 1 and 2. This involved streamlining notifications, removing the need to involve unnecessary team members, and concurrently tracking the package creator, who was likely to possess the answer.

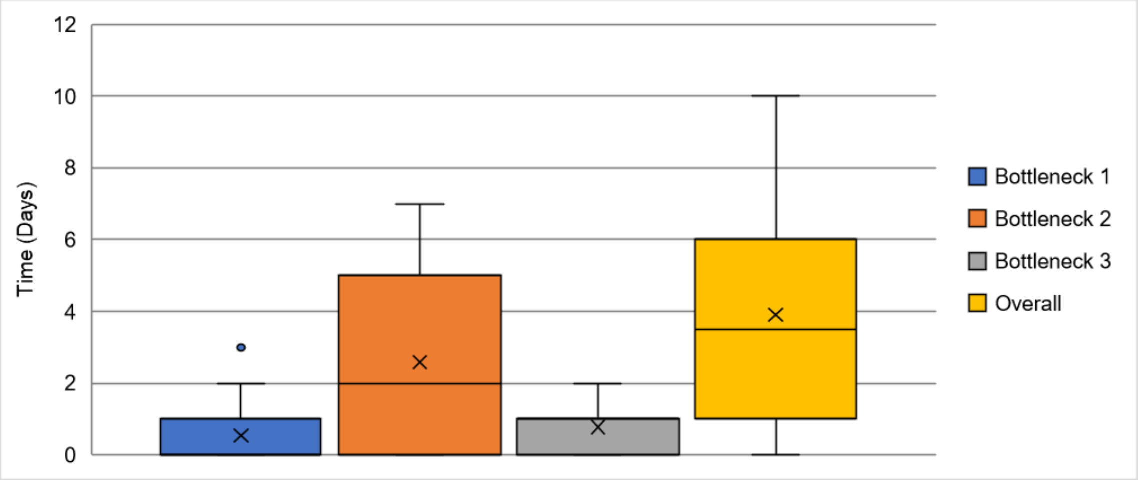


Figure 2: Bottlenecks for Project S (E-mails) based on Figure 1a

COMPARISON OF PROJECTS S AND P

The descriptive statistical analysis of the data gathered from both projects revealed a 49% improvement in mean response times: 3.91 days for Project S as compared with 2 days for Project P (Figure 2). Reliability in response times also improved across Project P, with a 9% reduction of the standard deviation of the response time data. It is important to note that there were many requests for Project P that were answered the day it was submitted resulting in a mode of 0.00, whereas the mode for Project S was 5.00 days.

Figure 3 displays the response time (t) for both the old RFI system (Project S) and the new automated RFI system (Project P) throughout the tendering period. The scatter plot for Project S appears erratic, lacking a discernible pattern. The trend line follows a mostly flat trajectory, with a notably low R2 value of 0.0009, indicating a minimal observable relationship. This suggests that RFIs are neither addressed better nor worse throughout the tender process, aligning with the idea that the previous RFI management approach hindered individuals from adapting to a systematic method, resulting in inconsistent performance. In contrast, Project P tender exhibits an observable learning curve associated with the adoption of the new system, resulting in more efficient responses over time.

Figures 4 and 5 provide a segmented analysis across fourteen-days rolling time intervals, focusing on the standard deviation and mean, respectively. This approach unveils the change in response time over specific time intervals, offering a valuable tool for identifying patterns, fluctuations, or shifts in performance that might be overlooked in longer-term averages. It aids in evaluating the impact of immediate changes or interventions on response times and detecting emerging trends that warrant further investigation.

A notable improvement associated with the New Automated System is evident with regards to mean response as shown in Figure 4. Such system creates significant enhancements as the tender progresses, with a substantial reduction in the mean average of response times as participants become accustomed to the system. For example, Project P's mean response time decreased from approximately 2.7 days to around 0.5 days. This improvement sharply contrasts with the old system, displaying fluctuations in mean response time ranging from 3 days to 7.5 days and no improvement as the tender progressed (response times even became more onerous for some time intervals). Consequently, the Automated System strongly leads to improved responsiveness with diminishing means over time. This pattern suggests that, for this case study, it took approximately 1 to 2 weeks to adapt to the new system, after which response times notably and significantly improved, as evidenced by the sharp reduction observed in Figure 4.

Figure 5 provides an insightful perspective, showing that initially, both projects had closely matched variability in response times during the first week of the tender. As participants adapted to the new system, there was a substantial reduction in response time variance. For example, Project P saw a decrease from approximately 3.3 days to about 0.5 days, a notable improvement compared to the old system, which maintained a standard deviation of around 3.5 days throughout the project duration. The results affirm that the automated system delivered efficiency and reliability benefits in response time for the case study.

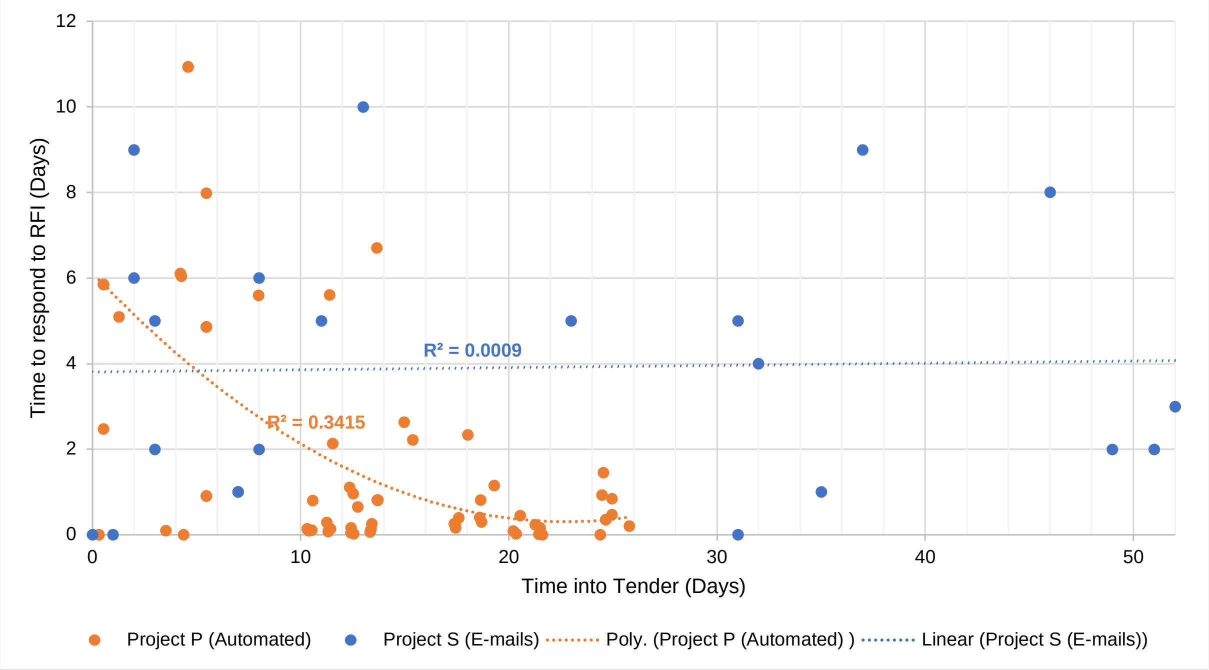


Figure 3: RFI Response Time Scatter Plot Comparison

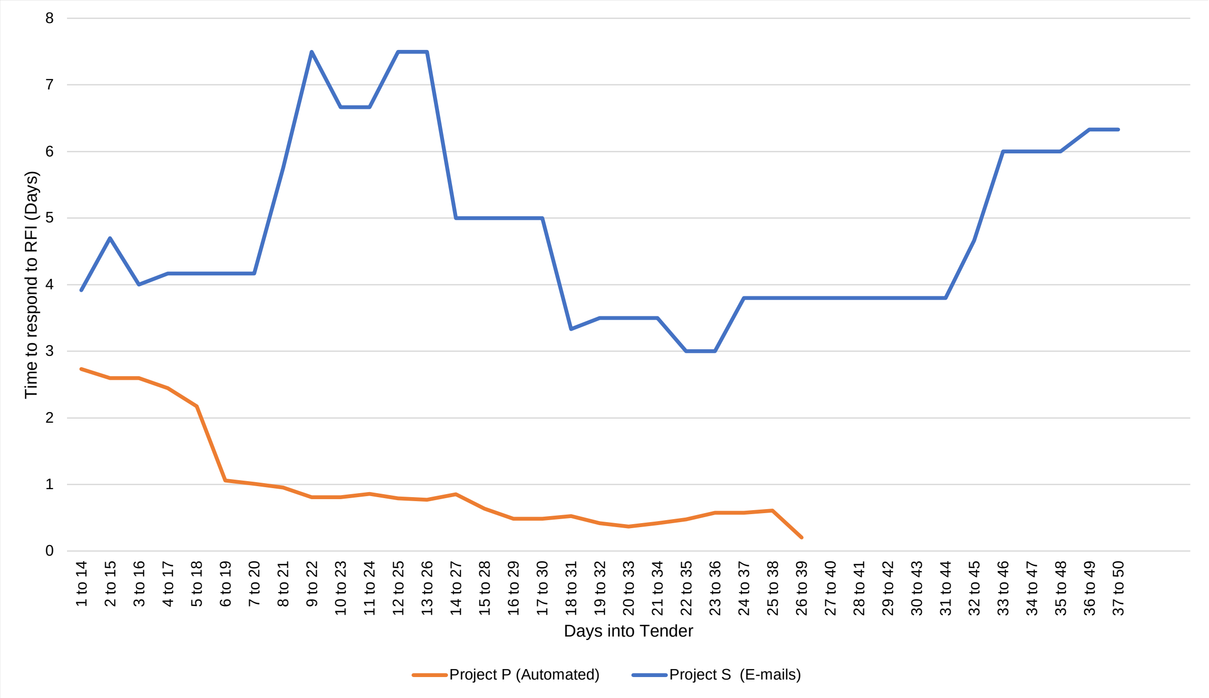


Figure 4: Fourteen days rolling tine horizon of the mean response times

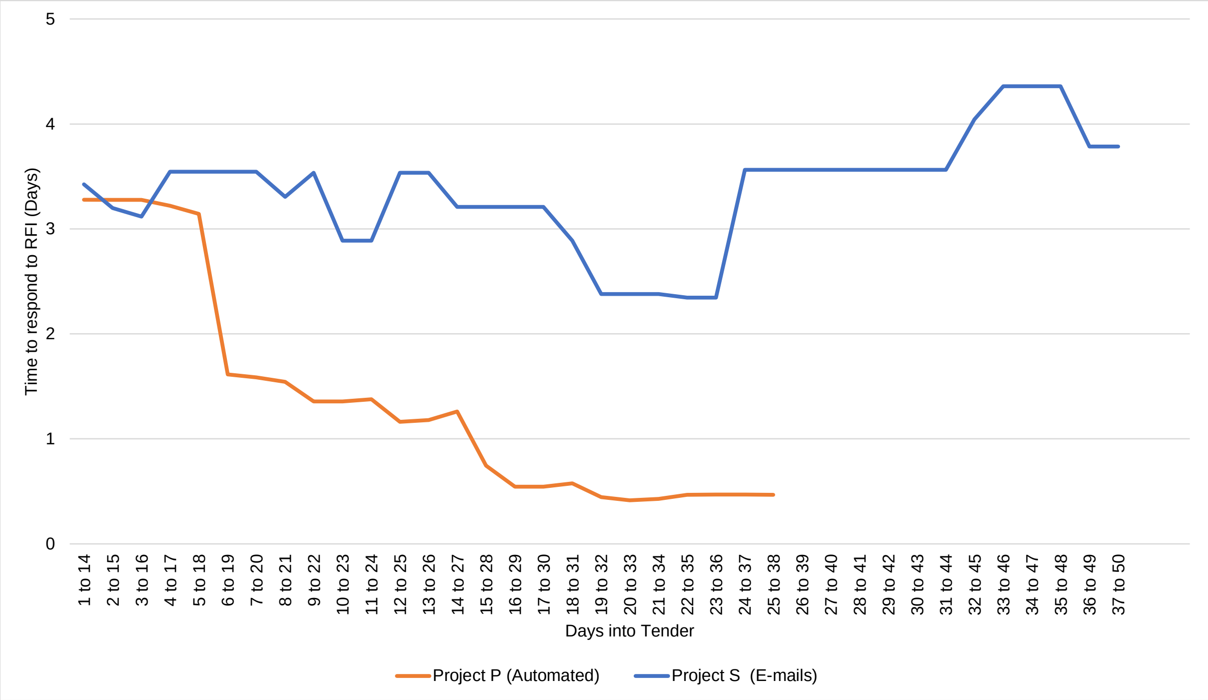


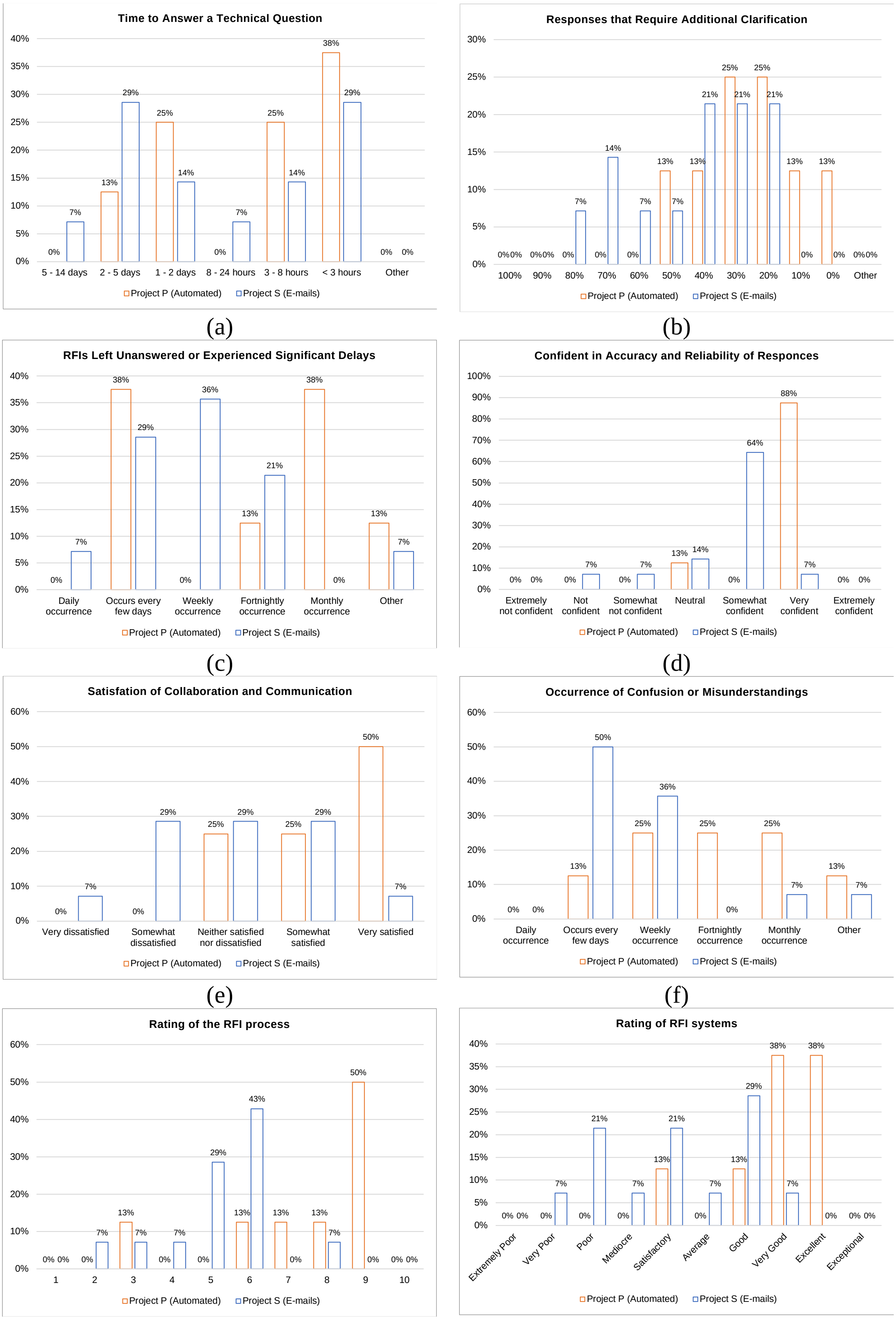
Figure 5: Fourteen days rolling tine horizon of the standard deviation

SURVEY RESULTS

Figure 6 summarizes the survey results to assess the RFIs systems in Project S and P. Graphs (a) to (c) corroborate the improvements from Projects S to P noted in the objective data, detailed in the previous sections. Staff perceived a shorter lead time to respond to a technical question (a): 29% for 2-5 days for Project S and 38% for 3h or less for Project P. A noticeable decrease was also observed for RFIs that require additional clarification (b) and RFI left unattended or experiencing significant delays (c).

Project P also had a higher levels of confidence on the accuracy and reliability of the information (d) and satisfaction levels regarding the collaboration and communication (e), in comparison to Project S. Staff also perceived the confusion or misunderstandings regarding the status of RFIs or their resolutions to be less recurrent (Figure 6f): every few days in Project S (50%) versus a monthly occurrence for Project P (25%). Lastly, the Automated System (Project P) was consistently more highly rated than the traditional manual email exchange format (Figure 6h): very good or excellent (over 75%) versus poor to satisfactory (50%).

The new system was generally well-received by suppliers and staff, as individuals appreciated the establishment of a consistent and repeatable mode of interaction, in contrast to the previous chaotic and inconsistent nature of the manual system, which relied on email exchanges. Some resistance may have been encountered from smaller suppliers less accustomed to such systems. However, procurement representatives effectively guided them through the process, ultimately leading to improved response times, thereby largely satisfying suppliers with the outcomes.



(a) (b)

(c) (d)

(e) (f)

(g) (h)

Figure 6: Survey results

CONCLUSIONS

This paper presents the results of a new automated system for RFI processing. A before and after case study, entailing both objective and subjective data, was carried out to assess the reduction in responses lead time and staff perception. Project S used a traditional system based on manual e-mail exchanges, while the new system designed according to lean principles was implemented in Project P. The objective data analysis focused on RFIs during the 3- and 5-months tendering periods for Project S and P, respectively. A reduction on the average lead time for RFI completion from 3.91 to 2 days was observed when comparing the two projects. The enhancements in the mean and standard deviations values can be clearly visualized in the fourteen day rolling averages (Figures 4 and 5). Regarding the subjective data, positive trends across all eight questions (Figure 6) were noted. The automated system was perceived to perform better than the manual e-mail process across all aspects examined, thus also corroborating the results observed for the RFIs data analysis.

In terms of limitations, certain factors, such as project size, complexity, type, prior supplier relationships, and the learning curve of the new system, were outside the scope of control for this study. Project size, complexity, and type could not be regulated due to the unique nature of each project within a feasible timeframe. Furthermore, altering these variables within such a timeframe would be impractical, given the rapidly evolving industry landscape. Different corporations also have varied supplier relationships, influenced by diverse joint venture arrangements, resulting in a range of supplier dynamics. Nonetheless, both projects underwent a fair and competitive procurement process following the company policy. The learning curve associated with implementing a new system is inevitable, as it takes time for all features to be fully utilised. In this sense, the improvements observed here are likely to be heightened if measured for upcoming project although further research is necessary to corroborate that.

Future research in automated RFI management systems for construction projects offers promising avenues for exploration. Building on the comparative analysis between traditional manual exchanges (Project S) and the automated system (Project P), further studies could delve into long-term effects on project timelines and budgets. Exploring user experiences and scalability, as well as integrating AI and machine learning, could enhance predictive capabilities. This research underscores the importance of ongoing innovation to optimise construction project management and outcomes. Lastly, this paper also showcases the potential to combine industry practice and research at an undergraduate level, ultimately, contributing to showcase and demonstrate the benefits of lean via a bottom-up route (i.e. conceptualisation and implementation of new system driven by an entry level staff).

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