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# The Application of Quality Control Tools in Improving the Short Form Contract Procurement Process

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**Abstract**

There are several quality control tools for problem solving and process improvement, but selecting the optimal tool is not necessarily an easy matter. This study aims to introduce improvements in the Short Form Contract (SFC) procurement processes for a contracting unit in a Saudi industrial company by applying a set of quality control tools. It was noted that the department was performing inconsistently in terms of SFC procurement, and this was causing variable processing times, low consumer satisfaction levels, excessive workloads, and inadequate provision of services. This might negatively affect the firm's integrity and reliability and open it to attacks on operational, environmental, safety, and economic grounds. The data collection plan included extracting data from company reporting system, interviewing a variety of subject matter experts (SMEs) and leaders involved in process execution, and reviewing several historical documents. In accordance with the available data and nature of the problem, the study was designed to deploy a set of the seven basic quality tools, graphical charts and diagrams, the failure mode and effect analysis (FMEA), and waste elimination analysis to reduce delays in various process deliveries. The analysis showed that 57% of the requests were exceeding the target due to inconsistency in conducting various SFC procurement processes caused by the variation in understanding the procedures related. The analysis also identified the sub-processes that would highly influence the overall process performance and bring about the desired level of improvement. The study demonstrated the advantages of applying a set of quality control tools on contracting procurement operations. The chosen tools were employed to evaluate and improve the selected contracting unit's performance in terms of its SFC procurement procedures and remove any wastage in the process.

**Keywords:** Seven basic quality tools, Process Flow Chart, Cause-and-Effect Diagram, FMEA, The 8 Types of Waste, Contracting Procurement Process

## I. INTRODUCTION

The global nature of today's economy has significantly impacted the way things operate in an organization for both consumers and societies. Both entities impose more demands and conditions forcing organizations to optimize their processes to retain their position in their markets. If organizations are to meet the requirements of their customers, both in general terms and detailed specificities, the quality of the organization's services/products must continually rise; this will be the crucial element to stability and future economic growth. Quality management has become central to the way organizations manage themselves in most instances; its main aim is to hit the target performance levels whilst simultaneously boosting market values and keep the organization competitive [1].

The application of quality within organizations is a broad topic and has considerable variations across product/service purchase, manufacturing, and delivery. The concepts of quality control tools first appeared around the industrial revolution [2]. One of the primary quality control needs of modern businesses is quality control and procurement. To become more competitive, both in pricing and the time it takes to get products to the market, many companies will launch procurement quality control to make their products less complex and maximize value delivered to the customer. Procurement is significant in creating value and one of the primary drivers of competitive advantages [3,4]. Procurement consumes resources, which means that companies must think of efficient ways of saving costs in this area without damaging the level of quality control related aspects, i.e., ensuring that all items procured by the company meet the requirements, expectations, and specifications of the manufacturing process [5,6]. If company procurement quality is degraded, this can negatively influence productivity, internal user satisfaction, quality of products and services, customer satisfaction, and ultimately competitive advantage and profits. However, few researchers have paid significant attention to quality control in procurement. In particular, there is little comprehension of how companies can improve quality control in procurement if they are hindered by institutional indifference, lack of managerial resources, and financial constraints [7].

The way in which procurement processes are contracted is central to the way an industrial company operates. To gain a better understanding and more unified practices regarding the way procurement processes are implemented, a Saudi industrial company, where this study was undertaken, has created a Contracting Procurement Manual (CPM). Each of the regional contracting units within all of the company's five administrative area departments across the nation has to comply with the CPM policies when implementing contracting procurement processes. Based on procurement contract's budget and duration, there are three forms of contracting systems covered in the process, Short Form Contract (SFC), Mid Form Contract (MFC), and Long Form Contract (LFC). SFCs are used if the procured service has a value under $1 million with an execution

period of less than six months. The manual further divides SFC procurement requests by type of pricing (lump sum, time unit rate, or work unit rate) and the method used for selection (selective bidding or single source). The manual also mandates the level at which all SFC procurement requests should be approved, taking the aforementioned methods into account.

This study aimed to utilize a set of quality control tools and demonstrate the advantages they can bring to contracting procurement operations at one of the Area Contracting Units (ACU) of the Saudi industrial company. The unit has an inconsistent processing time of SFC procurement requests and that has led to having many complaints from end-users and excessive workloads for the procurement department. The quality control tools chosen were employed to evaluate and improve the selected contracting unit's performance in terms of its SFC procurement procedures and remove any wastage in the process. Additionally, the study analyzed every stage of the SFC procurement processes as laid out in the CPM, namely, Purchase Requisition Supplement (PRS), Bid Slate Development, Job Explanation Meeting, Bid Opening Evaluation, Contract Awarding, and Purchase Order (PO) Development. By doing so, authors intended to contribute to the extant literature on procurement by assessing quality control in procurement performance levels within the industry through demonstrating how practical quality control tools can lead to quality improvements in an organization's procurement department.

## II. RELATED WORK

In dynamic and competitive environments, with companies always coming under price pressures, quality is the only essential competition element. As one of the central processes in any quality management system, procurement and resource management operations directly impact the final product quality and organizational performance. Efficient procurement and resource management processes, centered on strong relationships with all suppliers, will make organizations more effective and efficient and can be the foundation for long-term success through satisfying all stakeholder expectations [8]. Quality control tools may be implemented in various stages of operational processes. They can be used during product development, manufacturing processes, and finished goods performance assessment. The primary aim of the quality control process is to avoid fluctuations in standards and make processes more predictable. It is widely accepted that tight control of operations and keeping predictability levels high are central to business success [9].

Many researchers have stressed that no quality control system can be successfully implemented unless proper quality control tools are employed [10-12]. It has been suggested that many organizations fail to introduce appropriate control tools [13]. As a lack of consistency frequently causes unsatisfactory quality, statistical strategies, including statistical process control (SPC) tools are central to quality control/improvement processes [14]. Such tools are essential in the provision of acceptable levels of quality control. A Japanese researcher, Kaoru Ishikawa, detailed seven essential foundational tools that all organizations should use for quality control, these being control charts, scatter diagrams, cause-and-effect-diagrams, Pareto diagrams, histograms, check sheets, and flowcharts [15-17]. Disconnection of tools is referred to by the American Society for Quality as "the basic seven", "the first", or "the old" [18] while Montgomery [19] refers to them as the "magnificent seven". Employing such visual strategies lets workers in a factory undertake diagnosis and potential elimination of quality control difficulties with no particular expertise in statistics [20].

This literature review intends to examine the seven essential tools for quality control and how they can be used in a number of business environments, and the best ways they can be implemented. A review of the systematic deployment of quality control tools has been offered by Magar and Shinde [21], providing a basic overview of quality control tools and suggestions for improving the way they can be better applied. Such tools are instruments to collect data, analyze it, identify foundational causes, and assess outcomes so that product/ service quality can be improved. Pavletić, Soković and Paliska [22] studied the seven quality control tools in systems for quality management. Their study demonstrated that the tools could be deployed at every production stage, starting with product development and ending with marketing and consumer support. The study examined the ways these tools could be applied successfully in several sectors, including healthcare, tourism, civil service, process industries, and power generation. The study also showed that the systematic use of the tools will lead to improvements in quality. The study detailed the experience of a process industry company that employed the seven tools for handling customer claims, showing that using them for data collection, analysis, and visualization offers a solid foundation for data-based decision making and quality control. Nevertheless, although these tools are easy to apply and have been known for some time, the authors have demonstrated that they are not as widely used in service industries as one might predict. The authors stated that with modern computer capacity and automatic data harvesting, there is no technical reason why these tools should not be more widely applied in educating and training staff regarding quality control.

Many researchers have studied implementing the quality control tools in various sectors, including hospitality, finance, and healthcare [23]. Lee, Ng, and Zhang [24] examined difficulties related to poor service delivery in the Chinese healthcare environment for patients from various socioeconomic demographics; their investigations encompassed quality of service, access, and affordability. The study demonstrated the successful implementation of quality control in hospitals with integrated systems for measuring might improve the quality and performance. In another study, conducted by Rad [25], the analyses on the use of quality control tools were carried out in healthcare environments. It was found that the policy of quality control is more successfully implemented if senior management is fully committed. It was also shown that difficulties with organizational structure, strategy, and human resources can militate against successful quality control. Mellahi and Eyuboglu [26] investigated the crucial elements for successfully implementing quality control in Turkish banks. They found that management commitment and enthusiasm are essential requirements for quality control

successful implementation. In addition, the administration should have the necessary skills and dedication, and there should be national standards and education regarding quality control, supporting organizations to implement it sustainably. Şafakli [27] assessed quality management requirements in Northern Cyprus' financial sector. It was found that effective quality control requires managers to be committed and whole-firm training to be applied continuously, focusing on consumer satisfaction. Regarding implementing quality control in the hospitality sector, Sila and Ebrahimpour [28] analyzed and compared the quality control in a trio of luxury hotels in the north-east USA and how this influenced business outcomes. They found that the essential elements of quality control focused on consumers and the market and good leadership. It was shown that strategic planning is one of the hardest parts of implementation as it requires additional effort. Huseyin [29] examined quality-control philosophies in Northern Cyprus hotels, finding that even luxury hotel owners had little familiarity with quality control approaches requiring more significant investment and did not understand the novel, economical, and easy policies implementation for better quality management.

Modern quality control tools, e.g., failure mode and defect analysis (FMEA), are now used in healthcare, food services, and the software, automotive, and aeronautical industries, amongst others, to implement sustainable improvements in safety and quality [30]. FMEA is one of the best-known tools for quality control employed to improve products or processes continuously. When this technique is applied, risk priority numbers (RPNs) must be determined as they show the risk level linked to possible problems. Such numbers are usually calculated from previous experience and engineering assessment, and those methods can produce inaccurate or inconsistent figures when ordering priorities. It is better to use fuzzy logic techniques to eliminate problems and produce an accurately ranked list of priorities [31]. FMEA has been used for a considerable period in food services, software, and automotive industries, etc. Still, it is only relatively recently that it has been used in healthcare as a proactive means of improving hospital efficiency and patient safety.

In research by Parvez, Rakib and Islam [32], a pair of integrated FMEA approaches were used for choosing the optimal suppliers in a supply chain risk situation. If RPNs produce identical figures for two different decisions, then this cannot be handled by standard FMEA. However, integrating FMEA approaches allows the limitations of conventional FMEA to be superseded. In order to respect confidentiality, this research does not contain the precise names of suppliers. No respondents found anything negative in the selection processes, and all expressed satisfaction with it. Nevertheless, there are still certain limitations to the research [32]. In another study, conducted by Parsana and Patel [33], the research represented an attempt to offer an efficient tool to solve problems in the quality of manufacturing processes by executing FMEA processes alongside suggested practices for controlling processes. This research is intended to identify and eliminate contemporary and possible future problems in the in-house manufacture of a cylinder head. This research has examined the potential reasons for failure and the influence they could have, and how to prevent them. Severity values, Occurrence number, Detection, and Risk Priority Number (RPN) are among the parameters requiring determination. In addition, the authors of the study put forward specific actions that should be implemented as soon as possible to prevent possible risks that will help make the process of manufacturing the cylinder head more efficient and effective and lead to greater consumer satisfaction. The preventative measures suggested by these researchers should cause a considerable decline in industry losses related to finances, quality, and time.

## III. METHOD

The analysis approach used in this study goes under the quality management system to improve. It is being utilized to improve the SFC procurement process at the designated ACU within the industrial company. Nowadays, there are many quality control tools available that are usually applied for problem-solving and process improvements. The selection of the most appropriate and applicable ones is not always an easy task. Many organizations have used a variety of tools without giving enough thinking to their selection. They have then experienced difficulties in making any progress. Those tools cannot solve every quality problem, but they certainly are means for solving problems. Consequently, it is important to know how, when, and which tools should be used in problem-solving or improvement and how to improve processes.

This study is an effort to demonstrate the benefits that may be acquired through using several quality control tools for data acquisitions and data analysis. The remaining part of this section provides brief information about these tools and essential aspects of the study, such as the data collection plan.

### III.I Data Collection Plan

Throughout the study, the data collection process has been conducted through various methods and procedures [34]. The SFC procurement process data has been extracted from the system through the Planning and Support Company Maintenance (P&SCM) Reporting System. In addition, several interviews were conducted with a variety of subject matter experts (SMEs) and leaders involved in process execution. Moreover, various data were collected via reviewing several historical documents. A summary of the ' 'study's data collection plan is illustrated in Table 1.

**Table1.** Data Collection Plan

| Study Objective | Data Collected | Data Collection Mechanism | Data Interval |
|---|---|---|---|
| Improving SFC procurement cycle time to enhance the department's ' KPI's and | Approved SFC requests procured for Regional Terminal Department (RTD). | SAP platform via the P&SCM reporting system | SFC requests procured between 2013 |

| | | | |
|---|---|---|---|
| deliver the requested contract services timely and effectively | Feedback and insights from SMEs and leaders about the SFC procurement process. | Interviews | and 2019 |
| | Historical data (Reports, KPI's trends, investigations, and action plans). | Industrial company internal database | |
| | | Contract Procurement Manual | |

### III.II Tools Used

This section will focus on the analysis tools used along with a brief description of those tools. These tools are the seven basic quality tools, graphical charts and diagrams, the failure mode and effect analysis (FMEA), and the 8 types of waste analysis. In accordance with available data and nature of the problem under investigation, only some of the seven basic quality tools were used in this study. The following is a brief description of those tools in addition to other quality improvement tools that have been applied in this study.

#### *III.II.I The Seven Basic Quality Tools*

Since the 1960's, the seven basic quality tools were first promoted by Ishikawa, one of the famous gurus in the quality management field. These tools can assist an organization in problem-solving and process improvements. These tools are check sheets, flowcharts, histograms, Pareto charts, cause-and-effect-diagrams, scatter diagrams, and control charts. These tools are extensively utilized as graphical problem-solving methods and as general management tools in every process between design and delivery, and few can be used in both process identification and/or process analysis [35]. Among the seven basic quality tools, only process flowcharts and cause-and-effect-diagrams were applied in the study.

##### *1) Process Flowchart*

Process flowchart presents a graphic structure that describes the sequence of steps in a process. It includes the inputs, activities, decision points, and outputs through the process. It can be applied as a problem-solving tool to detect and analyze the steps of the process that may have potential problems so they can be further analyzed for overall process improvement [36].

##### *2) Cause-and-Effect Diagram*

Dr. Kaoru Ishikawa developed the cause-and-effect-diagram in 1943 as a problem-solving tool that investigates and analyzes all potential or real causes that result in a single effect [36].

#### *III.II.II Graphs and Charts*

Graphs and charts are classical tools that are used to summarize quantitative data in graphical representations. Both bar and pie charts are used in this study for data demonstrations. A bar chart is used presenting relationships between variables. Simultaneously, a pie chart is used to represent the percentages of different categories [36].

#### *III.II.III Failure Mode and Effect Analysis (FMEA)*

Failure mode and effect analysis (FMEA) is an optimal management tool for studying possible ways in which a system may fail in uncertain circumstances. FMEA is a tool for risk analysis that can be employed during design processes for improving product reliability [37,38]. It has also achieved industry recognition as an element of the Six Sigma methodology [39]. FMEA undertakes risk analysis in three different areas: probability, impact, and control. Although risk managers often look at probability and impact, as per Hopkin [40], FMEA is unique in having a "control" element that aims at risk avoidance or mitigation. For evaluating each of the aforementioned areas, FMEA employs an appropriate point scale for each area (the higher the score, the worse the situation) where the Risk Priority Number (RPN) can be found through the multiplication of the points awarded for probability, impact, and control.

#### *III.II.IV The 8 Types of Waste*

The eight types of waste that are found in most processes and organizational systems may create a cost of poor quality if they are not well identified and reduced or eliminated [36]. The following presents each of these types of waste with a brief description as in [36].

- **Overproduction:** making or doing more than is required or earlier than needed.
- **Waiting:** for information, materials, people, and maintenance.
- **Transport:** moving people or goods around or between sites.
- **Poor Process Design:** too many/too few steps, non-standardization, and inspection rather than prevention.
- **Inventory:** raw materials, work in progress, finished goods, papers, and electronic files.
- **Motion:** inefficient layouts at workstations, in offices, poor ergonomics.
- **Defects:** errors, scrap, rework, nonconformance.
- **Underutilized Personnel Resources and Creativity:** ideas that are not listened to, skills that are not used.

Due to the nature of the problem under investigation, not all waste types were identified in this study.

## IV. RESULTS AND DISCUSSION

This section illustrates the application of the tools defined in the previous section on the problem under investigation. This illustration starts with presenting the SFC procurement process flowchart followed by a detailed description of each step presented. A variety of graphs and charts will then be presented and analyzed to prove the feasibility of implementing the process improvement. After that, a cause-and-effect-diagram will be demonstrated to address the potential causes of the problem, which will be the input of the FMEA that will allow developing a ranked failure modes and possible causes list. Finally, the waste evaluation practice will be performed for those causes to support the study in further evaluation.

### IV.I Process Flowchart

The SFC procurement process, Figure 1, consists of five high-level steps as follows:

- Purchase Requisition Supplement (PRS) and Bid Slate Development
- Job Explanation (Ex) Meeting
- Bids Opening and Evaluation
- Contract Awarding
- Purchase Order (PO) Development


**Fig. 1.** SFC Procurement High-Level Process Flowchart

The high-level process flowchart of the SFC procurement process is illustrated in detail through the deployment flowchart, Figure 2, which highlights the relationships between stakeholders and the process flow.

The performance of the designated ACU in the SFC procurement process is monitored by the annual average SFC procurement time, a company KPI involving the processes from "Finalize Bid Slate and Initiate PRS" to "Approve PO in SAP System". Thus, the KPI measures the procurement time that starts when the PRS is created until the PO is electronically approved. A detailed description of the processes involved in KPI calculation is presented below.

- **Finalize Bid Slate and Initiate the Purchase Requisition Supplement (PRS):** Upon receiving the feedback from all interested contractors, the contract advisor will finalize the bid slate and will initiate the PRS in the system, and have it routed for approval. The PRS includes all related information, including but not limited to the procurement and pricing methodology, list of bidders (Bid Slate), justifications and remarks, and other essential details that are linked to the work order and estimated budget of the required service.
- **PRS Approval:** The PRS will be routed for approval by the contract advisor triggering multiple approval levels starting from his/her concurrence on the request and passing through his/her direct supervisor to a minimum of 3 supervisory level reviewers and finally to the contract signatory for final approval.
- **Plan/Conduct Job Ex Meeting, Announce Bid Closing Date (BCD) and Send the Request for Proposal (RFP) and Request Bidders for Profile Update:** The contract advisor, upon PRS approval, will start planning for the job explanation meeting when he/she sends an invitation email to all bidders, who are included in the approved bid slate list, and concerned parties announcing the date and location of the meeting. The department will explain the SFC's work scope, company's safety, and quality policies and other related subjects, and a site visit may be offered to all bidders during the meeting. Prior to closing out the meeting, the BCD will be announced, and RFP packages will be distributed to the participating bidders to utilize for submission. Additionally, a period of five working days would be given to allow bidders to send their related inquiries or questions to be answered and clarified by the SME's.
- **Bids Opening:** After the BCD, the contract advisor will confirm receiving all proposals and invite the Bid Review Team (BRT) to open the submitted bids and evaluate them accordingly.
- **Evaluate the Compliance and Qualifications of Submitted Bids:** After opening all submitted bids, the contract advisor will evaluate the proposals and assess them concerning the CPM policies and requirements. This evaluation will be followed by the BRT technical/commercial evaluation and acceptance prior to the contract awarding.
- **Initiate Bid Award Recommendations for Approval:** After bids opening and acceptance, the financial rack-up will be prepared to award the contract to the lowest bidder, and the contract advisor will initiate the awarding recommendation workflow and have it routed for approval.
- **Bids Awarding Approval:** The awarding workflow will be initiated by the contract advisor triggering multiple approval levels starting from his/her direct supervisor to a minimum of 3 supervisory level reviewers. Finally, it will be approved by the contract signatory.
- **Initiate Purchase Order (PO):** Upon awarding approval, the contract advisor will prepare and create the PO in the system and route it for approval. The PO is an official document that will be considered to announce the awarding of the contract. It is the only document that authorizes the contractor to mobilize and perform the work required under SFC scope.
- **Purchase Order (PO) Approval:** The PO will be routed for approval by the contract advisor triggering multiple approval levels starting from his/her concurrence on the request and passing through his/her direct supervisor then to a minimum of 3 supervisory level reviewers and finally to the contract signatory for final approval.

### IV.II Graphs and Charts

In this section, various graphs and charts are being utilized to demonstrate several analytical figures that prove the SFC procurement performance issue within the designated ACU. The analysis of the problem initiated when an unsatisfactory performance of the SFC procurement time was reported by the

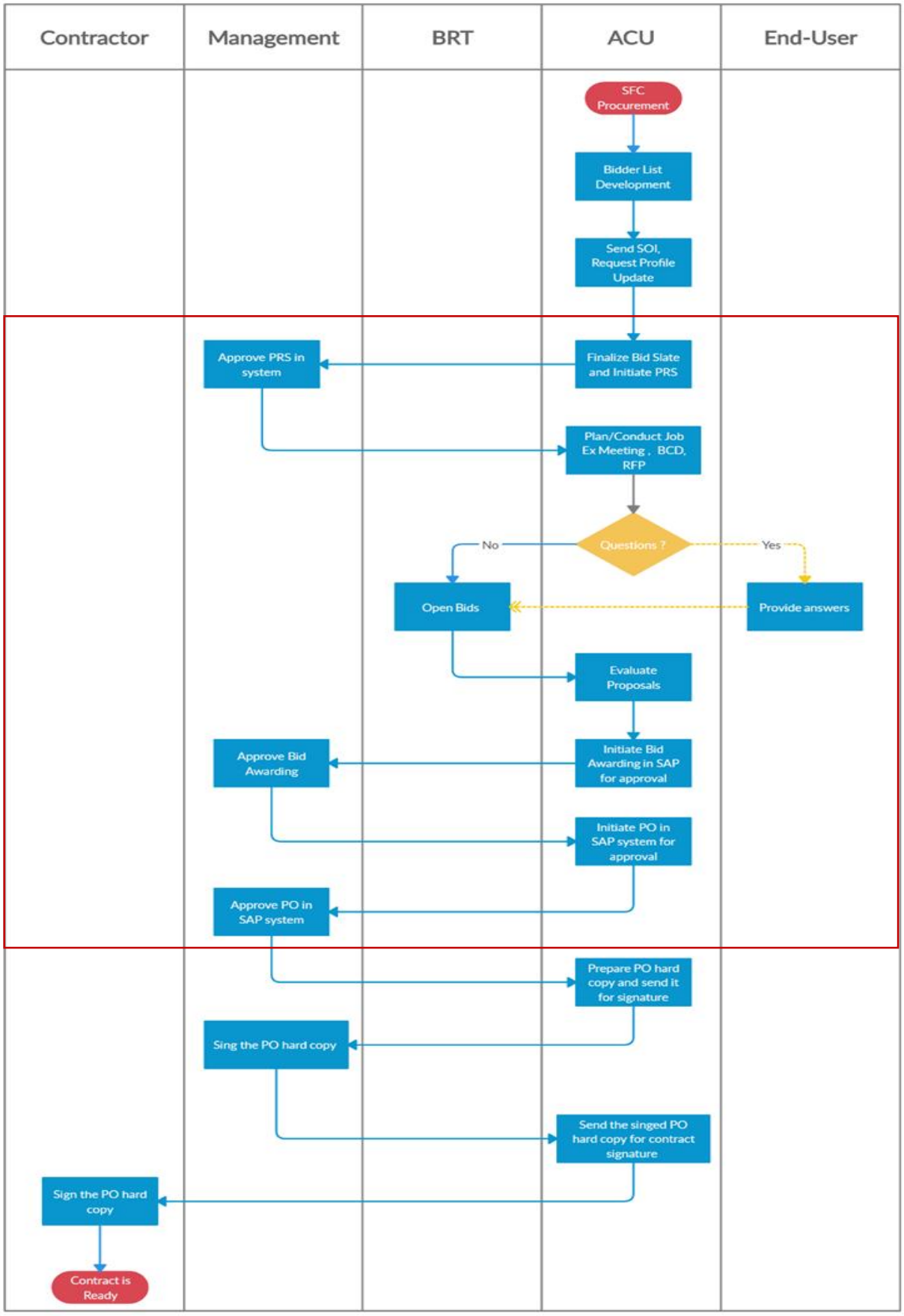


**Fig. 2.** SFC Procurement Deployment Flowchart

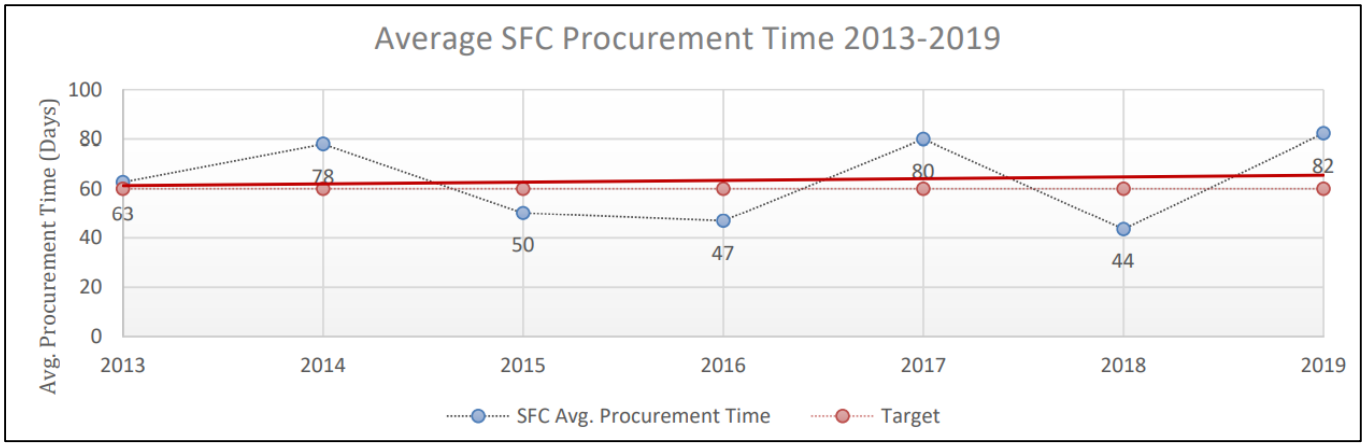


**Fig. 3.** SFC Average Procurement Time (2013 – 2019

department's operational internal assignment meetings. The KPI of 2019 was found 82 days actual annual average time vs. 60 days annual average company target. Accordingly, a database is initiated, including 71 SFC requests extracted from the system between the years 2013 and 2019 for the designated RTD procured SFC's. Hence, the analysis evaluated the designated ACU performance in the SFC procurement process from 2013 to 2019. As presented in Figure 3, there is a sign of inconsistency in the performance of the process as 57% of the records are found off-target (exceeding the target). In addition, since 2013, the average SFC procurement time trend is showing an undesirable increase, which undoubtedly supports the need to have an SFC procurement process improvement effort.

Besides, a benchmarking practice is conducted with other contracting units within the same Admin Area to estimate the required ideal duration to procure the SFC request considering interview approach for data collection. According to Figure 4, a variation appears in estimating the time necessary to complete a procurement cycle. As shown in the figure, the designated ACU would take 45 days to process an SFC request, while the overall Admin Area contracting units would take an average of

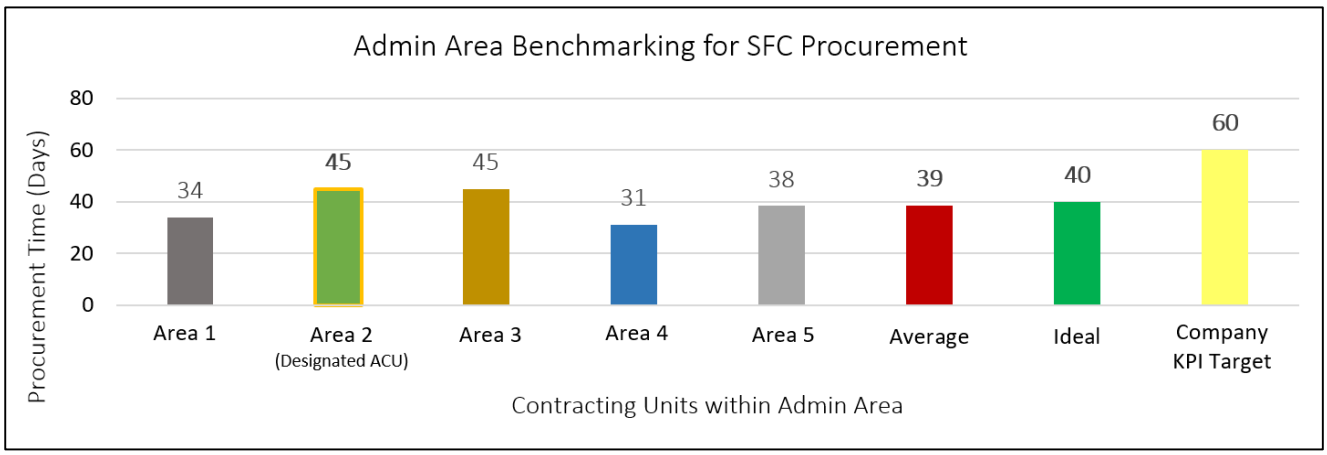


**Fig. 4.** Admin Area Benchmarking for SFC Procurement Duration (Days)

39 days to process an SFC request. Moreover, the CPM's ideal duration is 40 days, and the company KPI, identified by the Admin Area Contracting Division, is 60 days. Therefore, the discrepancy in the process performance, the undesirable trend, and the diversity in process understanding and implementation drive the study toward performing comprehensive evaluation and analysis on the collected data and SFC's process steps within the designated ACU.

As stated previously, 71 SFC requests for the period from 2013-2019 have been analyzed considering various approaches. The annual overall average procurement time is found around 63 days, and among the 71 requests, 38% are exceeding the average company target of 60 days, Figure 5.

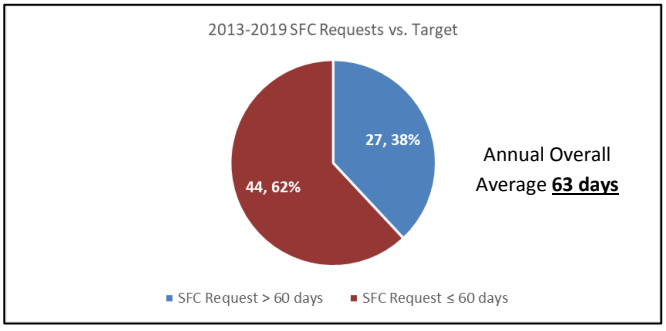


**Fig 5.** SFC Requests Compared to the Target (2013 – 2019)

In this part of the study, the analysis focused on evaluating the average time each sub-process takes compared to the ideal time recommended. Table 2 presents the overall percentage of the requests with a deficient sub-process, defined as a sub-process with an average execution time that exceeds the recommended duration. As a result, seven deficient sub-processes were found. When taking these deficient sub-processes into further analysis, sub-process 5 was found with the highest percentage of the defect with almost 70%, followed by sub-process 4 (56%) and sub-process 1(49%). Moreover, sub-processes 2, 6, and 7 were found with a percentage of defect hovering around 30%. Additionally, Table 2 has been presented in another shape of data illustration to provide a complete overview of the deficient sub-processes.

**Table 2.** Comparing SFC Procurement Sub-Processes Average and Ideal Durations

| Sub-Process No. | Sub-Process Description | Average Duration | Ideal Duration | % of Defective Requests |
|---|---|---|---|---|
| 1 | PRS/Bid Slate Creation - PRS/Bid Slate Review | 5.9 | 0 | 49% |
| 2 | PRS/Bid Slate Review - PRS/Bid Slate Approval | 5.1 | 5 | 28% |
| 3 | PRS/Bid Slate Approval - Job Ex-Meeting including Q&A and RFP | 6.5 | 15 | 5% |
| 4 | Job Ex-Meeting including Q&A and RFP- Bids Opening and Evaluation | 7.6 | 5 | 56% |
| 5 | Bids Opening and Evaluation - Bid Award Creation | 28.9 | 5 | 70% |
| 6 | Bid Award Creation - Bid Award Approval | 8.8 | 5 | 34% |
| 7 | Bid Award Approval - PO Creation | 1.8 | 1 | 34% |
| 8 | PO Creation - PO Review | 0.1 | 0 | 3% |
| 9 | PO Review - PO Approval | 3.5 | 5 | 21% |

Figure 6 illustrates the sub-processes vs. the number of requests with a deficiency in the sub-process. The blue columns represent the total number of requests covered in the study, while the red ones represent the number of defective requests.

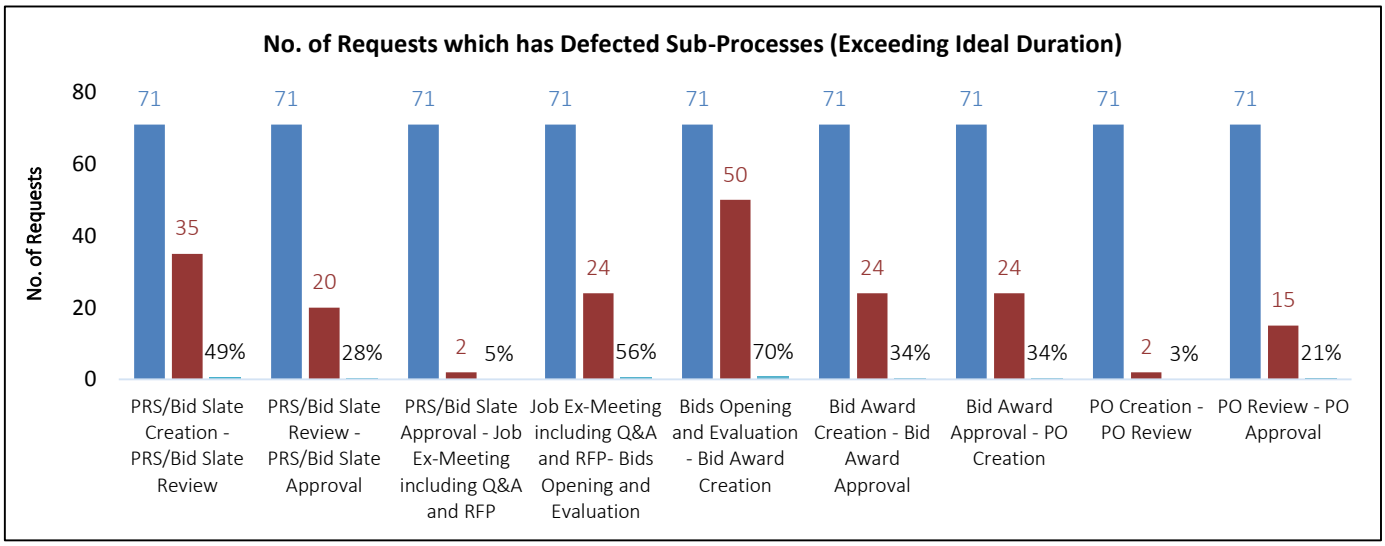


**Fig. 6.** SFC Requests with Sub-Processes Deficiency

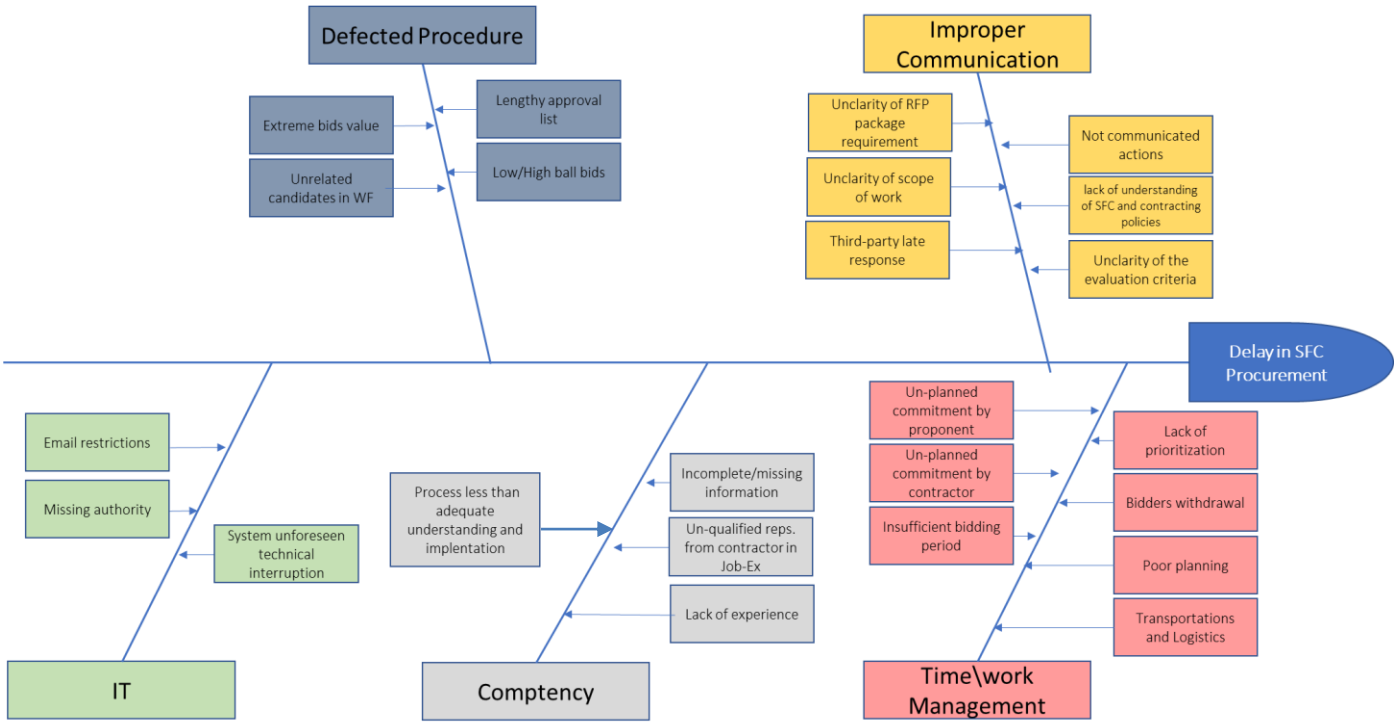


**Fig. 7.** Cause-and-Effect Diagram

### IV.III Cause-and-Effect Diagram

The cause-and-effect diagram, Figure 7, has been developed through brainstorming sessions with SME's, proponents, and several members who participate in the SFC procurement process. Initially, the effect was identified as a delay in the SFC procurement. Then, brainstorming resulted in five categories for the possible causes: Improper Communications, Defective Procedure, Time/Work Management, Competency, and IT. Under each category, several root causes were identified and considered in conducting the FMEA in the subsequent analysis stage.

### IV.IV Failure Mode and Effect Analysis (FMEA)

The FMEA analysis began with identifying each sub-process potential failure modes, followed by listing all associated possible causes that have been identified and illustrated in the cause-and-effect-diagram, Figure 7. Then, a brainstorming approach was followed to evaluate and determine the level of occurrence, severity, and detection of the failure modes considering the scaling system adopted by [36]. The RPN is the result of the multiplication of the values of occurrence, severity, and detection of the proposed scaling system. Hence, Table 3 presents the output of the FMEA analysis of the SFC procurement process.

**Table 3.** FMEA Matrix

| Sub-Process | Potential Failure Mode | Potential Causes | RPN |
|---|---|---|---|
| PRS/Bid Slate Initiation | Safety pre-qualification alerts for contractors during initiation | Till the time of PRS initiation, the contractor profile (or some required documents) become outdated (the profile expired) | 196 |
| | SAP system indicates that some PRS information is invalid | Not communicated actions (by proponent) related to provided information (work orders closure, budget approval) | 162 |
| | Missing additional information while PRS initiation | overlooked (unintentionally) missing information | 54 |

| | | | |
|---|---|---|---|
| PRS/Bid Slate Review | PRS initiator overlooked the concurrence workflow (WF) | Lack of prioritization/PRS initiator overload | 60 |
| PRS/Bid Slate Approval | Delay/Slow WF approval | Lengthy approval process | 324 |
| | | Missing authority for any of the reviewers | 189 |
| | | One of the reviewers is on unplanned leave | 216 |
| | WF rejection | Unrelated candidates (personnel) in WF | 135 |
| | | Missing description, remarks, or attachments | 180 |
| Job-Ex Meeting including Q&A and RFP | Invitation emails do not reach some bidders | Sending emails from inside the company to outsiders is under data restrictions | 168 |
| | Late response from the bidders to invitation | Bidders are not willing to participate and giving the subject low priority | 210 |
| | The required access for the bidders is not ready the date of the meeting | Poor planning (last-minute action) | 108 |
| | Some/all bidders no show | Bidders transportation or Logistics get interrupted by any reasons | 162 |
| | Bidders show a sign of poor experience regarding the scope understanding | Bidders are sending un-qualified representatives to attend the meeting | 135 |
| | Slippage in the deadline for the Q&A period | Delay in answering questions or inquiries of bidders due to lack of experience | 252 |
| | Rescheduling of Job-Ex meeting | Proponent gets busy in unurgent operational commitment | 135 |
| | The site visit is not conducted | Poor planning led to bidders did not receive the required permits for visiting restricted access areas. | 81 |
| Bids Opening and Evaluation | Bids evaluation is taking a long time to be performed | BRT is involved with other commitments | 441 |
| | | Some BRT members with lack experience | 90 |
| | | The ambiguity of the evaluation criteria | 90 |
| | Safety pre-qualification alerts for contractors while bids evaluation | Till the bids opening stage, the contractor profile (or some required documents) become outdated (the profile expired) | 196 |
| | Bids opened do not comply with the RFP package format (not as per the requirement) | RFP package is not appropriately explained during the Job-Ex meeting | 144 |
| | | Bidders implementation in the RFP is less than adequate, although it is explained in Job-Ex | 72 |

| | | | |
|---|---|---|---|
| | Bids are not complying with SFC terms and conditions | Bidder's lack of understanding of SFC policies | 72 |
| | Bids require clarifications | Low/High Ball Bids (The proposed cost for one proposal is either far less or far more than others) | 392 |
| | | Bids are proposed regarding the ' 'bidder's terms and conditions | 90 |
| | | Bids value is over proponent the estimated budget | 270 |
| | Bids submitted are less than expected (less than two) | Bidders quitting due to other business commitment or not willing to continue to participate | 192 |
| | | The planned bidding period is found insufficient (not enough to prepare and submit the proposals), although it was announced during the Job-Ex meeting | 108 |
| | Some 'bidders' withdrawal from bidding | Bidders quitting due to other business commitment or not willing to continue to participate | 168 |
| | | Scope of work along with its requirements are not clear to bidders | 63 |
| | Bidders did not submit their proposals before BCD, and they request a BCD extension | Bids did not reach on time due to carrier/logistics delay | 280 |
| | | The planned bidding period is found insufficient (not enough to prepare and submit the proposals), although it was announced during the Job-Ex meeting | 108 |
| | | The bidders experience late response from the third-party service provider that is required as of the scope of work | 72 |
| | | The bidders experience a late response to their inquires due to the proponent's lack of experience issues | 210 |
| | | Lack of understanding of the contracting procedure | 84 |
| | | Scope of work along with its requirements are not clear to bidders | 63 |
| Award Recommendation WF Initiation | Safety pre-qualification alerts for contractors while bids evaluation | Till the awarding stage, the contractor profile or some required documents become outdated (the profile expired) | 196 |
| | Delay in signing final rack-up documentation | One of the concerned personnel is on unplanned leave | 216 |
| Award Recommendation WF Approval | Delay/Slow WF approval | Lengthy approval process | 324 |
| | | The missing authority of any of the reviewers | 189 |

| | | | |
|---|---|---|---|
| | | One of the reviewers is on unplanned leave | 216 |
| | WF rejection | Unrelated candidates (personnel) in WF | 135 |
| | | Missing description, remarks, or attachments | 180 |
| | SAP system failure | The system experienced an unforeseen technical interruption | 24 |
| PO SAP Initiation | Safety pre-qualification alerts for contractors while bids evaluation | Till the PO initiation stage, the contractor profile or some required documents become outdated (the profile expired) | 196 |
| PO SAP Review | PO initiator overlooked the concurrence WF | Lack of prioritization/PO initiator overload | 60 |
| PO SAP Approval | Delay/slow WF approval | Lengthy approval process | 324 |
| | | The missing authority of any of the reviewers | 189 |
| | | One of the reviewers is on unplanned leave | 216 |
| | WF rejection | Unrelated candidates (personnel) in WF | 135 |
| | | Missing description, remarks, or attachments | 180 |
| | SAP system failure | The system experienced an unforeseen technical interruption | 24 |

**IV.V Process Waste Evaluation**

In this part of the analysis, the potential waste associated with the sub-processes has been evaluated and summarized in Table 4. However, due to the nature of the process, some waste types were not identified.

**IV.VI Analysis Insights**

Throughout the analysis, the interviews and brainstorming approaches have been utilized intensively to collect feedback and thoughts about the SFC procurement process's optimum implementation. Therefore, the following points summarize the main insights that were observed during the analysis.

- Although all Admin Area units refer to a common CPM, the understanding level of the process appeared to vary between Admin Area units depending mainly on the experience level and the knowledge. This was realized when reviewing the Admin Area benchmarking and evaluating their performance in the process, Figure 4.
- The performance of the designated ACU in the SFC procurement process was inconsistent. The annual average procurement time had experienced an undesirable trend that motivated the team to analyze the SFC procurement process to achieve the potential process improvement.

**Table 4.** Process Waste Evaluation

| Sub Process | Potential Waste | Waste Description | Effect Level |
|---|---|---|---|
| PRS/Bid Slate Initiation | Waiting | Waiting for essential requirement | High |
| | Defects | Incomplete/Missing information | Moderate |
| PRS/Bid Slate Review | Poor process design | Extra steps with no value-added | Moderate |
| PRS/Bid Slate Approval | Poor process design | Too many reviewers in workflow | Moderate |
| | Defects | Missing authority | High |

| | | | |
|---|---|---|---|
| | Waiting | Waiting for approval | Moderate |
| | Underutilized personnel resources and creativity | Personnel unable to make decisions | Moderate |
| Job-Ex Meeting including Q&A and RFP | Waiting | Poor planning and waiting for arrangement | Moderate |
| | Underutilized personnel resources and creativity | Concerned personnel unable to make decisions timely | High |
| | Defects | Incomplete/Missing information | Moderate |
| | Poor process design | Too many paper-based actions | Moderate |
| Bids Opening and Evaluation | Defects | Incomplete proposals | High |
| | Underutilized personnel resources and creativity | Concerned personnel unable to make decisions timely | Moderate |
| | Poor process design | Too many paper-based actions | Moderate |
| Award Recommendation WF Initiation | Waiting | Waiting for essential requirement | High |
| | Defects | Incomplete/Missing information | Moderate |
| Award Recommendation WF Approval | Poor process design | Too many reviewers in workflow | Moderate |
| | Defects | Missing authority | High |
| | Waiting | Waiting for approval | Moderate |
| | Underutilized personnel resources and creativity | Personnel unable to make decisions | Moderate |
| PO SAP Initiation | Waiting | Waiting for essential requirement | High |
| | Defects | Incomplete/Missing information | Moderate |
| PO SAP Review | Poor process design | Extra steps with no value-added | Moderate |
| PO SAP Approval | Poor process design | Too many reviewers in workflow | Moderate |
| | Defects | Missing authority | High |
| | Waiting | Waiting for approval | Moderate |
| | Underutilized personnel resources and creativity | Personnel unable to make decisions | Moderate |

- There was a noticeable performance variation between units in planning and conducting the job explanation meeting. That depended mainly on the assigned contract advisor's experience and how effective his/her planning and communication skills were.
- The SFC procurement KPI interval (from PRS creation to PO approval) was not designed to achieve the proponent's satisfaction. According to the proponent feedback, the current interval was not covering the logical cycle of the SFC procurement, i.e., when PRS is created until the proponent can use the requested service after obtaining the awarded contractor official signature.
- The bids evaluation sub-process was a significant improvement area within the SFC procurement process, where 70% of the analyzed requests experienced a substantial delay during this sub-process.
- Although the PRS review sub-process requires a single action to be executed, there was an illogical delay in its performance where the defect percentage was 49%. This was considered as a strong motivator to study and analyze the SFC procurement process to attain the process improvements.
- Across the Admin Area units, there were no specific internal procedures for the SFC procurement process since the CPM was considered the main reference.
- Data access restriction was a primary factor that limited the scope of the study and negatively affected the analysis strategies.

### IV.VII Recommendations

Upon evaluating the analysis outputs and reviewing the observed insights, recommended actions have been developed to accomplish the main objective of the study and to assure SFC process procurement improvement. Table 5 summarizes the recommended activities and shows the assigned candidate for implementation.

**Table 5.** Recommendations

| **Long Term Recommendations** | |
|---|---|
| **Recommendations** | **Assigned To** |
| Conduct an internal periodical assessment for the designated ACU performance in the SFC procurement process, considering an effective combination of nominated personnel experiences. | ACU Supervisor |
| Develop an internal procedure for the SFC procurement process and thoroughly explain to involved candidates utilizing awareness sessions, workshops, and presentations. | ACU Supervisor |
| Raise the awareness of people involved in the process about the standardized procedure of the process presented in the CPM. | ACU Supervisor |
| Coordinate with the SAP system development team to establish a tracking mechanism through Electronic Contraction Network (ECN) that blocks a contractor from being initially nominated until his/her profile's requirements are updated. | ACU Supervisor |
| Coordinate with the company contracting department to adjust the conditions and regulations against the SFC-selected bidders. The required adjustments are as following:<br>1. Suppose the bidder accepts the Job-Ex meeting invitation but was unable to attend the meeting. In that case, it will result in blacklisting his vendor ID unless strong justifications are provided and accepted by the contract advisor.<br>2. If the bidder accepts to bid but withdrawal from bidding, it will blacklist his vendor ID unless strong justifications are provided and accepted by the contract advisor.<br>3. Suppose it is confirmed that bidders send un-qualified representatives to the meeting. In that case, it will result in blacklisting his vendor ID unless strong justifications are provided and accepted by the contract advisor. | ACU Supervisor |
| Communicate all related contractual procedures and updates through emails to all registered bidders regularly. | ACU Supervisor |
| Evaluate the option of modifying the SFC procurement KPI boundaries to be extended to cover all actions that come after the PO electronic approval, i.e., PO hardcopy approval by department manager and then PO hardcopy signing by the awarded contractor. | ACU Supervisor |

| | |
|---|---|
| Coordinate with the SAP system development team to add a function that alerts the contract advisor if any reviewers (who are included in the approval list) are on leave or do not have the authority. It will allow him/her to perform the corrective actions timely. | ACU Supervisor |
| Coordinate with the SAP system development team to develop a standard approval list by positions (maximum of 4 reviewers) and limit adding more reviewers manually without authority. | ACU Supervisor |
| **Short Term Recommendations** | |
| Eliminate the non-value-added sub-processes following the below actions:<br>1. Coordinate with SAP system development team to combine:<br>a. PRS review with the PRS initiation to eliminate the potential WF overlooking and shorten the processing cycle.<br>b. Award recommendation WF with PO approval to shorten the approval cycle.<br>c. PO review with PO initiation to shorten the processing cycle.<br>2. Reflect on the updates on the concerned documents and discuss these changes with concerned personnel. | ACU Supervisor |
| Raise the knowledge and understanding level of the SFC procurement process by completing e-learning training. | Concerned Proponents |
| Raise awareness of the process-related SAP IT issue that might be faced during the execution. | ACU Supervisor |
| Work with SAP system development team to activate the WF escalation mechanism to be processed by the next level approver when the approval workflow is delayed for one working day. | ACU Supervisor |
| Plan the Job-Ex meeting and prepare the required invitations, restricted access, and other logistics two (2) weeks ahead of the meeting. | Concerned Proponents & Assigned Contract Advisor |
| Communicate with SAP system development team to add a function that mandates the remarks insertion and attachments uploading prior to releasing any related workflow for approval. | ACU Supervisor |
| During the Job-Ex meeting, dedicate enough time to explain the RFP package and several contracting procedures to bidders and ensure their acknowledgment in writing minutes of meetings (MOM and attendance sheet). | Assigned Contract Advisor |
| Carefully select the SME's who shall attend the Job-Ex and participate in the ' 'bidder's inquiries clarifications (Q&A period). | Concerned Proponents & Assigned Contract Advisor |
| Develop an information validation sheet that helps the contract advisor discover any invalid information prior to filling the PRS request. | ACU Supervisor |

## VI. CONCLUSION

Problems with operational efficiency can be improved or eliminated by using the quality control tools. The tools harvest and then statistically apply data using knowledge science and cause-and-effect theories to address every problem involved in producing and delivering goods/services to consumers. Continuous quality improvement processes make the assumption, indeed the demand, that experts in quality control should work alongside organization management in actively deploying quality control toolkits in every aspect of decision-making and improvement implementation. Quality control toolkits can be employed in every aspect of production, starting with product development and marketing and consumer support services. There is currently a wide range of quality control/management toolkits available to management and experts, so choosing the correct one for each application is not always simple.

This study examined the potential for successfully applying quality control tools in a Saudi organization's specific area. In the present study, it is clear that the SFC processor's experience level and his/her knowledge and understanding to the process have the most significant impact on reducing the experienced

time delay within the process. In addition, the quality of the study could have been improved significantly, providing all the related data. Therefore, an organization with management that always considers continuous process development as one of its core strategies is recognized as one of the most effective and successful ones in the market as long as necessary data are made available to continuous process development teams. By applying the quality control management tools, the SFC procurement process at the designated ACU would be improved for sustainable and efficient process implementation. It would be much easier to deduct potential waste and failures within the process.

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