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DIGITALIZED CUSTOMER SERVICE

BY

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ABSTRACT

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Lean thinking is one of the approaches used to create more value for customers with minimum used resources by eliminating or reducing wastes. Lean techniques started with manufacturing processes, but nowadays, it is also applied to service organizations. This report introduces lean thinking using the value stream mapping and other process improvement tools in the Kahramaa customer service department to enhance customer satisfaction by reducing the service time by eliminating the non-value-added activities of the processes. In this project, the low voltage contractor procedure, which includes license and examination services, are studied to enhance the processes. After mapping the current state of the examination and license services, the non-value-added activities are identified. Improvement ideas are suggested to improve customer responsiveness and reduce costs. Improvement of 44% in LT, 32% in PT, and 100% in the material used were achieved for the examination service. For the license service, improvement of 71% in LT, 48% in PT, and 100% in the material used were achieved. Suggestions and recommendations were made to improve the efficiency and responsiveness of the two services.

DEDICATION

I dedicate this project to my lovely parents for their love and encouragement to complete my graduate study. To all my professors at Qatar University, who taught me all the necessary skills during the two years of my master's course. To my supervisor, Prof. Mohamed, for his support and guidance during the whole project.

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CHAPTER 1: INTRODUCTION

1.1 Problem Definition

Many organizations in Qatar provide customer service to support their customers. Most of the time, customers must visit customer service brands to buy a product or request a service. As a result of this, it can contribute to road traffic, papers, and time waste. Which can be costly not only for the organization but also for the environment. Kahramaa customer service is the department that provides the customers with services and taking care of their needs or wants. One of the organization's goals is to have excellent customer service by understanding customer expectations to provide them with service that exceeds their expectations and applying a high-quality level to the services. The department consists of different sections; each section or unit has its procedures and responsibilities. No one can neglect the fact there are still some procedures are based on papers. The paper-based processes could lead to security risks if the paper documents were misfiled, lost, damaged, or fallen into the wrong hands (Mills-Senn, 2014, p.28). According to the IDC study, 63% of businesses said the paper-based process negatively affects customer satisfaction. The rest of 77% said that a lack of integration between current systems negatively impacts the customer experience (Schneck, 2016). Since customer satisfaction is essential for the organization's success, this project will cover one of the customer service procedures to eliminate all the wastes found in the processes.

1.2 Effectiveness vs. Efficiency

Mouzas (2006) emphasized two indicators to assess the organization's performance: effectiveness and efficiency, as shown in Figure 1. Effectiveness is defined as producing the right result or the degree to which an organization achieves its goals (Zheng, 2010). Efficiency, on the other hand, is the relationship between the inputs and outputs. The efficiency aims to use the least amount of resources to produce the output. Effectiveness means pleasing the customer, while efficiency is pleasing the employee (Low, 2000). The organization's success relies on both. There are four main strategies to improve operations' efficiency and effectiveness: technology, materials, quality, and waste minimization. A lean strategy is all about effectiveness. The lean method is to please the customer in the most efficient way. In other words, the lean approach can improve efficiency by concentrating on effectiveness. Lean drives effectiveness first and efficiency second.

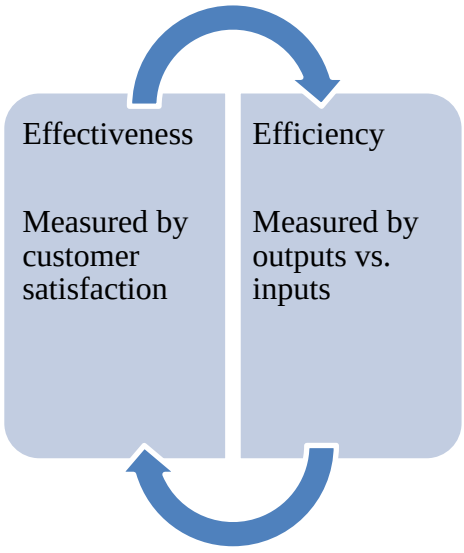


Figure 1. Performance indicators

1.3 Project Objectives

- To examine the value of lean thinking at the existing contractor license procedure in the customer service department.
- Study and analyze the existing contractor licensing procedure using process improvement tools and techniques.
- Identify different types of wastes available at the examination and license services.
- Propose improved procedures and study the effectiveness of the results.

1.4 Research Methodology

This research intended to improve customer satisfaction by eliminating waste, reducing the number of papers printed in the Kahramaa customer service department, and improving response time. The first step of the project is the documentary analysis method; as illustrated in the literature review, many documents and articles were studied discussing lean thinking in service areas that implemented lean. The gathered knowledge from the literature will be used to implement the lean thinking methods in Kahramaa low voltage contractor procedure. The second step is the observation method by observing the examination and license service processes. After collecting all the required facts and data, the VSM tool is implemented.

The project is divided into four phases as follow:-

First, the problem statement and stakeholders were identified. With daily observation, the voice of the customer, “VOC” was collected, which helped to develop critical to quality metrics. Interviews are conducted with electrical contractor companies to graph the kano model to visualize customer satisfaction.

A data collection plan was created to find the percentage of the printed sheets

at the measuring stage. Those collected data are used to predict future demands and understand the pattern of behavior using seasonal average method forecasting.

At the analysis stage, Minitab was used to analyze the data. The data collected was consolidated to study the total usage of paper. Graphical Summary Tool was used to study the descriptive statistics and normality test of the entire paper usage. The tool was also be used to study the 95% confidence interval of mean paper usage. Then, a Time series plot was then created to evaluate patterns in data over time. After the analysis of the time series plot, Individual-Moving Range (I-MR) Control Chart was made to track both the process level and process variation and detect the presence of special causes. I-MR chart was created for month-wise total paper usage. A Pareto chart was then created to compare the Total Paper usage by the two services, contractor license service, and supervisor examination service, to find 80% of paper usage services. After analyzing that, another Pareto Chart was made to compare the paper usage for the five processes works-Result certificate, examination paper, exam payment receipt, license, and license payment receipt. A Box plot was also created to compare the means of the five processes works paper usage. ANOVA was used to validate the conclusion made using a box plot. A graphical analysis study was done for the highest paper usage process based on the hypothesis test analysis. The system-thinking approach is used to examine the relationship between the number of papers and customer satisfaction. Furthermore, the Fishbone diagram is designed to brainstorm ideas for the reasons of imperfections.

After a clear understanding of the current procedure's issues, the lean thinking approach was applied to reduce the number of paper sheets used and eliminate all wastes. At the Improve phase, The value stream mapping method was implemented. The proposed results are then compared to the existing situation.

Finally, different recommendations are suggested on how to improve the current procedure. Figure 2 shows all the process improvement tools and techniques that are used in the project.

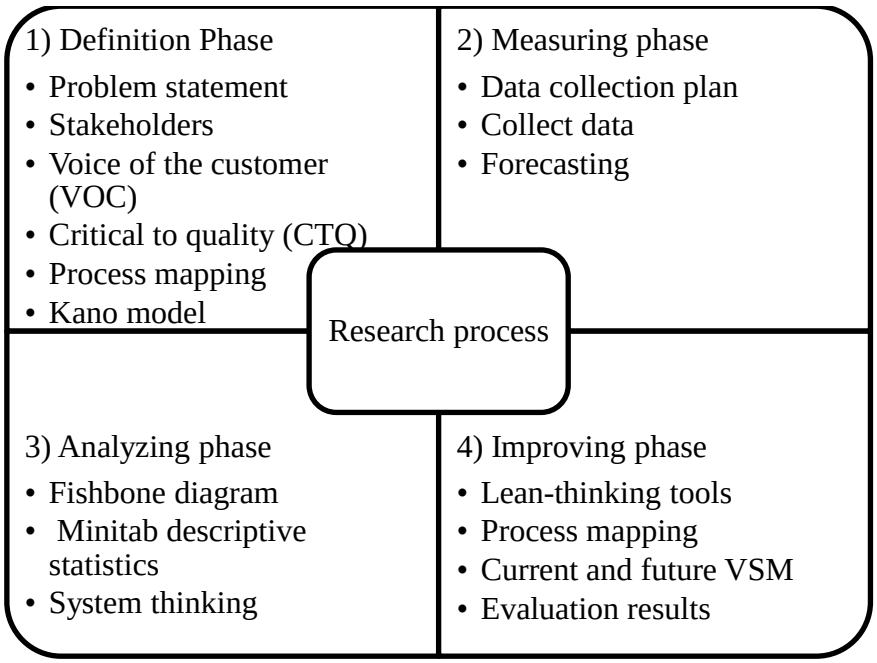


Figure 2. Research process

CHAPTER 2: LITERATURE REVIEW

2.1 Overview of the Concept of Lean Thinking

The concept of continuous improvement via incremental change based on outcomes underprops the notion of lean thinking. Lean thinking entails improving processes through waste eradication (Tsasis & Bruce-Barrett, 2008). In service organizations, waste encompasses waiting, errors, service delays, and wrong information. There are different types of activities, which are the value-added, and the other two types are non-value-added, known as "Muda," which means waste in the Japanese language.

- Value-Added Activities: The activities that add value to the process, and customers are willing to pay for it.
- Non-Value-Add (Incidental waste): The activities that do not add any value to the process; however, it cannot be avoidable with the current system. Process limitations or business regulations require it.
- Non-Value-Add (Pure waste): The activities that do not add any value to the process are considered immediately unnecessary.

Lean thinking achieves waste elimination by identifying value-added and non-value added steps in each process. According to Tsasis and Bruce-Barret (2008), by eradicating the non-valued added steps, an organization creates "a system in which each step contributes to enhance performance" (p. 192). In manufacturing, improved performance may encompass enhanced product quality, increased productivity, and cost reduction. However, enhanced performance in service organizations entails better service delivery to the customer (Tsasis & Bruce-Barret, 2008; Thangarajoo & Smith, 2015; Sapountzis & Kagioglou, 2007). In this regard, lean thinking involves designing and executing a system with perfect processes by recognizing key events that contribute

to delivering value-added services to patrons. To create a system with excellent processes, a service organization must identify its customers and service dimensions valuable to them (Tsasis & Bruce-Barret, 2008). Hence, lean thinking helps organizations create systems with perfect processes to eliminate waste.

History of lean thinking

Lean thinking can be traced back to the sixteenth century (the 1500s). At that time, the Venetian Arsenal, based in Venice Italy, started to use an assembly line when manufacturing boats. This could be the first historical example of flow production, an essential concept of lean thinking. Many centuries later, in 1908, the famous car manufacturer Henry Ford introduced the "Model T," a modular car that was built using interchangeable parts (Tony, 2010). This discovery enabled Henry to pioneer flow production in his Highland Park plant in 1913 by adding fabrication equipment in the process sequence. The ford motor company was able to produce cars at a much faster, more efficient, and effective rate and use a "moving assemble line."

In 1926 Henry ford added product variety to the manufacturing process and introduced the term "mass production." During the 1930 s, W.Edwards Deming created a process of undertaking "continuous improvement" commonly known as the Plan-Do-Check-Act PDCA cycle (Tony, 2010).

After world war two, Deming taught the PDCA cycle, the value of statistics, and other quality improvement methods to Japanese businesses; through this, Deming made a significant contribution to Japan later reputation for innovative, high-quality products and its economic power born out of this (Tony, 2010).

Henry Ford officially started the movement of lean thinking. After that, Kiichiro Toyoda and Taiichi Ohno developed lean by the Toyota Production System (TPS) in 1930. Ohno developed a new perspective on Just in time production when he visited

the U.S in 1956. Throughout 1960, the Toyota motor company gradually developed a management system based on lean principles. Taiichi Ohno led the Toyota production system into an integrated framework focusing on problem-solving, leadership, production operation, supplier collaboration, product and process development, and customer support. Finally, Womack, Jones, and Roos popularized the concept of lean thinking by publishing a book named The Machine That Changed the World in 1990. The book mainly explains the idea of lean, which started from TPS in Japan. Afterward, the authors expanded the concept of lean standards even further. Lean techniques started from manufacturing processes, but nowadays, it is also applied to hospitals, agencies, governments, administration, and other service organizations (Botalla, 2007).

2.2 Applications of Lean Thinking

Lean thinking is applied in various industries, including healthcare, resource and cost utilization, system redesign and efficient reconfiguration, project management governance, and overall visibility and system mapping. First, health managers deploy lean thinking to eliminate waste and ensure that all work adds value and serves customer needs (Sapountzis & Kagioglou, 2007 Leite & Vieira, 2015). Before applying lean thinking, health leaders must create a culture receptive to it. Commitment to lean should begin at the top echelon of a service organization and involve all personnel in redesigning processes to ameliorate flow and reduce waste (Sapountzis & Kagioglou, 2007; Joosten, Bongers, & Janssen 2009). In healthcare, lean thinking can support the development of ‘perfect’ processes and systems and enhance healthcare delivery in the long-term (Joosten et al., 2009). Hence, applying lean thinking can improve hospitals’ service delivery processes.

Second, lean thinking can help service organizations reduce cost and resource utilization. According to Sapountzis and Kagioglou (2007), by eliminating non-valued

added procedures and associated wastes, lean thinking facilitates continuous process improvements, improves process efficiency, cuts costs associated with waste processes, and effectuate resource deployment (Decker & Stead, 2008). Third, organizations apply lean thinking to system redesign and efficient configuration. In this regard, service firms can convert "factual demand signals into pull-based schedules for those customers actively contributing to the business's growth and success" (Sapountzis & Kagioglou, 2007, p.25). Fourth, lean thinking enables project managers to negotiate complex and dynamic environments by re-engaging a pluralist metaperspective at the organizational configuration and strategic purpose levels (Sapountzis & Kagioglou, 2007). In such a way, leaders can improve the chances of achieving established project goals. Finally, organizations can deploy lean thinking to achieve overall visibility and system mapping. In particular, lean thinking allows organizations to realize high scores in delivery time, response time, and setup time by accentuating "teamwork, continuous training, and learning, produce to demand ("pull"), mass customization and batch size reduction, cellular flow, quick changeover, and total productive maintenance" (Sapountzis & Kagioglou, 2007, p. 34). In the end, lean thinking correlates positively with improved service delivery and advanced customer service.

2.3 Principles of Lean Service

Lean thinking principles address various challenges occurring within and between business units due to variations in management thought processes and business culture. In this regard, Womack and Jones (1996), as cited in Thangarajoo and Smith (2015), defined lean thinking as a "way to specify value, line up value-creating actions in the best sequence, conduct these activities without interruption whenever someone requests them, and perform them more and more effectively" (p.2). There are five lean thinking principles, including defining value from the customer viewpoint, identifying

value streams, making the value flow, executing pull-based service creation, and continuously striving for perfection (Thangarajoo & Smith, 2015; Gupta & Sharma, 2016). By implementing these principles, an organization can identify waste by creating perfect service processes.

The first principle of lean thinking entails defining value from the customer's perspective. It necessitates firms to identify the customer and what is valuable to them. Delineating value provides the "means of identifying the form, feature, or function that a customer is willing to purchase in the circumstance where they cannot perform the required task on own or without investing considerable cost or time" (Thangarajoo & Smith, 2015, p.2). Womack and Jones state that service organizations should define value precisely in terms of specific services with specific capabilities offered at special prices through a dialog with specific patrons (as cited in Thangarajoo & Smith, 2015). Defining a service's value through the customer's perspective allows firms to satiate demand by delivering services desirable to customers. It assists organizations in reducing waste by eliminating service features undesirable for customers.

The second principle of lean thinking involves identifying the value stream. Value stream denotes "the set of all specific actions required to bring a specific product (service) through the three critical management tasks of a business unit," including tasks associated with problem-solving, information management, and physical transformation (Thangarajoo & Smith, 2015, p.2). The value stream mapping (VSM) enables organizations to review and identify all activities involving creating a service, determining value-adding activities, and eradicating non-value-adding activities (Thangarajoo & Smith, 2015; Gupta & Sharma, 2016; Mostafa, Lee, Dumrak, Chileshe, & Soltan, 2015). VSM requires a service organization to assess its value stream to identify direct and indirect value-adding and non-value-adding activities needed to

create and deliver products to the customer (Thangarajoo & Smith, 2015; Mostafa et al., 2015; Lyons, Vidamour, Jain, &Sutherland, 2011). Eventually, the firm can eliminate non-value-adding activities and perspective those adding value from the customer's perspective.

The third principle of lean thinking entails the introduction of flow in value-added activities after eliminating non-value-adding events. This principle recognizes the importance of flow in the value stream (Thangarajoo & Smith, 2015). Smooth flow in the value stream reduces waiting time, eradicate sub-optimized functional groups, and facilitates continuous improvement (Thangarajoo & Smith, 2015). The fourth tenet, the pull-based production, is the most counterintuitive of lean thinking (Thangarajoo & Smith, 2015). It guarantees that customers receive their desired services (Jaaron & Backhouse, 2012). Pull-based production reduces inventory accumulation by supporting considerable cooperation with patrons, allowing firms to comprehend the needs and expectations and produce only the needed products (Thangarajoo & Smith, 2015). The final tenet of lean thinking involves pursuing perfection continuously. Many organizations following lean techniques, but they have noticed that it is not sufficient for improvement. Therefore, continuous improvement is necessary for each organization. Implementing the first four principles increases the transparency of activities in the entire value stream. This principle necessitates the creation and perpetuation of "the culture of constantly searching for opportunities to improve operational efficiency, reduce costs and improve service quality is induced in an enterprise" (Thangarajoo & Smith, 2015, p. 4). The five principles of lean thinking collectively place organizations on a continuous improvement path to deliver sustained value to the customer.

2.4 Impact of Applying Lean Service

In service industries, lean thinking entails a collection of practices used to accomplish high operational performance. In contexts where service standardization is centralized, lean facilitates process improvement and service organizations' quality of services (van Assen, 2018). Some of the practices associated with lean thinking include: "The capability to create flow, including setup time reduction and pull quality control and human resource development, ultimately improves firm performance due to process improvement performance and customer-focused performance, i.e., the extent to which an organization effectively meets its customer needs (van Assen, 2018, p.1)". Hence, lean thinking triggers process improvement and customer-focused enhancement, supporting the delivery of quality and timely services to clients in service organizations. By recognizing and eradicating non-value-adding activities from the customer's viewpoint, the approach ameliorates service creation processes, leading to a better customer-centered performance in terms of speed of complaint handling, quick response to inquiries, and client gratification via the enhancement of business procedures (van Assen, 2018; Negrão, Filho, & Marodin, 2017; Jasti & Kodali, 2015). Lean service also positively impacts operational and financial throughput in service firms (van Assen, 2018). Hence, the current literature points to a direct and positive correlation among lean thinking, customer-centered improvement performance, process improvement performance, and customer satisfaction.

Applying lean thinking in service organizations can help improve employee behavior. According to Vignesh, Suresh, and Aramvalarthan (2016), lean thinking entails

" …understanding the philosophy of continuously finding ways to reduce waste by applying lean tools and techniques for customer satisfaction. Service firms need to meet

each customer's specific requirements so that they can always stay ahead of their competitors (p.1)".

By inculcating a culture of waste minimization and continuous improvement in organizations, lean thinking facilitates the delivery of improved quality in service sectors. Based on the value stream of lean service, Qu, Ma, and Zhang (2011) outline several types of waste in service, as shown in Table 1.

Table 1. Types of Wastes in Services

No.	Types of Wastes in Service	Significances
1	Service design waste	No response to customer needs and resulting in unnecessary excess features
2	Service item waste	Flaws in the service process
3	Serviceability waste	Does not make full use of service capacity
4	Service process waste	Low-efficiency work
5	Service delay waste	Phenomena that waiters or customers wait

Qu et al. (2011) underscored the need for service organizations to train and educate employees on waste analysis in lean service. In such a way, they will be adequately equipped to eradicate non-value-adding activities and expedite service delivery (Gupta, Sharma, & Sunder, 2015). As a whole, lean thinking is a fundamental approach to shaping employee behavior to ensure the expeditious provision of quality services to customers.

Eight types of wastes can be determined in any business process to remove, simplify, or integrate it. Table 2 illustrates the types of wastes and their definition.

Table 2. Waste Types and Definition

Type of Waste	Definition
Waiting	Waiting time is an idle time when people, equipment, information, or material is not ready or complete.
Inventory	When there are too many unwanted materials, excessive information, and unused documents are stored in organizations.
Overproduction	Produce quicker or sooner than what is required for the next step.
Physical movement and material movement (Transportation/Motion)	Excessive movement of people or employees that do not add any value to the product consumes time and energy. It may also cause exhaustion to workers due to unnecessary motion.
Unnecessary process	An extra step is not crucial, and it is beyond the customer's requirement.
Defect	The extra effort that has been made due to mistakes and errors throughout reworks.
Variation	Different approaches are used to accomplish the same activity.
Underutilization of employee	When employees' skills are abused, and limited responsibilities are given for completing tasks. Moreover, do not provide them with specific training and insufficient business tools accessible for employees.

Lean Thinking and Service Workers' Value Productivity

Lean thinking is an enabler for organic structures in service organizations. Service departments are usually exposed to more significant customer demand variety than manufacturing units. In this regard, Jaaron and Backhouse (2012) note, "The lean

thinking approach in services recognizes that manufacturing lean tools, which emphasize standardization and the elimination of variation, are not appropriate for service organizations, which need to absorb variety in customer demand" (p.8). To absorb this demand variation, service organizations must transition to adaptive firms, also called organic structures. Organic structures remediate pitfalls associated with reductionist and mechanistic pitfalls. Organic structures derive their features from lean thinking (Heinonen et al., 2013; Jaaron & Backhouse, 2012). The features of lean thinking are that:

"Individual goals are tied with organizational goals, and that service workers desired behavior is articulated by the ability of individuals to meet customer demand from the first time of contact…the tasks are not governed by rigid rules or procedures, and the service workers share the responsibility of the work (Jaaron & Backhouse, 2012, p.8)". The execution of lean thinking produces radical changes that improve service workers' value productivity in various ways. First, the practice shifts task handling in service organizations from a functional specialization to a teamwork model and changes employees' work from handling simple processes to performing diversified tasks (Jaaron & Backhouse, 2012). Second, it transitions the personnel's role from controlled to empowered and transforms a service firm's emphasis from training to continuous education (Jaaron & Backhouse, 2012). Third, the execution of lean thinking transforms service organizations' performance measurement from relying on numbers to fathoming quality and value (Jaaron & Backhouse, 2012). Finally, it changes organizational philosophy from a target orientation to customer orientation, converts managerial roles from monitoring to supporting, and alters the organizational structure from a top-down hierarchy to flat (Jaaron & Backhouse, 2012). Eventually, these changes produce affective commitment that initiates improve service productivity in

service organizations.

Lean Thinking and Organizational Change

Lean thinking is a central facilitator of change in service organizations and an enabler of organic structures that initiate multiple service departments' shifts. According to Jaaron & Backhouse (2012), lean thinking supports shifts from functional specialization work to teamwork. Besides, through organic structures, lean thinking facilitates organizational changes involving employee roles, employee work, emphasis, performance measurement, organizational culture, and organizational structure (Jaaron & Backhouse, 2012). Consequently, through these organizational shifts, lean thinking increases continuous value creation and throughput and cuts costs and losses (Aghakhani, Khoorasgani & Shahmansoury, 2016). Lean thinking promotes organizational learning – "a set of measures such as knowledge acquisition, information distribution, information and memory interpretation, which consciously or unconsciously affect the positive organizational development" (Aghakhani et al., 2016, p.219). Lean thinking is grounded in the principle of continuous improvement via incremental change based on outcomes (Tsasis & Bruce-Barrett, 2008). In such a way, lean thinking provides an avenue for organizational transformation. Such change entails creating perfect processes to eradicate waste and improve efficiency, service access, customer service, customer satisfaction, and continuous quality improvement (Tsasis & Bruce-Barrett, 2008; Pearce & Pons, 2017). Lean thinking facilitates emergent and ongoing changes to perpetuate a culture of excellence in service organizations (Pearce & Pons, 2017). In general, lean facilitates essential transformations in service organizations.

CHAPTER 3: RESEARCH METHODOLOGY

The research methodology chapter is divided into four stages. The first stage is the definition stage; the second is the measure phase, the third stage is analyzing the problem, and the fourth stage is to improve it.

3.1 The Definition Phase

The deliverables of this stage are shown in Figure 3.

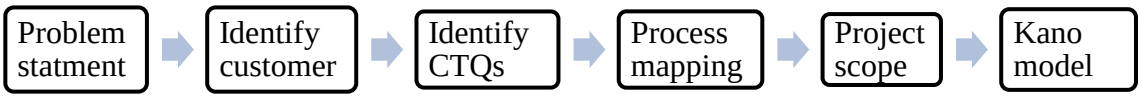


Figure 3. Definition phase deliverables

Problem Statement

Customers visit the Kahramaa customer service department to receive a contractor license certificate, Supervisor certificate, or pay for the service. This problem causes large quantities of paper usage, increasing fuel consumption and pollution due to road traffic and increasing other intangible losses. It was noticed that during the year 2019, there were approximately more than 3000 papers are used for contractor license procedure. The problem statement is to reduce the number of printed sheets, eliminate all the wastes within the contractor's license procedure, and improve customer satisfaction.

Identify customers and stakeholders

There are two types of customers, which are internal and external. The internal customers are the individual employee within the organization. They are:-

1) Customer service engineers: they are responsible for approving or rejecting service requests. Implement the procedures as per ISO standards.
2) Head of the section: responsible for the internal and external management for one of the customer service department units.
3) Customer service manager: is directing and planning all the units in the customer service department.
4) Sr-Engineer: Managing and improving the productivity and efficiency of the team. Should act as a leader for the team by providing them with all the required resources and training also assess their performance.
5) IT leaders: are responsible for developing and implementing electronic systems.

External customers: - The contractor companies who fall between the consumer and the organization but are not a part of the organization.

1) Contractor companies are responsible for repair or install electrical wires and components for the consumer.

The consumers are the citizens who benefit from the services that the contractor's companies provide.

- Customer segmentation

Customer segmentation has been divided based on the type of services. One of the company license requirements is to have a qualified supervisor who has been passed the Kahramaa examination. Due to this, the project segmentation is divided into two, as shown in Figure 4:- one for the examination service request procedure. The other

segment is for the license service request procedure.

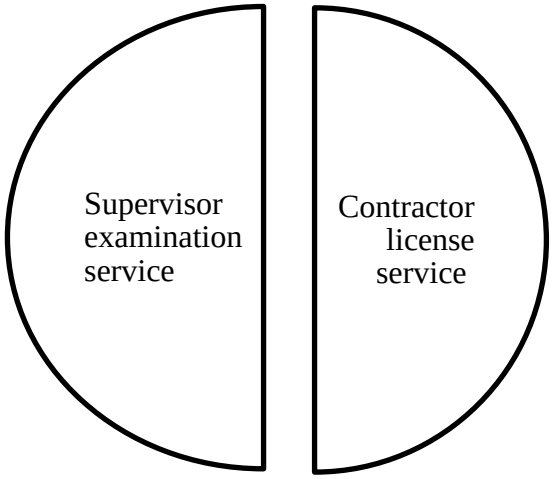


Figure 4. Project segmentation

The two segmentation will be covered in this project.

Critical to Quality

It is crucial to consider the VOC "voice of the customer" because it will help understands better customer needs. Using careful observation during daily work, the most common repeated sentences that are usually heard from the customers are: -

- "When should I come back to collect the license?"
- "How long will it take to receive the certificate?"

The service quality is what most matters to the customers, consisting of speed, reliability, and treatment or interaction. Customer satisfaction is co-related related to the speed of the service. The faster the service provided, the more satisfaction of the customers. The service's reliability depends on the system's quality, so it is vital to have a reliable system to avoid delay. Appropriate and friendly interaction between the

organization employee and the customer is recommended to gain customer trust. To develop a CTQs tree, first, the voice of the customer (VOC) is translated into the measurable specification, as shown in Figure 5.

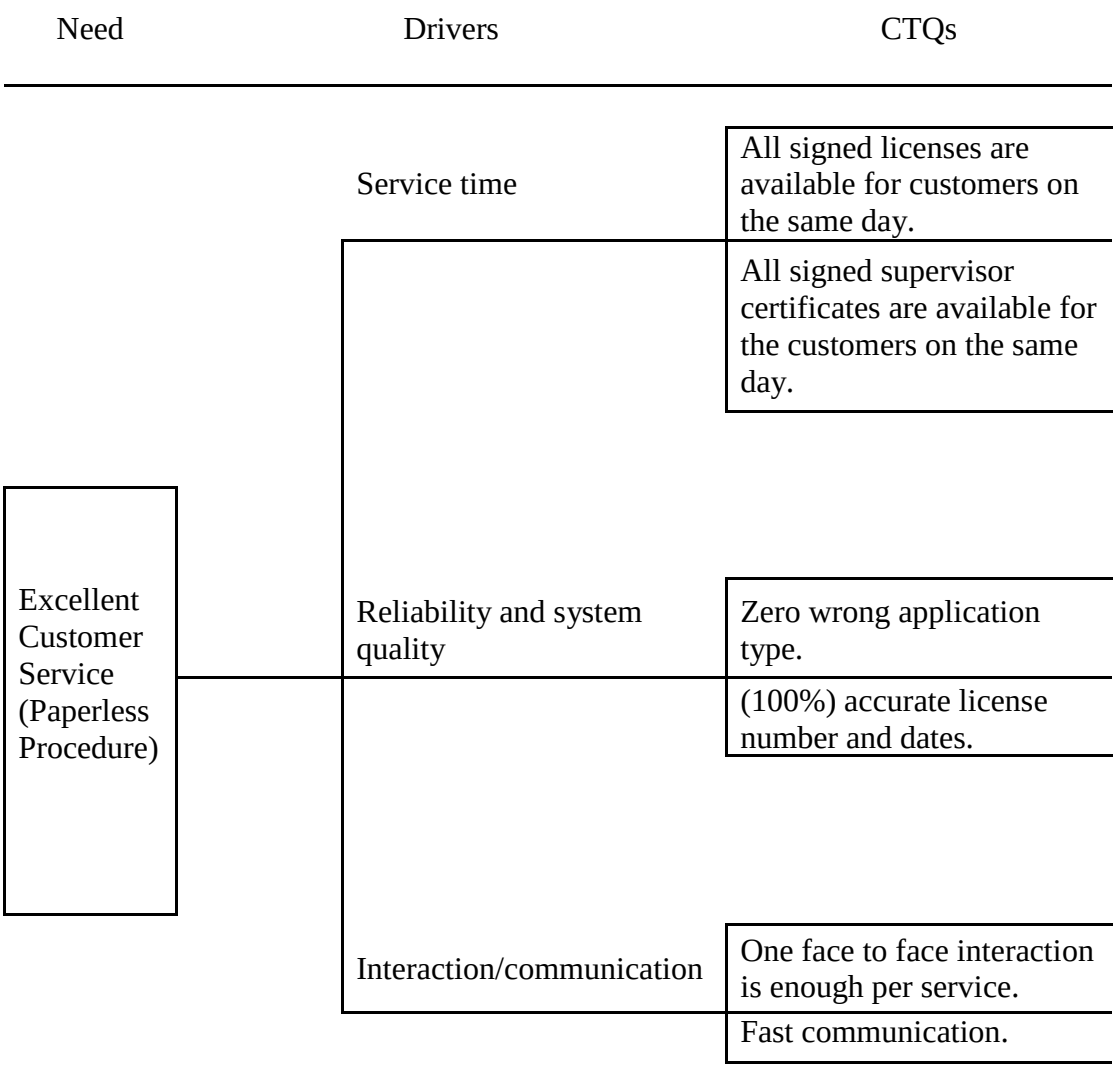


Figure 5. Critical to quality tree

The need is to deliver excellent customer service by implementing paperless procedures.

Process Mapping

There are different levels of process mapping. The highest level is SIPOC, as shown in Table 3, which identifies the suppliers, inputs, processes, outputs, and customers at a high-level view. This approach makes it easy to understand each process's critical elements at a glance and where the process begins and ends. The processes for all inputs are shown in Figure 6 and Figure 7.

Table 3. SIPOC Process Map

Suppliers	Inputs	Processes	Outputs	Customers
Customer service	Exam request	See below	Result certificate	Supervisor
Customer Service	License request	See below	License	Contractor companies

The processes for both exam and license services are described at a high level in Figure 6 and Figure 7 respectively. The processes for the exam request are defined in seven steps.

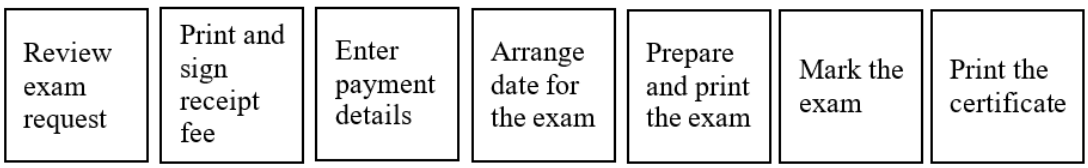


Figure 6. Processes for the exam request

The processes for the license request are defined in six steps, as shown in Figure 7.

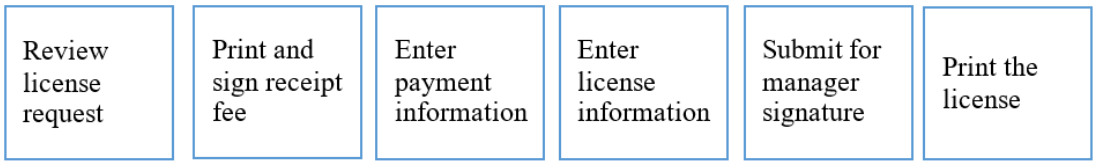


Figure 7. Processes for the license request

Project Scope

The scope of the project is to investigate one of the procedures used in the customer service department. The low voltage contractor's license procedure was selected for the scope of the project. The procedure includes the examination service and license service. Other customer service procedures are out of content.

Kano Model

To visualize the customer satisfaction against the presence or absence of service Kano model is used. This model has three different types of attributes: basic, performance, and excitement attributes. The model is two dimensions. The vertical axis represents the satisfaction level, and the horizontal axis represents how well each need has been fulfilled. This model is used to enhance customer satisfaction. The customer requirement outcome is represented by one of the following:-

- Attractive (A): The customers will love the attributes that fall in this, and the absence will not affect the dissatisfaction level.
- One-dimensional (O): These attributes will increase the customer satisfaction level, and the absence will reduce satisfaction and increase dissatisfaction.
- Must have (M): Attributes that are basic and must be available in the service because customers will be unhappy if it is not there. However, these attributes don't increase customer satisfaction rates.

- ❖ Questionable result (Q): This outcome shows that either the response is illogical or the question is wrong.
- ❖ Reverse (R): Attributes that fall under this category must be eliminated as these attributes are bad to customer satisfaction, and its dysfunctional absence will be an advantage.
- ❖ Indifferent (I): Attributes under this category neither contribute to dissatisfaction nor in customer satisfaction.

- Kano Questionnaire

The target customers are the contractors' companies. Interviews have been conducted with a sample of these targeted customers. There are two parts to the interview questions, which are the functional question and the dysfunctional question. The functional question is, "How do you feel if that attribute is available in the service?" and the dysfunctional question is, "how do you feel if that attribute is not available in the service?" Five alternatives were provided to choose from by the customers, such that one choice must be selected for each of the functional and dysfunctional, as shown in Table 4.

Table 4. Evaluation Dimensions

The Functional Form of a Question	Dysfunctional Form of a Question				
Kano evaluation table	1. I really like it	2. I fully expect it	3.I am neutral	4. I can tolerate it	5. I really dislike it
1. I really like it	Q	A	A	A	O
2. I fully expect it	R_A	Q	I	I	M
3. I am neutral	R_A	I	I	I	M
4. I can tolerate it	R_A	I	I	Q	M
5. I really dislike it	R_o	R_M	R_M	R_M	Q

From the contractor's interview, it was concluded that the contractors' companies were providing files that include all the required documents before few years. Nowadays, the online system is used to accept contractor requests instead of hardcopy files. This characteristic has improved the service time of the procedure. Due to this, the customer requirements are met within due dates and at an acceptable speed. It was realized that the contractor's license's current characteristics fall under the performance or linear attributes, "more is better according to most contractors, which is represented as the linear line in Figure 8.

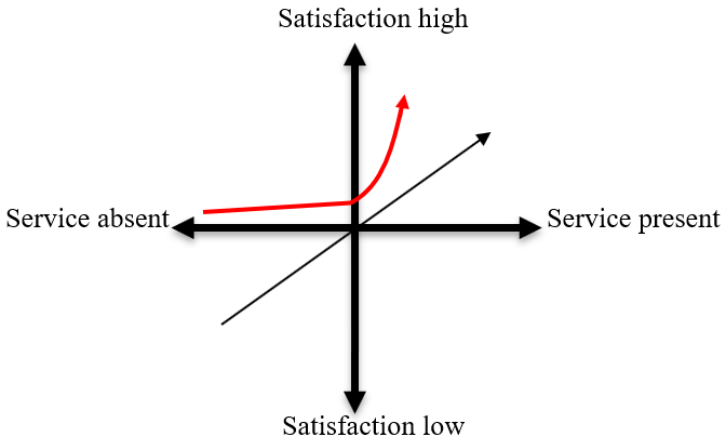


Figure 8. Kano model

One of the project goals is to add additional features or characteristics to the existing service to be more delightful to customers and reduce the service time.

Identify the Problems

The followings are the problems that can be found and result from the current procedures.

- Transportation

The road traffic is one of the causes that affect customer satisfaction. Nowadays, especially in the morning hours, there is a lot of traffic inroads. This causes the customers to be frustrated while they are driving on their way to the organization. Furthermore, the customers' location from the required destination, as some customers are located far away at AL-Khor or AL-Shamal, which needs a long driving hour to reach the destination and hence increase fuel consumption and air pollution.

- Time consumption

The current state of the procedure is time-consuming for the employee and the customers since the customers must visit the department more than once to finish all the requirements. Time equals money. Many organizations, for instance, airports and banks that provide self-service "kiosks" to the customers, not only reduce overhead costs by reducing paper forms and records they as well improve customer satisfaction by reducing waiting time (Brusco, 2011, p. 15). Most of the delay results from the external customer's side. When the license or exam results are ready, the employee must handle the papers until the customers are arrived to collect them.

- Environmental issues and human health

If the paper's consumption continues, more trees will be required to cut off to meet the demand. This consumption includes deforestation, water, air, and land pollution. The paper industry is considered the world's highest generator of air, waste products, and the gases that cause climate change. The industry is one of the highest users of raw materials, such as fresh energy, water, and forest fibers (Sharma, 2014). There are different environmental impacts from paper manufacturing, which are described as follow:-

1) Climate changes due to deforestation

Nowadays, 40% of wood is being harvested worldwide to get fiber, which is a raw material in paper manufacture. Because of the improvements in pulp processing technology and the increase in the demand for paper, any tree species can be harvested. The coniferous trees or softwood, such as fir and spruce, are preferred because of the strong paper, resulting from long cellulose fibers in the pulp. Another type is deciduous trees or hardwood, such as elm and polar (Suraj & Khan, 2015). This leads to the destruction of over 30 million forests per year. Besides endangering forest animal species, deforestation accounts for approximately 8% of carbon dioxides emissions throughout the globe, which majorly results in the greenhouse effect and climate changes through a break in the water cycles that keeps rainforests alive (Roston et al., 2020). Deforestation impacts carbon cycling, which is known as the Photosynthesis process. When large amounts of trees are cut down, carbon dioxide is no longer absorbed, and it stays in the atmosphere. Carbon dioxide acts as a greenhouse gas. The greenhouse gases have a warming effect, and because large amounts are being released into the atmosphere worldwide, leading to a global warming effect. The precipitation patterns are also affected by deforestation when it rains; trees absorb water through transpiration trees lose moisture, which is evaporating into the atmosphere. The clouds form from the evaporated water, and when enough is collected, it begins to rain; this cycle repeats itself. However, the water cycle is disrupted when deforestation occurs. This leads to desertification of fertile areas, negative effects on agriculture through increased temperatures, and a drastic decrease in rainfall.

2) The decrease in the water table

The papermaking industry uses more water to produce a ton of product compared to any other industry. This increases water consumption. It is approximated that the paper industry requires about ten liters of water to produce one sheet of A4

paper effectively. Due to constant paper production, paper industries have contributed significantly to famine in most parts. The tons of water used cannot be reused, which leads to a decrease in the water table (Suraj & Khan, 2015).

3) Air pollution

Papermaking industries are responsible for an outstanding contribution to the number of toxic chemicals released to the environment. During paper manufacture, oxides of Nitrogen, Sulphur, Carbon monoxide, and carbon dioxide are emitted. The Nitrogen oxides and sulfur oxides gases are massive contributors to acid rain. The greenhouse gas carbon dioxide has the largest percentage in terms of climate change (Saadia & Ashfaq, 2010). Paper consumption has a significant impact not only on the environment but also on human health. Bleach and other harmful chemicals are used to make the paper. These toxic chemicals are also let out into the atmosphere. For instance: Dioxin, used in the bleaching process, is known to cause cancer. (Tompson, Swain, Kay, & Forster, 2001; Sumathi & Hung, 2006, World Health Organization, 2016).

4) Water pollution

Paper industries waste ranges from wastewater are mostly suspended solids, inorganics, sodium carbonate, bicarbonate, chlorides, and toxic chemicals such as mercaptans and inorganic sulfides. The by-products have a high BOD and COD, and when discharged to the environment, they have drastic negative effects. The by-products can be purposely released into a water body or flow directly into a freshwater body. Since the waste was still untreated when released into the environment, it dissolves in the freshwater body. The by-product components might lead to water discoloration due to lignin and its derivatives present in the by-products since they are not readily biodegraded. When the organic matter is dissolved in water, it changes ecological characteristics and may lead to living organisms' death. The components

may also result in the water body having an odor. During the kraft process, sulfur-based compounds are used. The release of sulfur dioxide is dangerous because it is water-soluble and is the main cause of acid rain (Ince, Cetecioglu, & Ince, 2011).

5) Paper waste

Waste from paper industries increases the hazard of toxic inks, polymers, and dyes. The impact of this could be carcinogenic after incineration or infiltration through traditional disposal methods, for example, modern landfills. Also, methane is emitted when a waste paper rots. When it is composted or incinerated, it emits carbon dioxide. Carbon dioxide and methane are greenhouse gases (Beckline, Eric, Yujun, & Kato, 2016).

- Way of communication

The current procedure involves many physical communication activities. For instance: booking the exam date. The customers have to verbally communicate with the engineer to choose a suitable day for the exam. This approach is not very efficient and may cause some arguments or misunderstandings. Also, all the hand over outputs must be done physically. This approach forces the contractor's companies to find an appropriate time to pick up the license or exam certificate.

- Physical space

The filing document systems take a large amount of personal physical space, reducing the employee's productivity. Velte et al. (2008) quote that papers centric procedures, including filing, retrieving, distributing, and destroying documents, can lead up to 30% of the costs (p. 104).

- Low efficiency

Resources: The current plan required using many resources such as papers, stables, ink, and file folders; this will reduce the organization's efficiency and increase the paper trash.

System: There is some weakness in the system: receiving incorrect application type and generating manual license number and date.

Data representation: The monthly data are represented using manual software. This may lead to inaccurate information, which will result in bad decisions.

3.2 The Measure Phase

Data Collection Plan

Before analyzing the problem, it is essential to measure the situation by collecting a sample of data. The targeted data is the number of papers used. The sample of data is selected for the year 2019. Then, defining the dependent and independent variables. The dependent variable is defined as the number of papers (per month) used in the procedure, which depends on the number of the printed license certificate, supervisor certificate, and payment receipts. The primary data is collected using the secondary sources available about the number of requests that have been approved during each month. Each approved request required a specific output document. Thus, the number of license papers equal to the number of approved license requests, and the exam certificate papers equivalent to the number of approved supervisor requests. For the examination document papers, each exam contains ten pages of questions, a cover page, and an examination rule page, making it a total of twelve pages per customer. For the payment receipts, the number of paper sheets used is two per request. The assumption made is that the exact numbers of papers are used without making any mistakes or rework as shown in Table 5.

Table 5. Papers Usage in the Year 2019

Month	License Certificate	Exam Certificate	Examination Paper	Exam Payment Receipt	License Payment Receipt
January	16	14	168	28	32
February	11	24	288	48	22
March	18	27	324	54	36
April	26	27	324	54	52
May	24	23	276	46	48
June	15	9	108	18	30
July	19	13	156	26	38
August	14	14	168	28	28
September	18	17	204	34	36
October	29	18	216	36	58
November	12	7	84	14	24
December	11	9	108	18	22

The derived table above shows the number of papers used for different processes defined. It found that there are 3669 papers used for license and examination services during 2019.

- Number of visits

Table 6 shows the total number of visits the customers must attend to receive a new contractor license.

Table 6. Customer Visits

Number of Visits	New License
First visit	Attend for examination payment
Second visit	Attend the examination
Third visit	Attend for collecting result certificate
Fourth visit	Attend for a license payment
Fifth visit	Attend to collect the license

It found that to obtain a license, the customers must visit the department at least five times to complete the procedure.

- Forecasting

The quantitative forecasting approach predicts the future demands of the contractor's license and supervisor examination for the year 2020, using the historical data of the year 2019. One of the quantitative forecasting methods is the seasonal average; the results are shown in Figure 9.

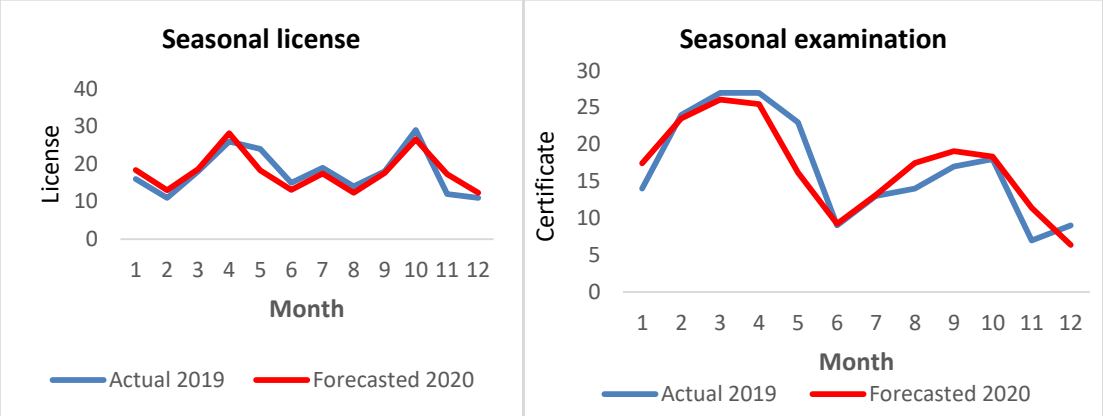


Figure 9. Forecasting for the year 2020

The graphs above followed the boom and bust cycle patterns. The aggregate demand curves can shift due to various forces that affect the overall economy. The curve shows that there is a period of expansion, followed by a period of contraction. The causes of fluctuation could be static effects, which are natural market fluctuations caused by changes in the free market conditions, consumer behavior changes, or companies' productivity. The second cause is known as shocks. The shocks are unpredictable events like financial panics or natural disasters that serve as sudden abnormal catalysts of contraction or expansion.

3.3 The Analyze Phase

Fishbone Diagram

The fishbone diagram; is referred to as the cause and effect diagram. The chart helps to brainstorm ideas for the reasons of imperfections. The effect of customer satisfaction depends on the five categories. The factors that affect the effectiveness and efficiency of the process are listed in Figure 10.

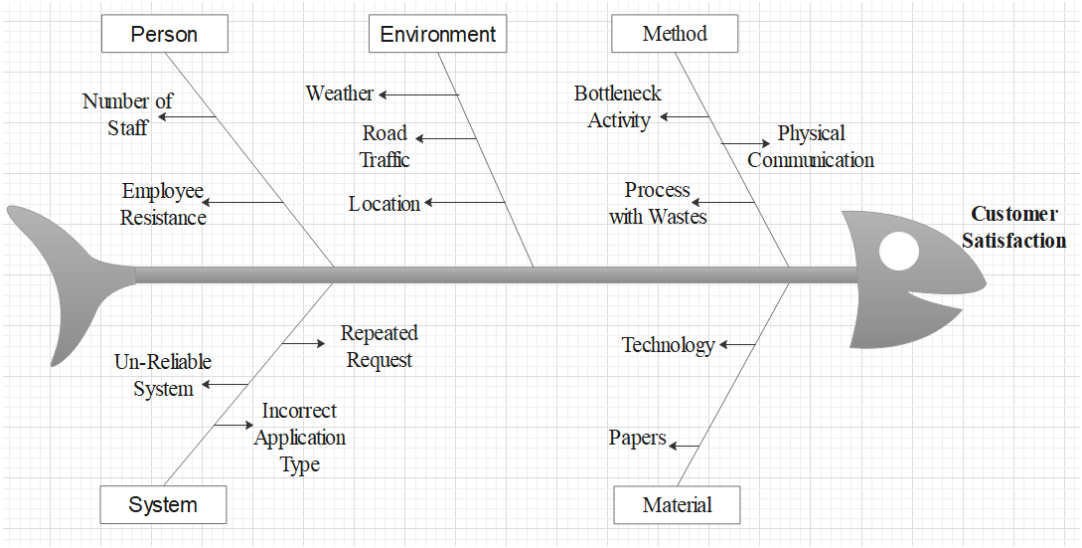


Figure 10. Cause and effect diagram

Five categories are identified with the root causes that affect customer satisfaction. The first category is the method used for the procedure. The current procedure or method involves physical communication; this forces the customer to visit the department. The procedure can have a bottleneck activity or some waste; this will increase the customers' waiting time. The system has an indirect effect on customer satisfaction because it is the channel for reviewing all customer requests, so it is crucial to ensure that the system is reliable. The paper sheets also can indirectly affect customer

satisfaction.

Furthermore, it is vital to improve the current technologies used. The more innovative technologies are used, the more delight the customer will be. The most important three categories that will focus on are the Method, Material, and System. For the environment category, the weather and road traffic influence the customer's mood and behavior. All the changes require a new way of thinking and doing things. Because of that, the employee resistance to changes is a natural reaction. Some employees have a narrow vision of seeing things, such as "what this change can bring to life."

Descriptive Statistics

Minitab 17 version was used to carry out the data analysis

- Consolidated data of total paper usage

The collected data was consolidated to study the total paper usage Table 7

Table 7. Total Paper Usage- Month Wise

Month	Paper Usage
January	258
February	393
March	459
April	483
May	417
June	180
July	252
August	252
September	309
October	357
November	141
December	168

- Data analysis of total paper usage using graphical summary tool

The Graphical Summary results Figure 11 shows that the average or mean monthly paper usage is 306 sheets with a standard deviation of 115 sheets. It can be concluded that the data follows a normal distribution as the P-value shown in the Anderson Darling Normality test is more than 0.05 (Alpha value). From the Box plot and the corresponding data given in the results, it can be interpreted that the minimum number of sheets used is 141 sheets to a maximum of 483 sheets. As the data collected is for one year, also concluded that 25% of the months, the paper usage was less than or equal to 198 sheets, 50% of the months, the paper usage was less than or equal to 284 sheets, and 75% of the months, the paper usage was less than or equal to 411 sheets. 95% Confidence Interval values show that the organization's average monthly paper usage will range from 293 sheets to 380 sheets.

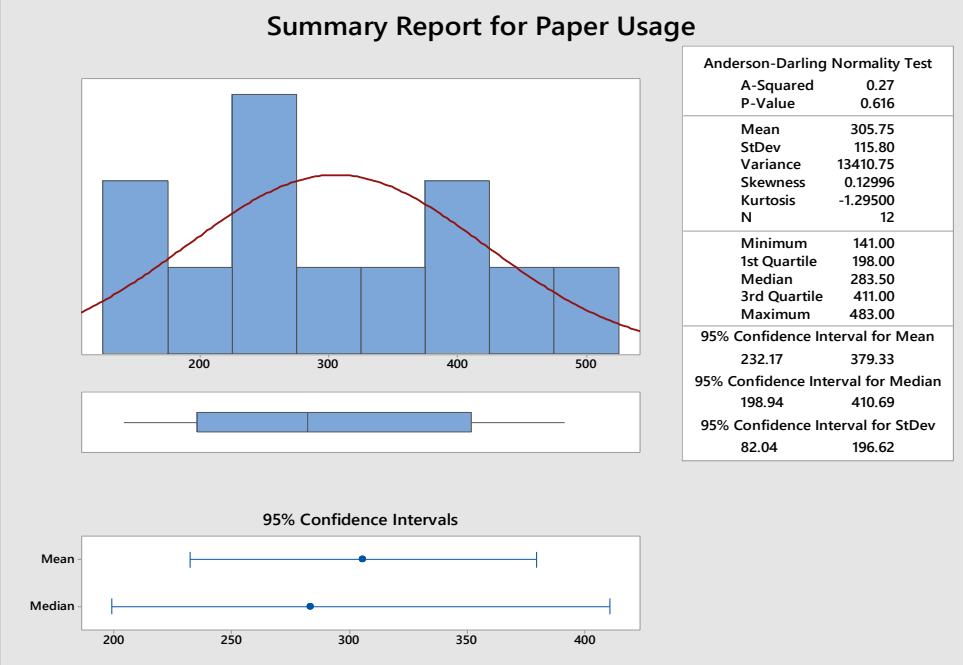


Figure 11. Month-wise paper usage by the graphical summary tool

- Time series plot of month-wise paper usage

The time series plot Figure 12 shows that the highest number of sheets were used in April (483 sheets), and the minimum sheets of paper were used in November (141 sheets).

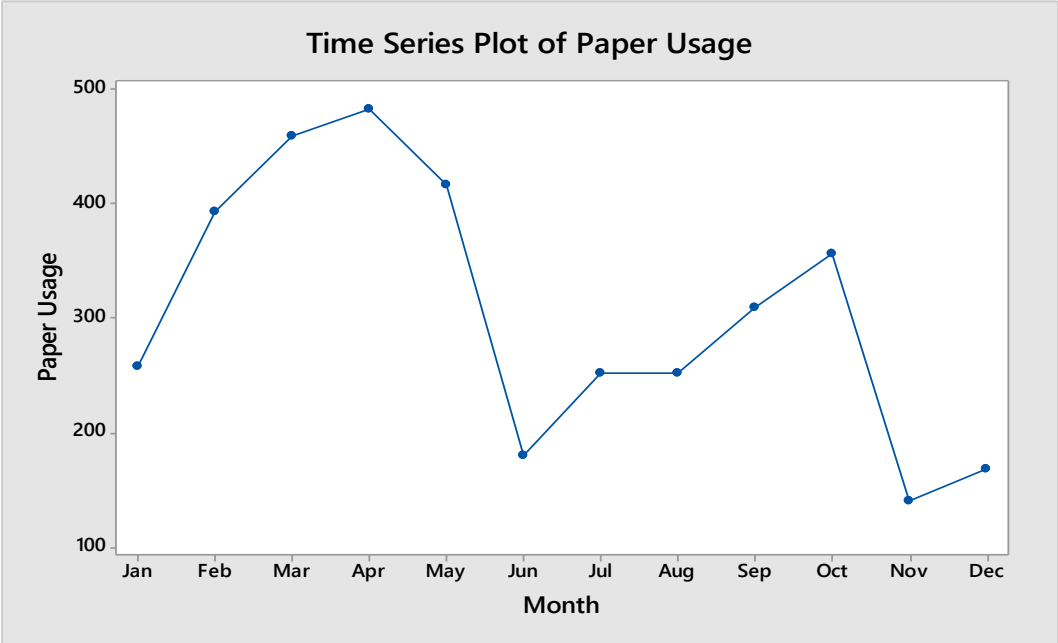


Figure 12. Time series plot of total paper usage

- Individual- Moving Range (I-MR) control chart of month-wise total paper usage

Figure 13 shows special causes seen by the red squares in the Individual Control Chart. The special cause tests failed are Test 5 and Test 6. The test failure details can be seen in the session window of Minitab output, as shown below in Figure 14. Paper Usage for April and May are special causes data points.

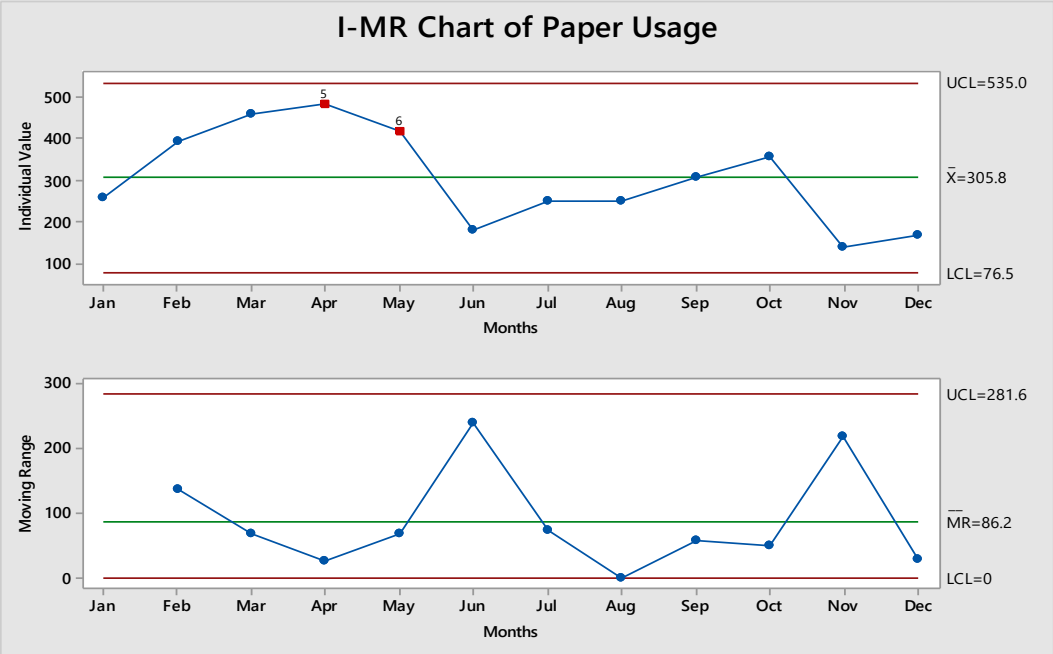


Figure 13. Individual moving range control chart of total paper usage

Test Results for I Chart of Paper Usage

TEST 5. 2 out of 3 points more than 2 standard deviations from center line (on one side of CL).
Test Failed at points: 4
TEST 6. 4 out of 5 points more than 1 standard deviation from center line (on one side of CL).
Test Failed at points: 5

Figure 14. Session window of minitab output- induvial moving range control chart of paper usage

Two special causes are found, which are test 5 and test 6, and the reason behind is the number of papers used during those months.

- Data analysis - paper usage by the three services using Pareto chart

  Pareto chart was used to compare the total paper usage by the two services-

  a. Contractor license service

  b. Supervisor examination service

The Pareto chart Figure 15 shows that near to 83% of the paper usage is by the supervisor examination services among the two services.

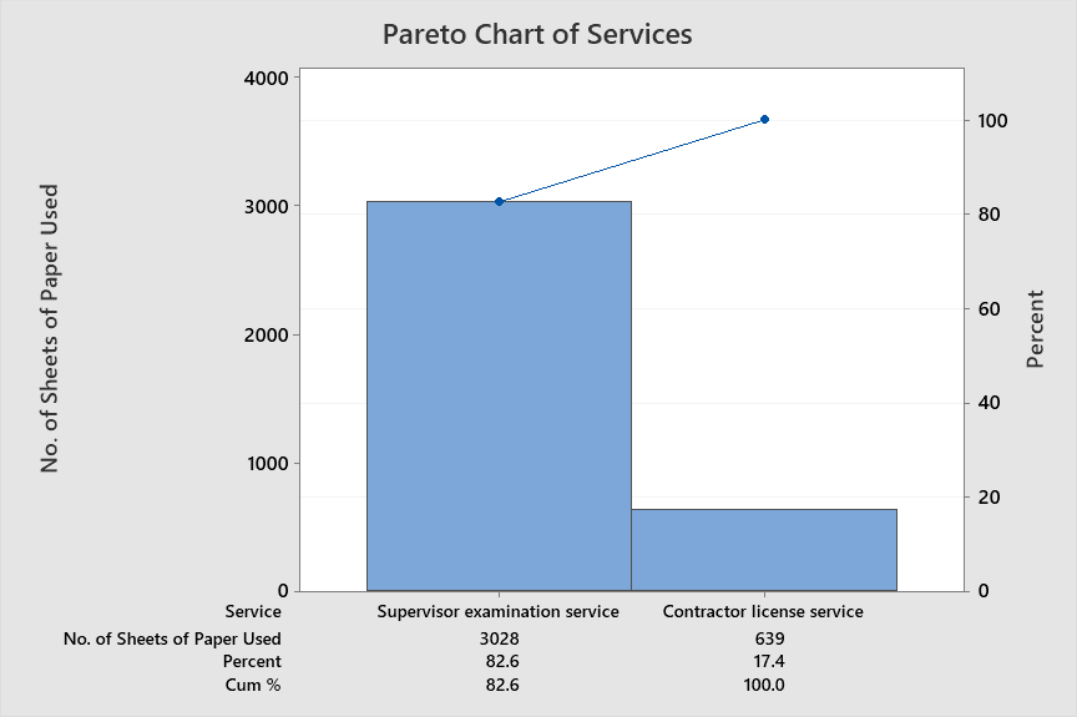


Figure 15. Pareto chart- services and paper usage

- Data analysis - paper usage for the process works using Pareto chart

  Pareto chart was used to compare the paper used for the five process works. The five process works carried out by the organization are

  1. License certificate
  2. Result certificate
  3. Examination paper
  4. Payment receipt (exam)
  5. Payment receipt (license)

From the Pareto chart Figure 16, it can be observed that near to 80% of the paper usages are for Examination Paper and Payment receipt (license) works.

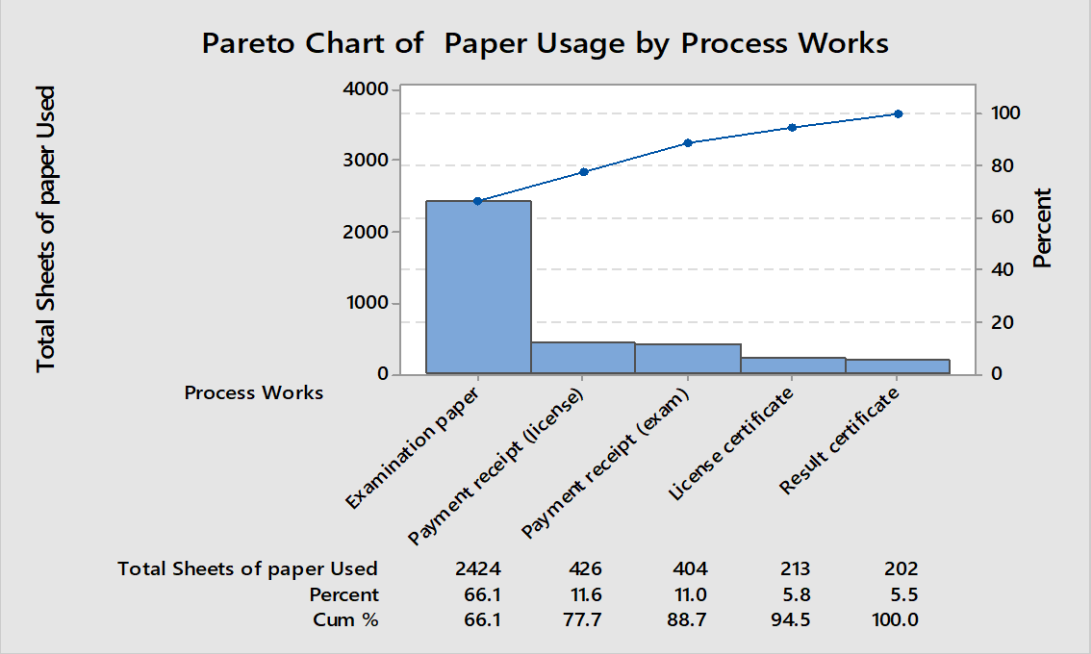


Figure 16. Pareto chart- paper usage for the process works

- Data analysis – comparison of paper usage for process works using box plot

The box plot Figure 17 shows that the examination paper is showing the highest usage and variation compared to all other works.

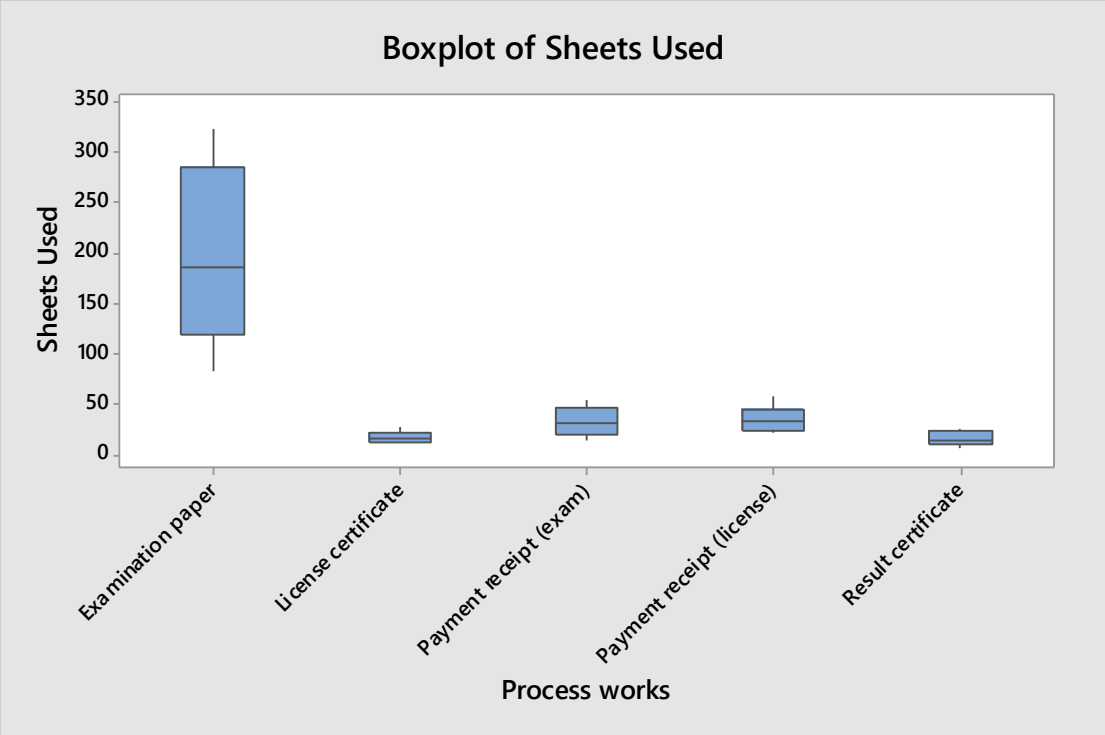


Figure 17. Comparison of paper usage for process works

- Validation of the box plot comparison and conclusion by

  Ho: All means are equal

  Ha: At least one mean is different

ANOVA results Figure 18 shows that the P-value is less than the alpha value (0.05). Hence, it can be concluded that one mean paper usage is statistically different than other paper usages. Figure 19 the 95% Confidence Interval Plot it can be concluded that paper usage by examination paperwork is statistically different from other paper works.

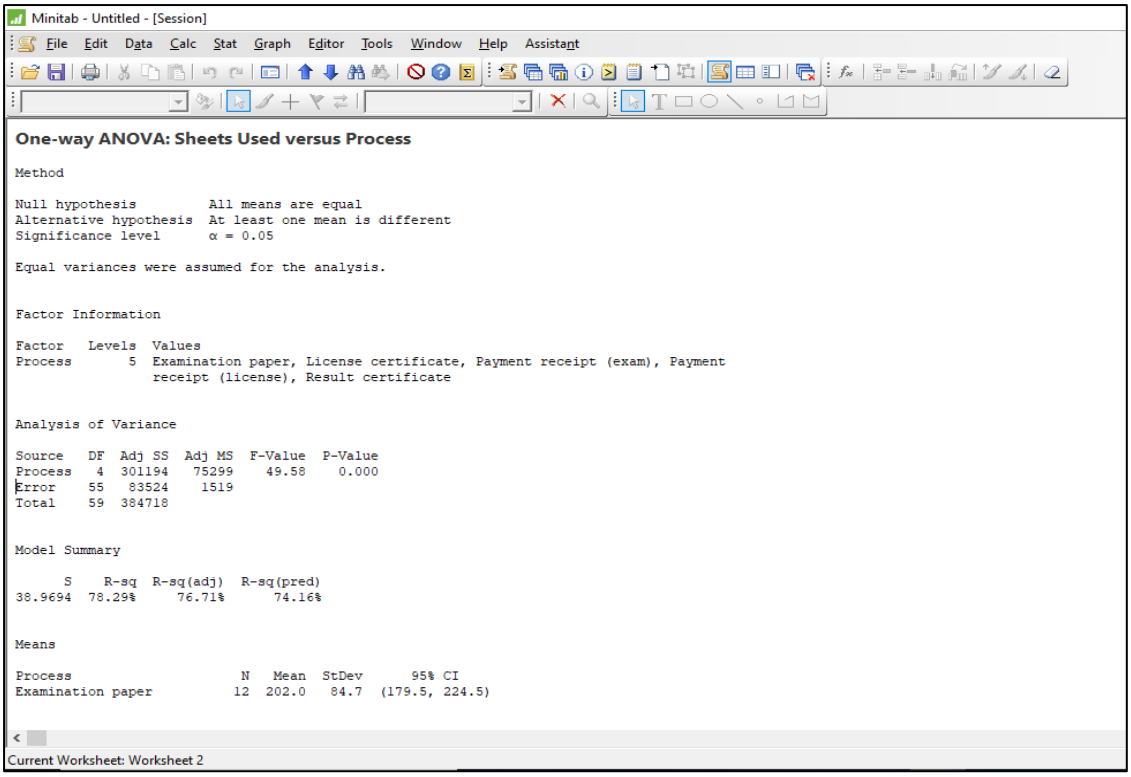


Figure 18. Anova comparison of mean paper usage for process works

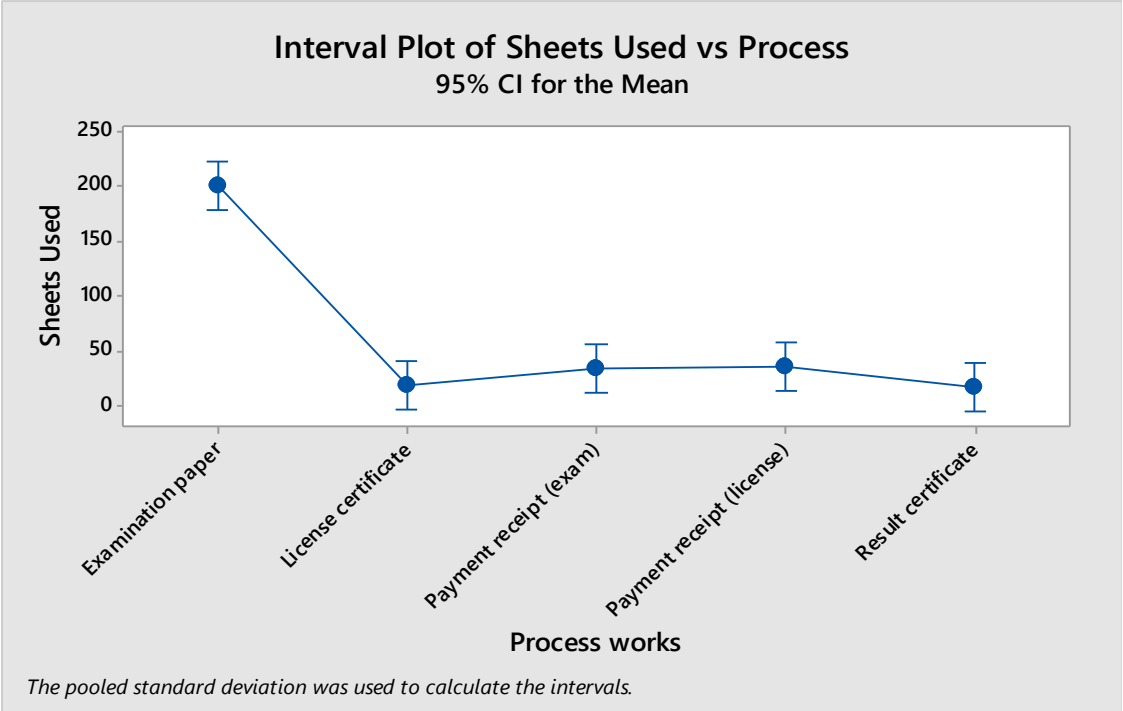


Figure 19. 95% CI of mean: comparison of mean paper usage for process works

- Data analysis of examination paper usage using graphical summary tool

The Graphical summary results Figure 20 shows that the average or mean examination paper usage is 202 sheets with a standard deviation of 85 sheets. It can be concluded that the data follows a normal distribution as the P-value shown in the Anderson Darling Normality test is more than 0.05 (Alpha value). From the Box plot and the corresponding data given in the results, it can be interpreted that the minimum number of sheets used is 84 sheets to a maximum of 324 sheets. As the data collected is for one year, 25% of the months, the examination paper usage was less than or equal to 120 sheets, 50% of the months, the examination paper usage was less than or equal to 186 sheets, and 75% of the months, the examination paper usage was less than or equal to 324 sheets. 95% Confidence Interval values show that the average monthly examination paper usage will range from 148 sheets to 266 sheets.

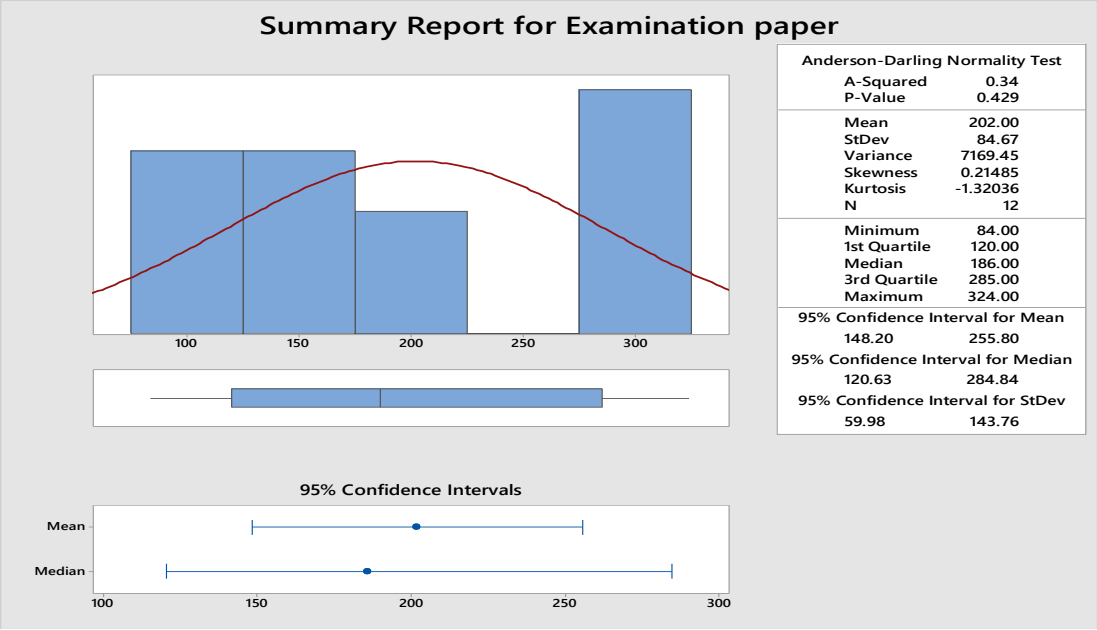


Figure 20. Examination paper usage by the graphical summary tool

System Thinking Approach

Online simulation "Loopy" is used to develop a relationship between all the elements that are related or results from using the papers. This helps to see the bigger picture in a holistic view and visualize the effect on increasing and reducing the papers on customer satisfaction. The signs are to show the relationship between the two consequence nodes. After running the simulation, two scenarios have been tested. The first scenario is the effect of increasing the number of papers, and the second scenario, the result of reducing the number of sheets. As shown in Figure 21, by increasing the number of sheets, customer satisfaction has been reduced, and vice versa is correct, as shown in Figure 22. The color indicates the percentage of increases or decreases, so when the circle is filled, its mean increases and vice versa.

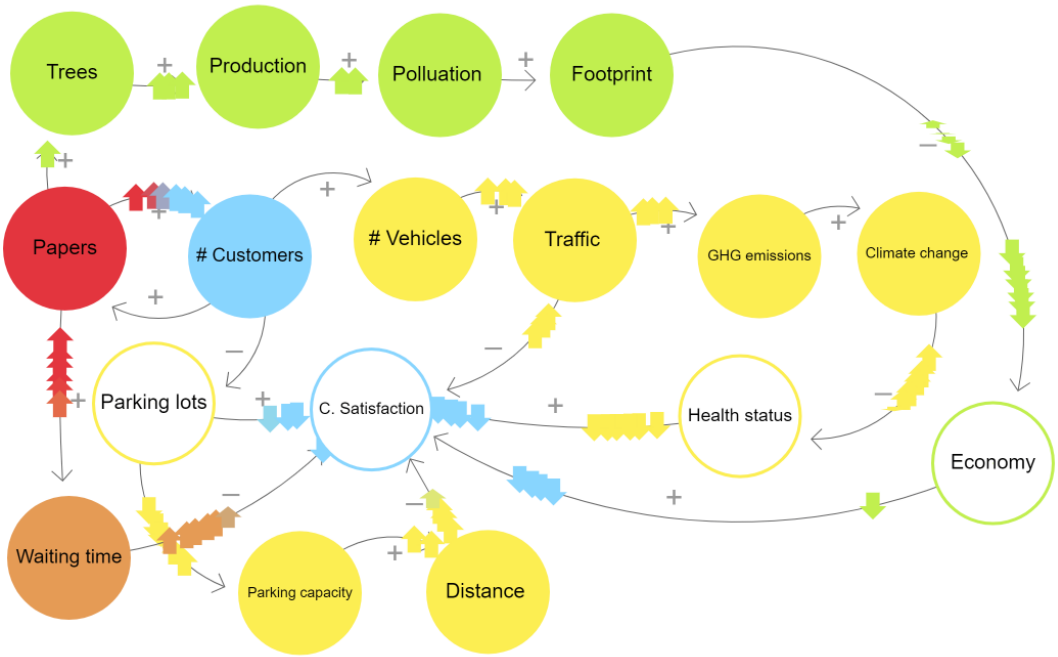


Figure 21. Increasing papers

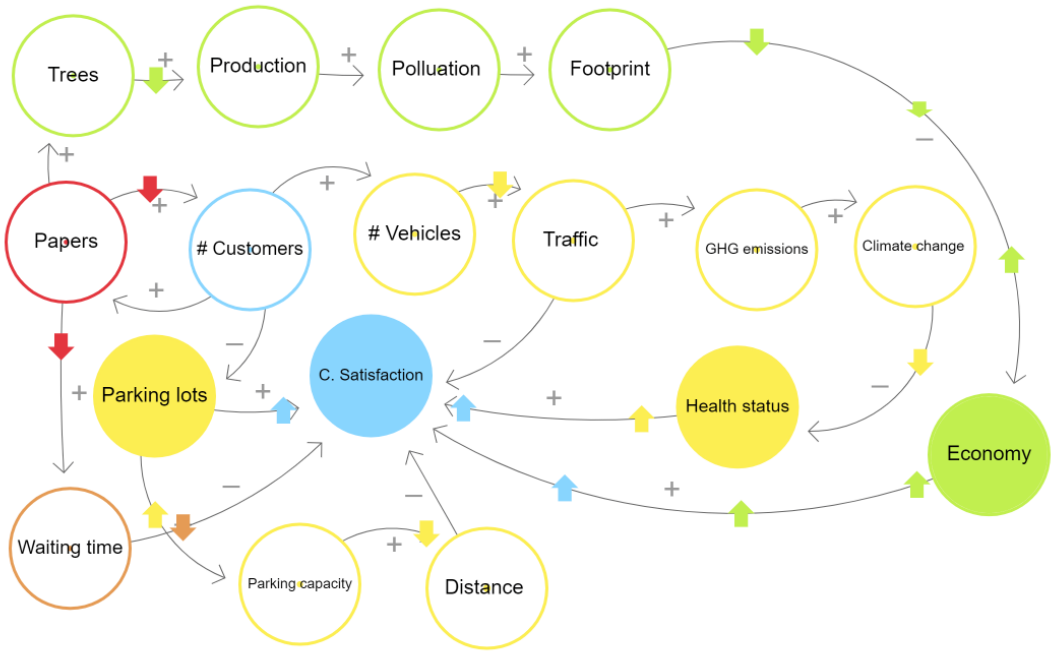


Figure 22. Reducing papers

3.4 The Improve Phase

Lean thinking (Value Stream Mapping Tool)

Lean thinking has been applied to different sectors. The service sector is usually under pressure to achieve excellent customer service, valuable support to its customers, and respond faster. The lean approach is used to optimize all the service delivery processes by targeting waste and eliminating them completely or moving to a more efficient state.

In every process, before identifying value and non-value-added activities, a process flow diagram is drawn. The process flow diagram gives a clear understanding of how a process works. Moreover, process mapping for the business process helps to comprehend all the steps, and the success of the process can be determined. After that, the value stream mapping of the current situation is drawn, and it uses some specific

symbols, which are known as a language of lean, to improve the process. Value stream mapping technically contains value-added and non-value-added activities, and it represents the overview of a current business process. Future value stream mapping can be obtained after lean techniques and tools have been applied to the current state.

The metrics that are considered in this project are:-

1) Process time (PT): Actual time takes one particular job to be completed without considering interruptions.
2) Lead time (LT): The addition of process time and delay time are described as lead time.
3) The material used: The physical things that are used to make or do an activity. The material that is considered in this project is the number of papers used per sheet.

To carry out waste elimination using VSM, six steps are used, which are demonstrated in Figure 23.

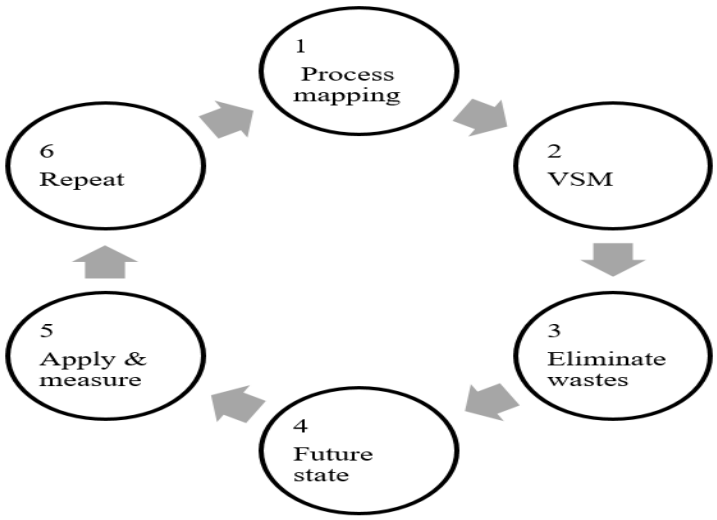


Figure 23. Steps of waste elimination

Step one (process mapping):- is to understand the current process flow

Step two (VSM):- is to construct VSM and to identify the waste of the current state

Step three (Eliminate wastes-Kaizen):- is to eliminate, simplify, and integrate wastes

Step four (future state):- is to construct the future enhanced VSM

Step five (Apply & measure):- is to implement and evaluate the proposed procedure

Step six (Repeat):- Do the same steps all over again for continuous improvement

VSM Implementation

1) Flow chart process mapping

A detailed flowchart is created to visualize the as-is process for both services; examination service in Figure 24 and license service in Figure 25.

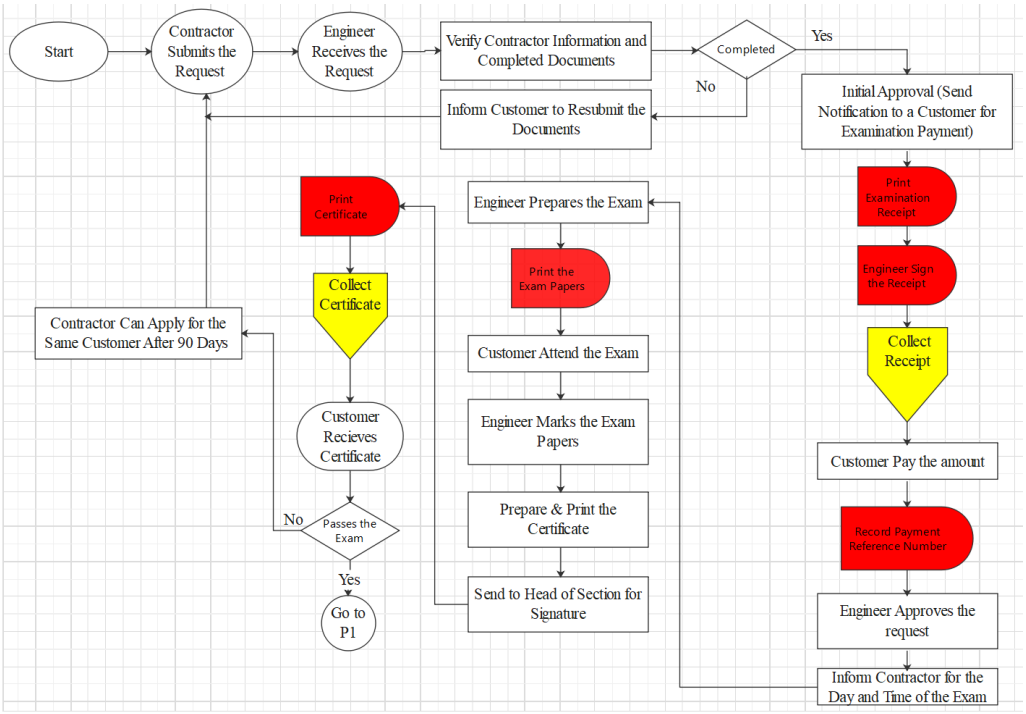


Figure 24. Flow chart for examination service

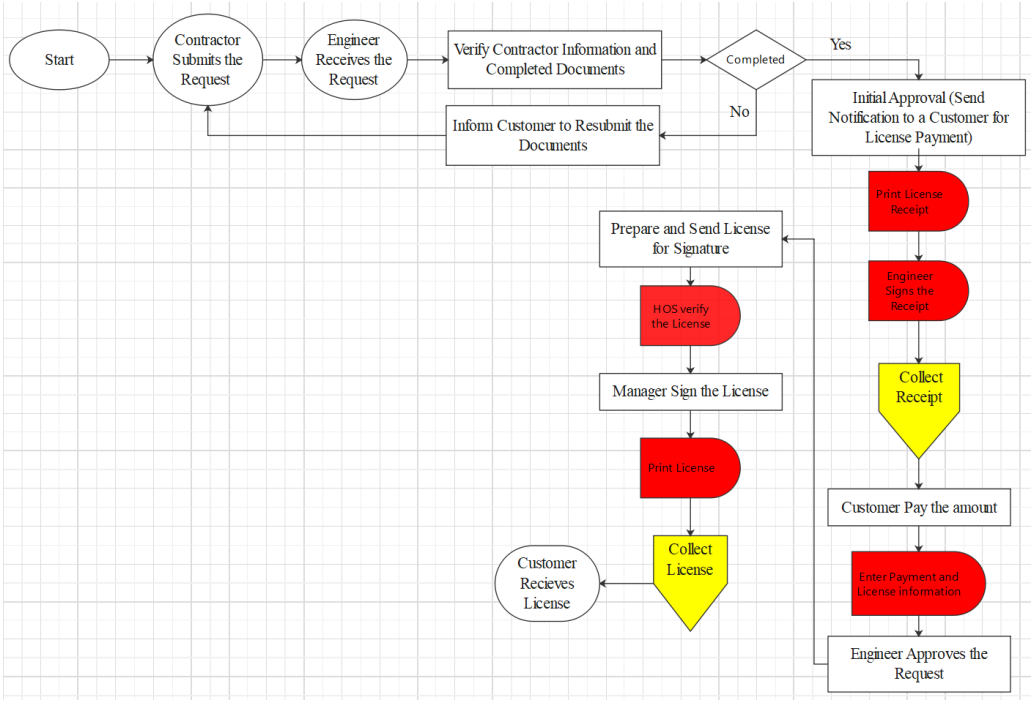


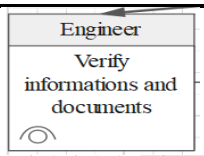
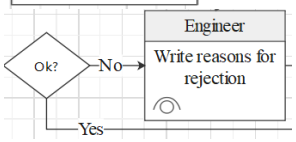
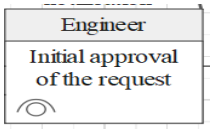
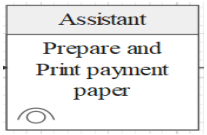
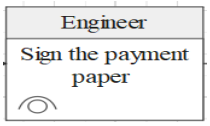
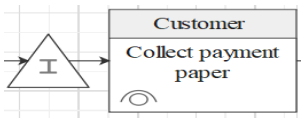
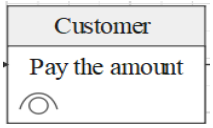
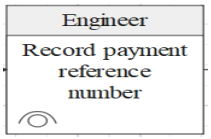
Figure 25. Flow chart for license service

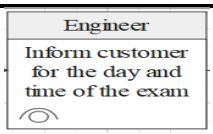
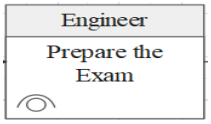
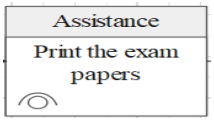
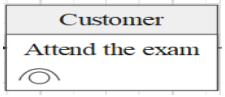
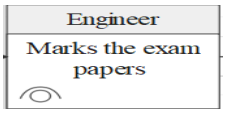
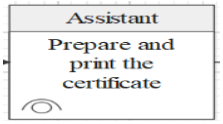
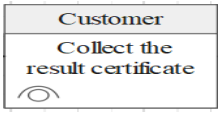
Two color-coded are used in the flow charts, which are:- red and yellow. This helps to highlight the delay and inventory areas. The red color represents the delay, and the yellow indicates inventory.

2) Value stream mapping

Next, construct a VSM map for the current state, which helps to understand all service activities. Expert observation and judgment were used to estimate the processing time and lead time for each activity. The VSM of each segmentation has been implemented separately. VSM map is made for both services: examination and license services, as demonstrated in Table 8 and Table 9, respectively. The tables include the details of the current activities. The entire current processes for both services can be found in Figure 26 and Figure 27.

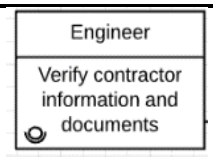
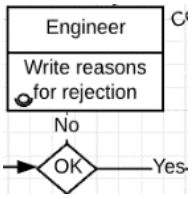
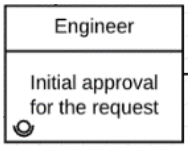
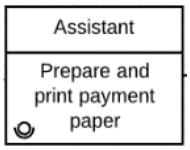
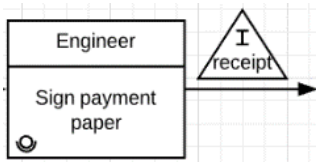
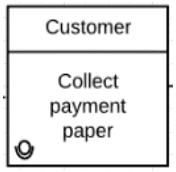
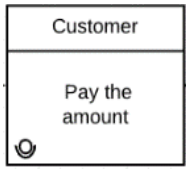
Table 8. VSM of the Current Examination System

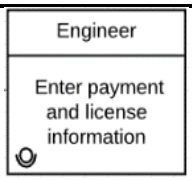
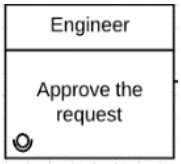
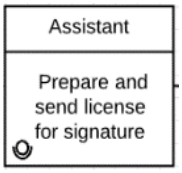
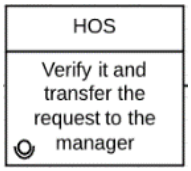
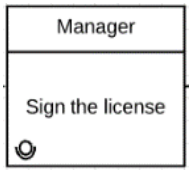
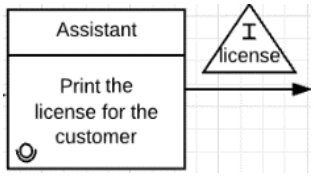
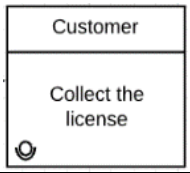
Step No.	Activity	Activity Description
1.		When the request is electronically received from the contractor, the engineer must check and review the request.
2.		The engineer must decide whether the examiner is qualified to attend the exam or not. If not: the engineer must write down the reasons for rejection to the company.
3.		If step 2 was yes. The engineer must give initial approval to the request so that payment notification is triggered to the company to visit the department for payment.
4.		When the request is under initial approval, the assistance must prepare the payment sheet. Which includes the amounts of fees the company must pay.
5.		The payment sheet must have the engineer confirmation, so the engineer must sign it.
6.		The payment sheet must be kept in the files until the customer visits the department to collect it.
7.		The customer must pay the amounts at the counter. At this activity, the contractor will receive another sheet that confirms the payment, which includes the payment reference number.
8.		After the payment, the customer must come back to the engineer to register the reference number in the system.
9.		The engineer gives the final approval for the request in the system.

Step No.	Activity	Activity Description
10.		At the same visit, the engineer discusses the date and time of the exam with the customer. Arrange and book a day after customer agreement.
11.		The engineer will prepare the questions for the exam.
12.		When the engineer prepares and chooses the questions, the assistance must print the exam papers according to the number of customers who will attend the exam.
13.		On the day of the exam, the examiner must visit the department to do the exam.
14.		After the examinations, the engineer must mark and grades all the exams papers. Which usually takes around 1-3 days.
15.		The assister must prepare the certificate of all the examiner's, which includes the names and company details, and the result either the examiner has passed or failed the exam.
16.		The result certificates should be sent to the head of the section for the signature.
17.		After signature, all the exam papers should be stored and kept in files. The assistant handles the result certificates until the customer comes back to collect them.

As can be seen in Table 8, the total steps in the service are 17 steps. The timings in each step are shown in Figure 26, along with the material used.

Table 9. VSM of the Current License System

Step No.	Activity	Activity Description
1.		When the contractor's company submits a request for a license, the engineer must review the information and documentation.
2.		Decision activity: where the engineer must decide whether the request satisfy all conditions. If yes, proceed to step 3. If no, inform the company either for correction or to apply for an examination service request.
3.		The engineer gives initial approval for the request so that payment notification is triggered to the customer to visit the department.
4.		The assistant prepares the payment paper by calculating the fees based on the company-grade and other factors.
5.		The engineer must confirm and sign the payment paper. The payment paper/receipt should be kept in the files (inventory) until the customer collects it.
6.		The customer must visit the department on a suitable day to collect the payment paper.
7.		The customer must use the payment paper to pay the amount (fees) at the CS counters. After the payment, the customer will receive another sheet from the counter, which includes the payment reference number and other information.

Step No.	Activity	Activity Description
8.		The customer must come back to the engineer to enter the payment reference number, license number, and validity date.
9.		The engineer must approve the request after entering all the required information.
10.		Prepare the license using CMS and send it for signature.
11.		The head of the section must verify that license, including the receipts at the CMS, then transfer the license to the manager for signature.
12.		The manager signs the license electronically.
13.		As soon the manager signs the license, the assistant prints it and saves it (inventory) until the customer visits the department.
14.		The customer must revisit the department to collect the license.

As can be seen in Table 9, the total steps in the service are 14 steps. The timings in each step are shown in Figure 27, along with the material used.

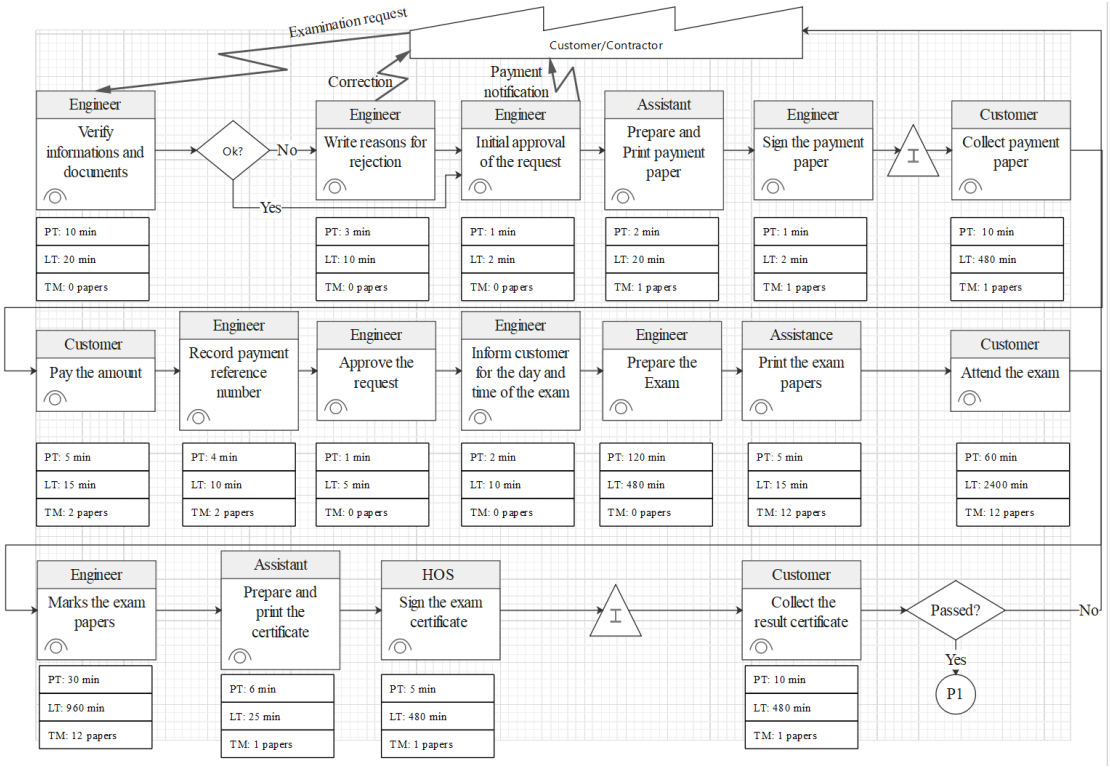


Figure 26. VSM of the current examination state

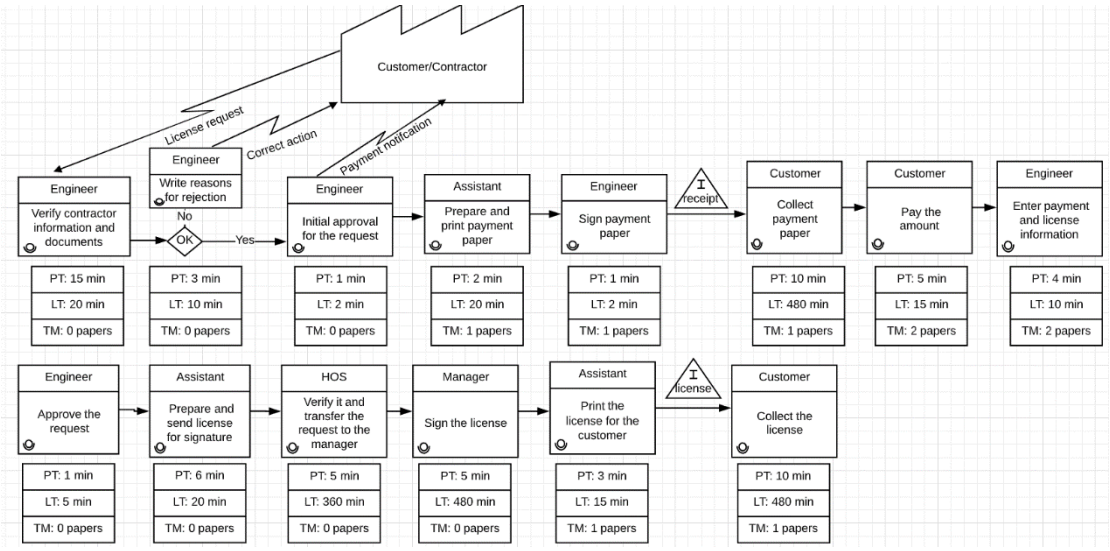


Figure 27. VSM of the current license state

From the above Figure 26 and Figure 27, the sum of the timings and resources used of

all the steps are summarized in Table 10 below.

Table 10. Current Description of Total Timings and Resources Used

Service Type	Total Process Time (min)	Total Lead Time (min)	Total Material Used (paper sheets)
Examination	275	5414	15
License	71	1919	3

The table above shows that, for the examination service, the total lead time is 5414 min, which means it takes approximately twelve working days. On the other hand, the total lead time for the license service is 1919 min, which takes four working days. Taking into consideration that there are eight hours per day.

3) Eliminate wastes

The next step in VSM is to eliminate waste, simplify, and integrate the current procedure for both services to reduce the wastes found in the activities. The yellow shape is the Kaizen Burst used to indicate the improvement required at the activity, as in Figure 28 and Figure 29. Some activities should be eliminated, and others should be improved or replaced.

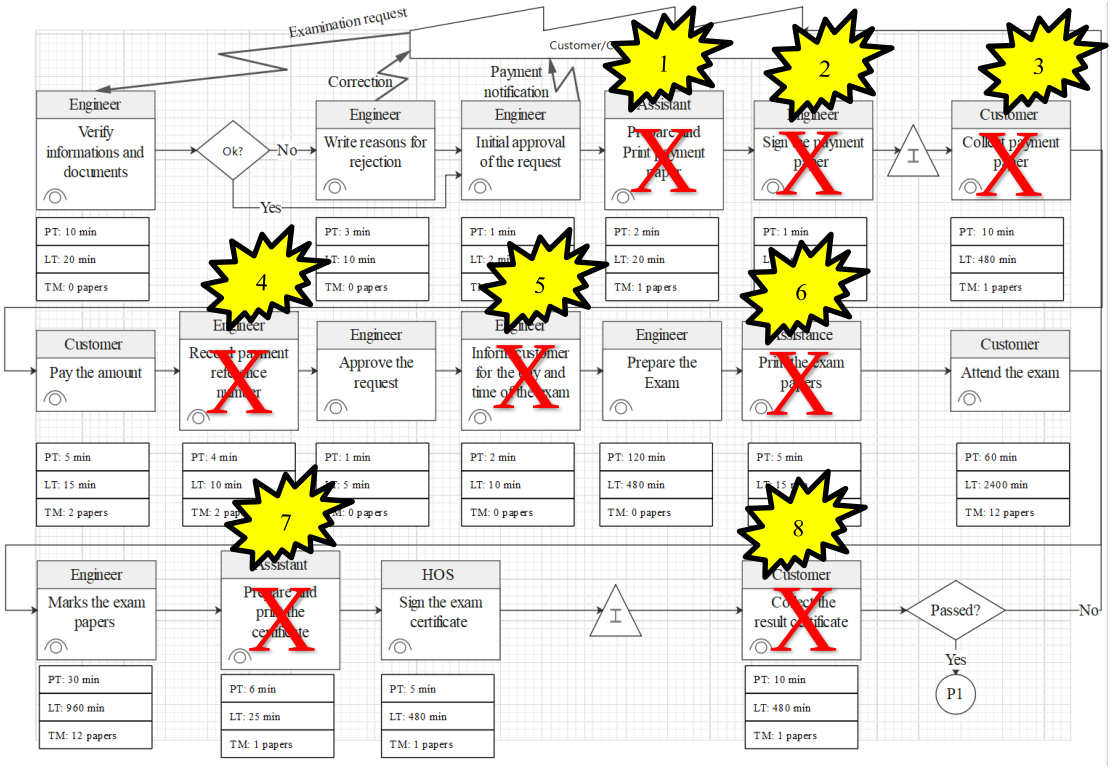


Figure 28. Eliminate wastes of the examination service

For the examination service request, there are eight activities found to eliminate or substitute:-

1) Eliminate unnecessary material used (over-processing and motion)
2) Eliminate unnecessary process (over-processing)
3) Eliminate inventory and transportation
4) Eliminate waiting time (over-processing)
5) Eliminate over-processing
6) Eliminate material used and motion
7) Eliminate material used and motion
8) Eliminate transportation and inventory

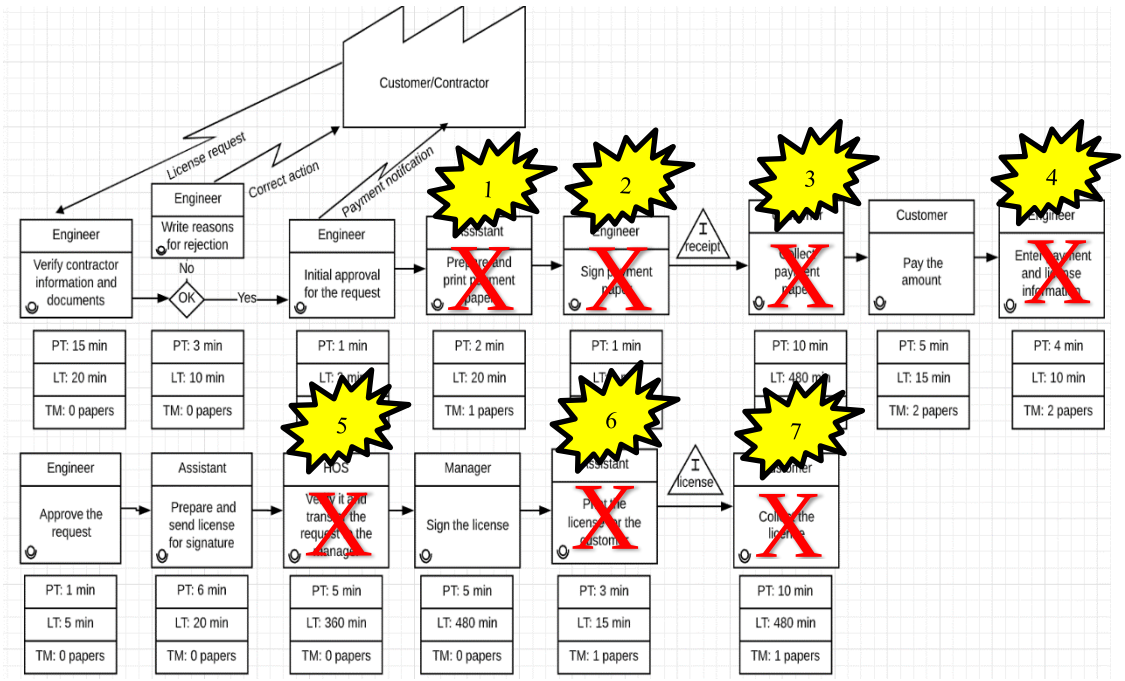


Figure 29. Eliminate wastes of the license service

For the license service request, there are seven activities found to be eliminated or substitute:-:-

1- Eliminate unnecessary process, and material used
2- Eliminate unnecessary process and inventory
3- Eliminate transportation and inventory
4- Eliminate waiting time (over-processing)
5- Eliminate unnecessary process (Double-checking)
6- Eliminate material used and motion
7- Eliminate transportation waste and inventory

After indicating the required improvement areas, the future state procedure was created.

4) Future state

The proposed future state for both services is shown in Figure 30 and Figure 31.

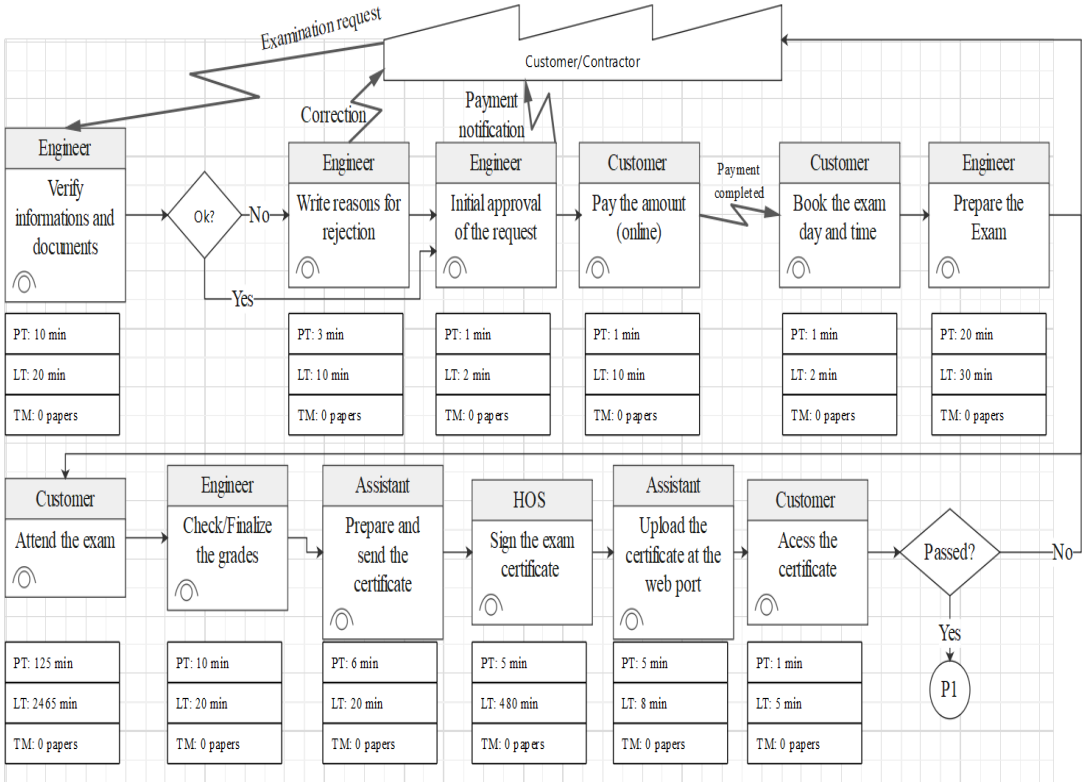


Figure 30. The future state of the examination service

It can be noticed that the total number of steps in the examination procedure is reduced to 12 steps.

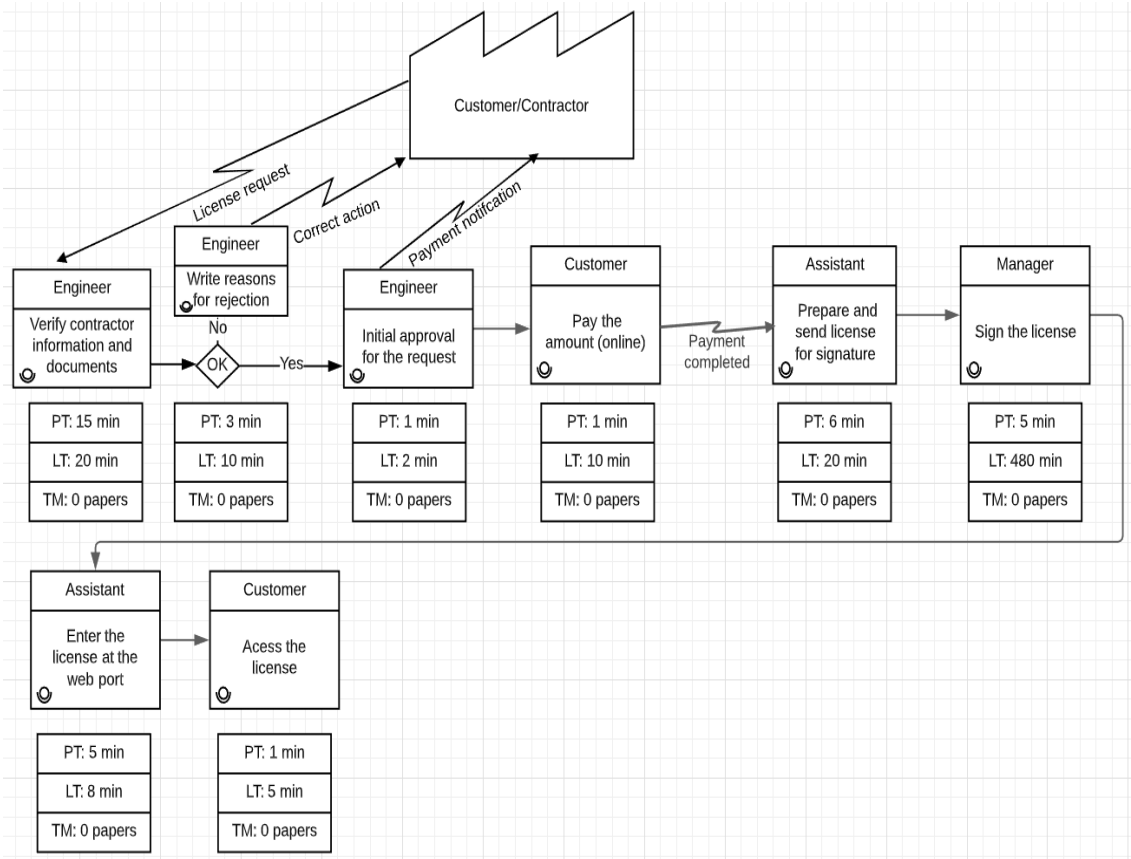


Figure 31. The future state of the license service

For the license service, the total number of steps was reduced to 8 compared to the current state.

From the above Figure 30 and Figure 31, the sum of the timings and resources used of all the steps are summarized in Table 11 below.

Table 11. Future Description of Total Timings and Resources Used

Service Type	Total Process Time (min)	Total Lead Time (min)	Total Material Used (paper sheets)
Examination	188	3072	0
License	37	555	0

The table above shows that, for the examination service, the total lead time is 3072 min, which means it takes approximately seven working days. On the other hand, the total lead time for the license service is 555 min, which takes two working days.

5) Apply and measure

Implementation and evaluation of the recommended process flow to be shared with the high-level management for changing the current state of the procedure. If the process is applied, then a control evaluation of the proposed state will be made.

6) Repeat

Repetition is key to continuous improvement. It allows the employee to be more aware and to spot any future errors. To find out better methods of doing the work, especially when new modern technologies are discovered. Lean thinking steps should be repeated at least every three months to ensure a better quality of work.

The proposed improvement

The following are the suggested ideas to improve the existing procedure.

- Paperless outputs strategy

The following are some suggested strategies to reduce operating costs. The first suggestion is to make all customer communications paperless by implementing a one-to-many communications immediate process. To make all the outputs available electronically to the customers. Figure 32 shows the proposed communication strategy. Any output can be loaded directly into the vault. As soon the communication is loaded to the vault, then the notification can be triggered to the customers to notify them to view. The customer can receive either e-mail or SMS notification. The customer can use the organization port, which in turn via a simple web service to retrieve the document that the customer notifies about. The communication stored on the vault and

made available on the port can also be made available to the call center at the CRM system so that in case any question the customers may have, the communication can be easily handled which they will have the same view of the communication as the customer.

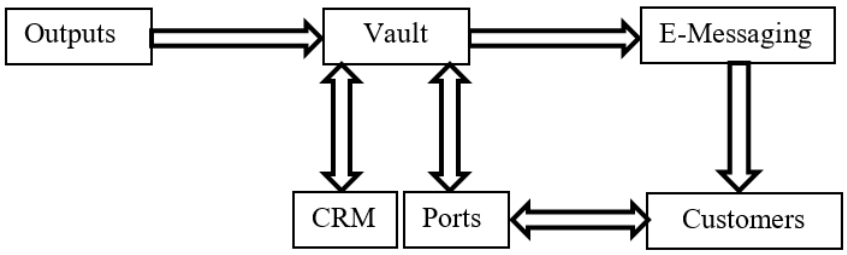


Figure 32. E-recieving outputs

The benefits of paperless communication strategy

This strategy will improve customer service since it will allow access to the right information at the right time from anywhere. Moreover, easy sharing and collaboration. The customers no longer have to visit the department to receive the contractor license or the examination results documents. This will save time for both employees and customers. The number of visits the contractor used to do will be reduced twice since the contractor can access both the license and examination paper from home. The employee's productivity will increase since they can focus on more important tasks instead of printing and handling contractor's sheets. More importantly, this will increase the responsiveness to the customers because it will eliminate the use of transportation to get their license or exam certificate.

- Computer-based examination

The exam papers should be kept in a very secure place to avoid falling into the wrong hands. To prevent this, the test can be done on the computer instead of a traditional paper-based exam. This will improve the security of the questions. Furthermore, it's a more organized way for the examiner to read because some customer has terrible handwriting. The proposed approach is to use at least six computers in the exam room. This may seem expensive, but it will save up some cost later since many papers are printed weekly for the exams. This approach will be more efficient in reducing papers' costs and more securely for questions. The proposed improvement is also to implement a system to carry out the exams. This system will be more efficient for the department in term of the followings:-

1) Eliminate the inventory of the exam paper sheets
2) Reduce the time spent on grading.
3) Increase the security of the questions.
4) Easy to track and restore the examiners' grades at any time.
5) Increase the accuracy of the grades and exam timing.

For example, true or false, multiple-choice, connections questions can be graded immediately with instant grading techniques.

6) Improve the quality of the exam questions by using practical virtual problems.

For instance:- quiz-based video programs. To make the assessments more practical and engageable than standard questions. Virtual reality can "immerse" examiner in an environment that seems more realistic and practical.

- Examination system flow chart

A flowchart is created for the proposed computer-based examination system. The flowchart shows the major components that fit and interact together. The system roadmap is shown in Figure 33.

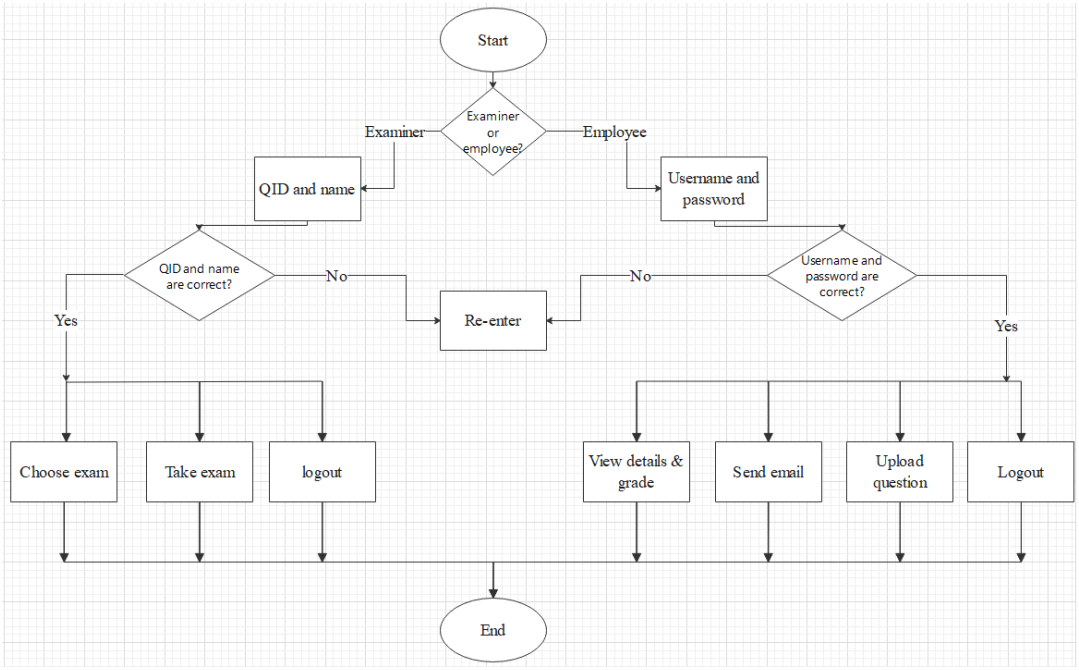


Figure 33. The proposed system for exams

- Confirmation exam date

Additional features can be added for the customers' webpage is to choose the desired dates, and an automatic confirmation message will be reached to the customer. This can improve reliability and avoid misunderstanding. The system should also be programmed by a maximum number of candidates per each date to avoid the over-crowded room. This feature can be more delightful to the customers and improve their satisfaction. Also, using this approach will improve the communication with the customers.

- Electronic payment system

Many customer service procedures have online payment, but there are still a few without. Such as the procedure used in this project. The organization must consider all the procedures by providing a safe, secure, and robust payment processing system.

This helps to ensure faster transaction speed and save time. Online payment can handle many transactions once compared to physical transactions. It's a user friendly because it will eliminate the need for printing receipts papers for the customers. Reduce the risk of loss since using an electronic payment system will be more accurate and traceable. This approach is more efficient in reducing printing materials and labor costs since the electronic payment system is automatic. Reduce the waiting time and number of visits for the customer, hence improve customer satisfaction.

- Data representation

Information is one of the cross-functional drives used to improve both efficiency and responsiveness. So, it is vital to have an effective way to represent data for the contractor's procedure because inaccurate information may lead to wrong decisions. The suggestion is to use power pi software to create a dashboard. To analyze the performance and clearly, represent the information. The value of information is crucial because it helps decision-makers to achieve the organization's goals.

❖ Microsoft power pi

Power pi is a visualization tool that helps to create reports and dashboards. It is a smarter decision for data representation and helps to make the right business decisions. The main advantages of Microsoft power pi are as follow:-

- Connect to multiple sources to create one report or dashboard.
- Visualize and model the data to deliver a real-time view.
- Provide a cloud service which enables sharing and collaboration with a group of peoples.
- Improve strategic decision making for the managers.

Demonstration

The data sample for the year 2019 was used to create a dashboard using different

charts and tools shown in Figure 34. Colors-coded used to represent the charts for the license service and examination service. The green color was used for the approved licensed and the red color for the rejected licensed request. For the examination service, the blue color was used to represent the passing state, and the purple is used for the failing state of the examiner's result.

Figure 34. Data visualization

There are five grades for the low voltage electrical contractor license, which are grade A to E. Each level has permitted electrical loads. Figure 35 shows from the highest to lowest the most-requested licensed grade. From Figure 35, it can be concluded that the most requested grade is "A." This makes sense because grade A has unlimited loads, and for the big projects, it is required to have a class A license. Also, it was noticed that the lowest request grade is "C" (500KW); this may be due to the reason that most

contractors prefer to request grade “B” (1000KW) instead of 500KW as there is only few difference in the requirement between the two grades.

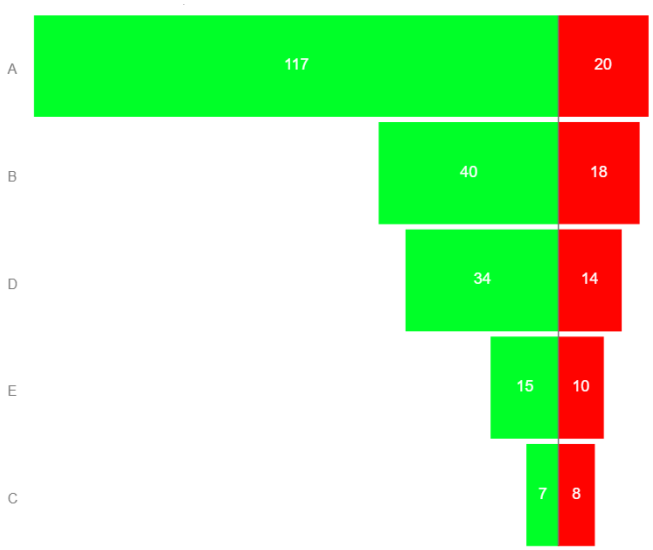


Figure 35. Approved and rejected by license grade

Another tool used is the donut chart to compare the total percentage of the approved and rejected license requests. Figure 36 shows that the total numbers of approved requests are 213 (75.27%), and 70 (24.73%) are rejected.

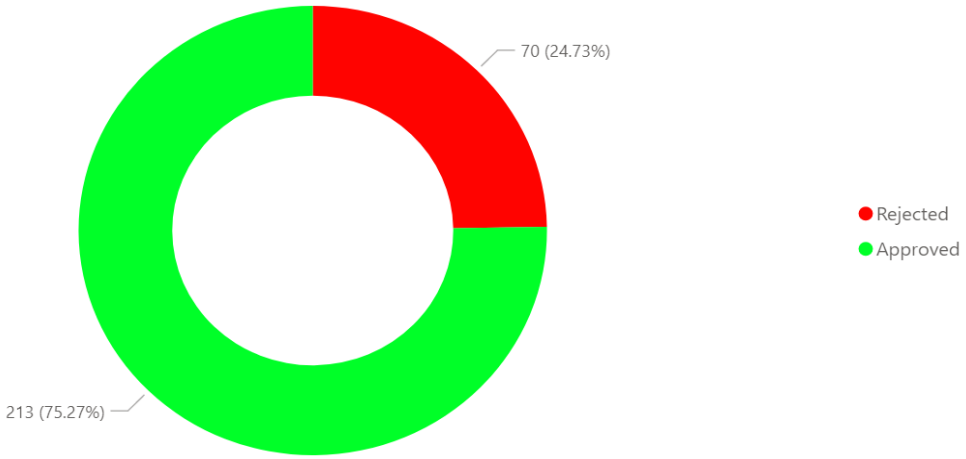


Figure 36. License service requests donut chart

The clustered bar chart can be used to sort data in either descending or ascending order. It also can be sort by approved or rejected requests. Figure 37 was sorted by descending order for the approved request. The highest approved requests were in October, and the lowest requests were in February. This tool can also be used to determine which months have the highest demand.

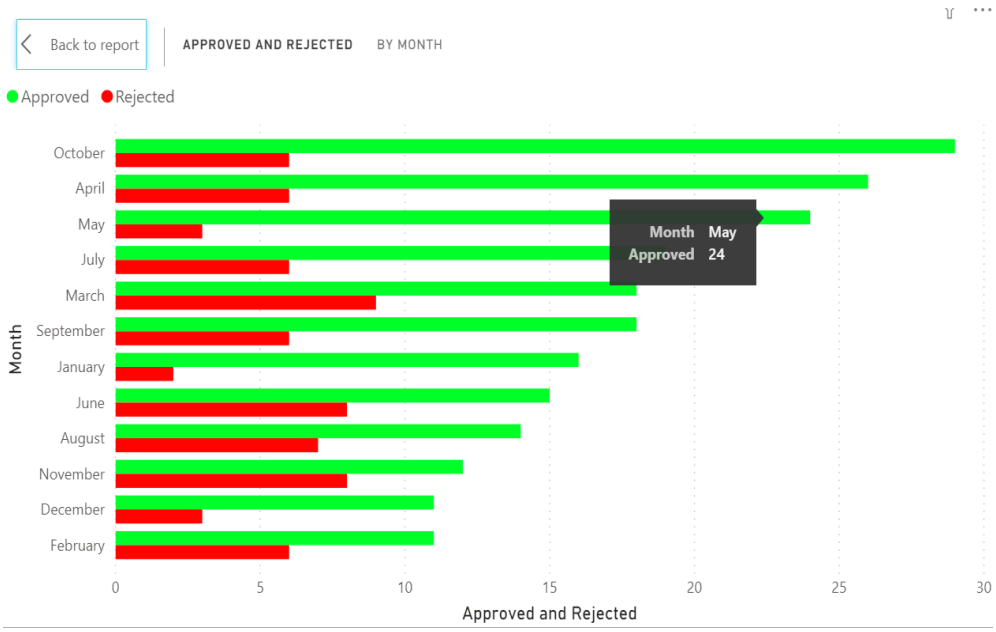


Figure 37. Clustered bar chart for license requests

The pie chart is used to compare the results of the examination. The percentage of how many are passed and failed the exam is shown in Figure 38. It was concluded that there is only a small difference between the two. The difference is almost 5%.

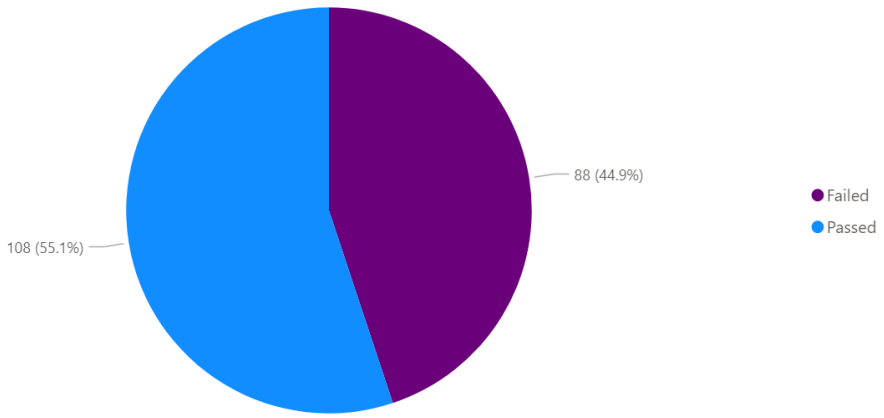


Figure 38. Pie chart for the examination results

The slicer is used to filter out the data. To allow interactive results as the user can choose any month, and all charts will be automatically changed as per the user selection. Figure 39 shows the results when October is selected. The cards are used to indicate the total results.

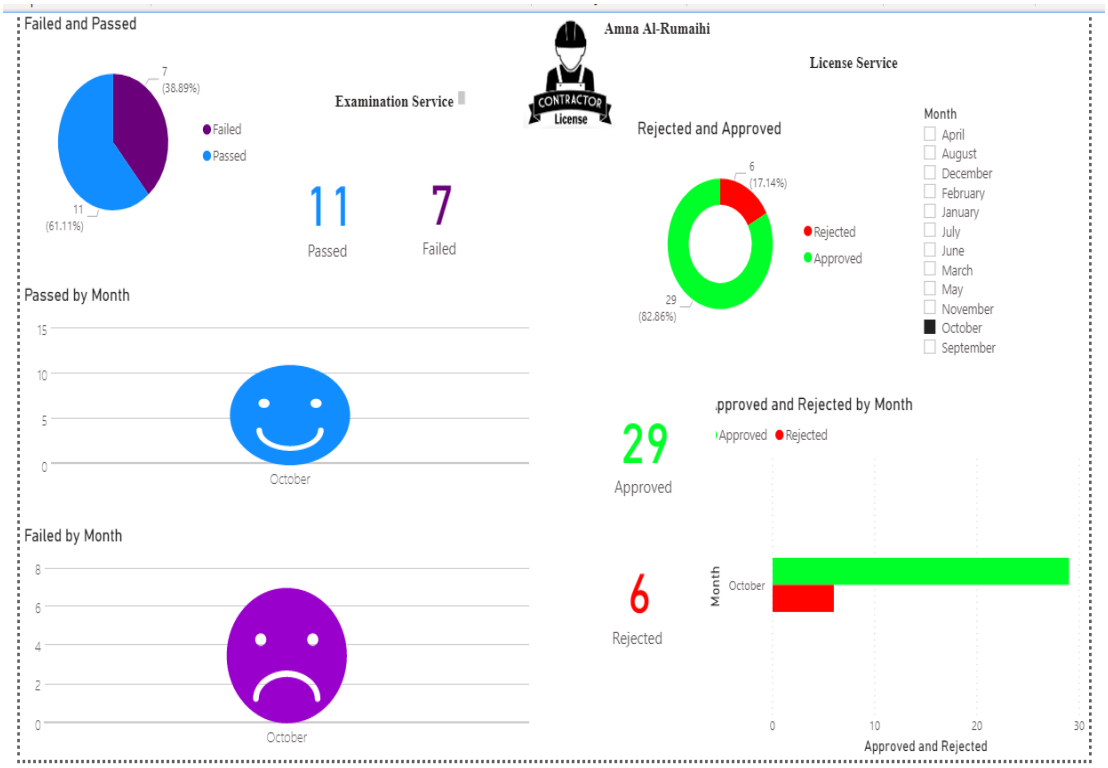


Figure 39. Data visualization for one month

Evaluation Results and Summary

- Measured metrics

The percentage of improvement is calculated for all the measured metrics with the following equation.

$$\left[\frac{Final\ value - Starting\ value}{Starting\ value}\right] \text{ X } 100 \qquad \text{Equation (1)}$$

Table 12 shows the comparison between the current state and future state for both services. The improvement percentage for both services are shown in the table.

Table 12. Comparison Between Current and Future State

Service	Metric	Current State	Future State	% Improvement
Examination	Process Time (mins)	275	188	32%
	Lead Time (mins)	5414	3072	44%
	The material used (papers/sheets)	15	0	100%
License	Process Time (mins)	71	37	48%
	Lead Time (mins)	1919	555	71%
	The material used (papers/sheets)	3	0	100%

Table 12 shows that all the measured metrics have been improved. The highest percent improvement was found in the material used. This indicates that the goal of the project was successfully achieved. The procedure was enhanced into a paperless process. Also, the wastes were reduced, which leads to fewer activities and lead times. This improvement will achieve higher efficiency and responsiveness to the customers, thus enhance customer satisfaction. Improving the effectiveness and efficiency of both services will allow the department to save time, money, improve communication, and provide the workplace's right environment.

- Number of visits

Table 13 shows that the number of visits the contractors or customers must attend to the department was reduced. Before the improvement, the customers must

visit the department at least five times. After the improvement, the customers can drop by to department only once on the examination day.

Table 13. Comparison of Customer Visits

Number of Visits	Before Improvement	After Improvement
First visit	Attend for examination payment	-
Second visit	Attend the examination	Attend the examination
Third visit	Attend for collecting result certificate	-
Fourth visit	Attend for a license payment	-
Fifth visit	Attend to collect the license	-

This shows that the proposed improvement saves some time for the customers and employees by reducing the number of visits that customers have to attend.

CHAPTER 4: CONCLUSION & RECOMMENDATIONS

4.1 Recommendations

Finally, the Recommendation section is to provide additional features that can be applied to improve efficiency and enhance customer satisfaction.

1) Spread awareness about lean thinking

Though lean thinking methodology can provide many advantages to the services, some businesses are unfortunately unfamiliar with this concept. The lack of awareness about the lean thinking concept could be a challenge. So it is crucial to spread awareness about the idea by implementing a lean thinking concept during internal auditing meetings.

2) Reliability and system quality

The contractor's license's validity is one year, and the license should be renewed within three months. If the company didn't request for renewal within that duration, the license is considered invalid, and the company must apply for a new license instead of renewal. It has been noticed that there is some renewal request type is submitted to the unit for review after passing three months, which in return, the engineers have to reject those types of requests and ask the company to choose a new license request instead of renewal. This can be improved by programming the system such that after passing 90 days from the expired license date, the renewal option will be invisible and not valid to the contractor page. This will improve reliability and system quality.

3) Strategic policies

The following are some strategic decisions that required a high level of management involvement and approval to be implemented.

- Re-test policy

If the examiner mark was far below the average 50%, the examiner could re-take the exam after one year instead of 90 days. This ensures that the examiner has gained more experience and skills. The current condition can be applied if the examiner mark was above average or near average.

- ISO certified

To ensure a high quality of service that the contractor's companies are providing to the consumer. An additional requirement is suggested to include that those companies should be ISO certified.

4) Benchmarking

Kahramaa is the only organization in Qatar that provides contractor electrical licenses to the companies. Thus it is vital to apply worldwide benchmarking with other companies. To compare performance metrics and business processes to achieve best practices in cost, time, and quality.

4.2 Conclusion

Imagine all customers can finish all their wants and needs without visiting the department. "All customers are no longer have to visit the department." The purpose of this project is to achieve a digitalized customer procedure with excellent customer satisfaction. The process improvement tools and techniques are used to achieve the goals. The low voltage contractor license procedure was selected for the project scope. A sample of data for the year 2019 was used to analyze the problem. The lean thinking approach was successfully implemented for two services: the examination service and the license service. After eliminating unnecessary activities, the improvement percentage for the proposed future state metrics were found to be high. A reduction of 100% is reached in terms of the materials used for both services. This will lead to a decrease the operational costs.

Furthermore, reduction of process time and lead time were achieved. This will help to increase the responsiveness to the customers. The proposed VSM and other recommendations will be presented to the customer service department for discussion and implementation. Using smart technologies and the lean thinking approach paperless working environment can be achieved.

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