



## Novel Data Analysis Approaches to Enhance the Quality of Customer Service in Saudi Government Sector

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### ABSTRACT

All people in this world require others to provide them with different services during all stages of their live. Some services are provided by government to all citizens or residents, which are called public services and some others are provided by some people to some other, which are called private services. Both types differ from country to country and from region to region. In Saudi Arabia, public services include education, health, police, trading, and environmental services. It is the aim of all government agencies in Saudi Arabia and other countries around the world to offer more services to their customers, improve the quality of their customer service, and enhance the existing services. Nowadays, most government agencies developed Information Systems (ISs) to help their customers in applying for services and help their employees in processing the services. However, hardly a government agency utilize the data in the employed IS to improve the quality of its customer service. This paper is dedicated to address this gap by proposing a number of data analysis techniques that can be utilized to improve the quality of customer service and enhance the existing services in the Saudi government sector. These data analysis techniques are based on a database structure that are proposed as well in this research paper.

**Keywords:** *Data Analysis, Information Systems, Saudi Government, Enhance the Quality.*

### 1. INTRODUCTION

Customer service is the process of providing people with the legitimate need they require, where “Legitimate need” means people’s right based upon the rules and regulations of the government and the service provider [1-3]. According to the situations, the same person can require different types of services. If for example, the customer is a seller of an equipment, then the service might be maintenance to that equipment. If the customer is a patient, then the service is the treatment to his/her illnesses. If the customer is a student, then the service is the education and so on.

Based upon the provider, services can be divided into

public and private services. The former is provided by the government to all residents or citizens in the country while the latter is provided by some people to some other people according to a business deal they made or they are going to make [3-7]. Public services differ from country to country and even in some countries, they differ from region to region but famous examples include police, health, education, social security, environmental, and trading services.

It is the aim of all service providers to offer more services to their customers, enhance the existing services, and improve the quality of their customer service. This paper discusses this subject in the context of Saudi government sector, where the tool utilized towards this aim is the Information Technology (IT). The main contributions of this paper are:

1. Proposing a novel database structure the can be utilized by most government agencies in Saudi Arabia for the purpose of providing services to their customers.
2. Proposing a number of data analysis techniques that efficiently utilize the services data to enhance the existing services and improve the quality of customer service in government agencies.

The remainder of this paper is organized into five sections. Next section gives the reader the necessary background to this research. Third section introduces the idea and benefit of Customer Service Information Systems (CSISs). Fourth section proposes a novel database structure that can employed by most Saudi government agencies. Fifth section introduces a number of data analysis techniques that can be utilized to improve the quality of customer service. Section number six summaries the paper and suggests ideas for future work.

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## 2. BACKGROUND

In order to provide techniques for improving customer service, we need first to define the customer service and understand its main components. According to the literature, customer service has three main pillars, which can be described as [3-8]:

1. Service: is a procedure that comprises one or more steps where each step has a number of inputs, outcomes, and checklist. Inputs might include documents and/or information. Outcomes might include progressing the service to the next step, returning it to the previous one, refusing it, and terminating it. Checklist includes checking the customer documents and information in order to take the right decision about the service/step. The service starts if the customer requested it and provided all required inputs of the first step. Each step is assigned to an individual employee or a group of employees to process it. The processing involves inspecting the checklist of each step in order to forward it to the right outcome.
2. Customer: is the beneficiary who is eligible to apply for the service and is required to provide the necessary inputs to the service as it progresses.
3. Provider: is the government agency that receives the request and processes it by assigning it to one or more employees.

Based upon the intervention required by the human during processing the service/step, it can be divided into two main categories:

1. Human Intervention Service/Step (HIS): is a service/step that requires a decision from the authorized employee who process it. This type of service/step requires careful inspection of the available inputs and circumstances in order to choose the right decision about the service/step. Such services/steps cannot be automated.
2. None-Human Intervention Service/Step (NHIS): is a service/step that does not require a decision from human. The available information is enough to process the service/step via an automated Information System.

## 3. CUSTOMER SERVICE INFORMATION SYSTEM (CSIS):

It is the fact that the number of beneficiaries increases day after day in Saudi Arabia, which follows the population. Additionally, the number of services they require have the

same trend. Therefore, it becomes difficult for the government agencies or any other service providers to process the services manually [3-6]. The best solution to such a problem is to develop an Information System (IS) for the customer to allow them to apply for services and allow the agency to process the services. These ISs have many names in the academic and industrial societies including CIS, CRMS, and CSIS (which is used in this research paper). The backend of these ISs is a database that store the customers, services, & employees data while the frontend is a number of forms that allow the service provider to manipulate these data [5-8]. The manipulating occurs according to the rules and regulations of the government agency. CSISs help the customers in requesting new services, tracking the status of active services, and replying to the queries received from employees who process the service. Moreover, CSISs help government agencies in storing of data in compact form, processing of services in less time & effort, and validating the received information in an efficient way [5-10]. One of the good examples of such CSISs in Saudi Arabia is SAFEER, which is a web-based IS developed by Ministry Of Education (MOE). It is dedicated for serving Saudi scholarship holders in any country around the world by providing them with all services they need during the scholarship period.

However, it is worth mentioning that most existing CSISs does not efficiently utilize the services data to improve the quality of customer service or enhance the existing services. The next two sections are dedicated for this purpose. The following section provides a novel database structure that can be utilized by most government agencies in Saudi Arabia in the backend of their CSISs. Furthermore, the section follows the next one proposes a number of data analysis techniques that can be utilized to give decision makers in government agencies the information they need in order to improve the quality of their customer service as well as enhance the existing services.

## 4. PROPOSED DATABASE STRUCTURE

Based on the previous two sections, a database structure that serves the business of most government agencies can be proposed. The database contains nine tables, which are listed below one in each subsection. Each subsection describes the structure of a table including all attributes and relations. It is worth mentioning that some tables in the following subsections have relations to some other tables, the scope of them are outside the subject of this paper (e.g. Employees, Customers ... etc.). Hence, these tables are mentioned and assumed to be existed in the database. In

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the text below, PK stands for Primary Key and FK stands for Foreign Key. The proposed tables in the database are:

5.1 Services: This table contains the details of all services provided by each government agency. The main attributes includes the agency id and service id, which are a compound PK. The table also has the name of the service, average, minimum, and maximum processing time of each service. The attribute “Agency Id” is a FK on Agencies, which contains the details of all government agencies.

Table	Attribute (Property/Relation)
Services	Agency Id (PK + FK on Agencies)
	Service Id (PK)
	Name
	Average processing time
	Minimum processing time
	Maximum processing time

5.2 Inputs: This is a lookup table that contains the details of all inputs required by the customers when requesting the service. The main attributes are the Input id, which is the PK, the name of the input, and its description.

Table	Attribute (Property/Relation)
Inputs	Input Id (PK)
	Name
	Description

5.3 Outcomes: This is a lookup table that contains the details of all outcomes that any service/step can produce. The main attributes are the outcome id, which is a PK, the name of the outcome, and its description.

Table	Attribute (Property/Relation)
Outcomes	Outcome Id (PK)
	Name
	Description

5.4 Steps: This table contains the details of all steps of each service. The main attributes include the service id and the step id, which are a compound PK. The service id is a FK on Services. The table also has the step name, average, minimum, and maximum processing time of each step. The step sequence attribute determines the sequence of the step in each service.

Table	Attribute (Property/Relation)
Steps	Service Id (PK + FK on Services)
	Step Id (PK)
	Step name
	Step sequence
	Average processing time
	Minimum processing time
	Maximum processing time

5.5 Steps Inputs: This table contains the details of the inputs of each step in each service. The main attributes of this table are the service id, step id, and input id, which are a compound PK that prevents redundant inputs per steps. Service id and step id are a compound FK on Steps and input id is a FK on Inputs.

Table	Attribute (Property/Relation)
Steps Inputs	Service Id (PK + FK on Steps)
	Step Id (PK + FK on Steps)
	Input Id (PK + FK on Inputs)

5.6 Steps Outcomes: This table contains the details of the outcomes of each step in each service. The main attribute of this table are the service id, step id, and outcome id, which are a compound PK that prevents redundant outputs per steps. Service id and step id are a compound FK on Steps and outcome id is a FK the Inputs.

Table	Attribute (Property/Relation)
Steps Outcomes	Service Id (PK + FK on Steps)
	Step Id (PK + FK on Steps)
	Outcome Id (PK + FK on Inputs)
	Justification

5.7 Checklists: This table contains the details of the items that each step should pass in order to progress to the next step. The main attributes of this table include the service id, step id, and the item id, which are a compound PK. Both the service id and the step id are a compound FK on Steps. The table also has the item name, description, average, minimum, and maximum processing time of each item.

Table	Attribute (Property/Relation)
Checklists	Service Id (PK + FK on Steps)
	Step Id (PK + FK on Steps)
	Item Id (PK)
	Item name
	Item description
	Item sequence
	Average processing time
	Minimum processing time
	Maximum processing time

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5.8 Employees Responsibilities: This table contains the responsibilities of each employee in the government agency. Each employee can be assigned one or more steps from the same or different services. The main attributes of this table are the employee id, service id and step id, which are a compound PK. This guarantees the uniqueness of steps assignment per employee and it allows assigning any step to more than one employee. The employee id is a FK on the Employees (a table that is assumed to exist, which contains the information of all agency employees). The service id and step id are a compound FK on Steps, which guarantee the integrity of the data in this table.

Table	Attribute (Property/Relation)
Employees Responsibilities	Employee Id (PK + FK on Employees)
	Service Id (PK + FK on Steps)
	Step Id (PK + FK on Steps)

5.9 Processed Services: this table contains the details of all requested services. The main attribute of this table are the customer id, service id, employee id, and the request timestamp. There is no PK in this table because any customer can request the same service more than one time. In order to guarantee the integrity of the data in this table, a number of FKs have to be created as follows. The customer id refers to Customers (a table that is assumed to exist, which contains the information of all customers). The service id refers to Services and the Employee id refers to Employees.

Table	Attribute (Property/Relation)
Processed services	Customer Id (FK on Customers)
	Service Id (FK on steps)
	Step id (FK on steps)
	Employee Id (FK on Employees)
	Submission timestamp
	Outcome id (FK on outcomes)
	Completion timestamp

## 5. DATA ANALYSIS TECHNIQUES

This section proposes a number of data analysis techniques that can be utilized to enhance the quality of customer service in government sectors. The proposed techniques assume the existence of a CSIS that have a database as described above. Each of the following subsections proposes a data analysis technique that efficiently utilize the existing data in CSIS to give the decision maker a good reading on how to improve the quality of customer service or improve the existing services. The text below provides the equations and approaches required to develop such data analysis techniques while the select statements/algorithmic implementations are left due to their simplicity.

5.1 Reviewing the structure of the services/steps: It is important that the government agency (service provider) regularly review the structure of its services to improve their qualities. The reviewing process suggests either changing the structure of the service or keeping it as is. Changing the structure includes adding one or more steps and/or removing one or more steps. One of the vital tools for reviewing service structure is to statistically summarize the historical data of each step in the service to find its successful rate. The successful rate can be defined by the following equation:

$$\text{Step successful rate} = \frac{\text{number of steps progressed to the next step}}{\text{total number of steps}}$$

From a statistical point of view, the successful rate of steps should increase as the service advances through the steps. If any step has a successful rate less than its predecessor, this suggests moving that step before the first step that has a higher successful rate [2-8]. If that is impossible due to rules and regulations, then the checklist that causes this decreasing in successful rate might be moved earlier.

5.2 Determining services/steps timescale: professional service providers provide their customers with the time required for each service/step to be processed (e.g. Ministry of Commerce and Industry-MCI announced that the processing of a commercial registration takes 180 seconds for individual institutions). Determining the processing time is easy only if the service is completely automated and does not require a human intervention (NHIS) [3-5]. However, if the service is a HIS, then its processing time depends upon human and differs from one employee to another or even from season to season. In this case, it has to be treated statistically. For this reason, the database structure proposed above stores the submission and completion timestamp of each processed step. This allows determines the average,

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minimum, and maximum processing time for each service/step. These values can be calculated using the following equations and then stored in the relevant fields:

$$\text{Average processing time} = \frac{\Sigma(\text{completed timestamp} - \text{submission timestamp})}{\text{total number of processed steps}}$$

$$\text{minimum processing time} = \min(\text{completed timestamp} - \text{submission timestamp})$$

$$\text{maximum processing time} = \max(\text{completed timestamp} - \text{submission timestamp})$$

5.3 Administering Human Resource (HR): it is important that the government agencies make sure that services/steps do not halt or left without assignment [1-2]. In order to guarantee that, the service provider has to make sure that any requested service/step has the enough HR to process it. Enough HR means the total working hours of all employees who are free & eligible to receive service/step is more than or at least equal to the average processing hours of all active relevant services/steps. Mathematically, this can be represented by the following equation.

$$\sum (\text{daily working hours} \times \text{number of available employees}) \geq \sum (\text{average processing time} \times \text{active services/steps})$$

5.4 Determining the efficiency of HR: the main processor for all services/step is the HR. Therefore, it is a wise approach to assess HR based on the quality of processing services/steps. Two main metrics can be utilized for this purpose:

a) Processing timescale: Good employees should process services/steps in time very near to the average processing time and under all circumstances should not exceed the maximum processing time. Outstanding employees are expected to process services/steps in time very near to or less than the minimum process time.

b) Processing quality: processing quality means taking the right decision. Thus, it can be represented by the total number of services/steps that are not returned to the employee as incomplete or wrongly processed.

5.5 Reducing the number of refused services/steps: professional service providers save their employees and customers time via decreasing the number of refused services/steps especially those refused due to missing/wrong documents/information. Statistical analysis of historical data can be summarized to give the customers important information about the most likely reasons that cause refusing the services/steps. This will increase the awareness of the customers so that they take extra care about the inputs that might cause refusing the services/steps. Hence, decreasing the number of refused services/steps.

5.6 Reducing the storage size of CSIS: some inputs are common between several services/steps. Accordingly, it will save the database size if these documents are stored in the customers profiles and then the customers refer to these documents when applying for services.

## 6. CONCLUSION AND FUTURE WORK

It is the fact that all employees in all jobs around the world are working towards providing services to others. While each employee serves others, he/she receives services from others. Nowadays, processing services require an Information System (IS) that is called Customer Service Information System (CSIS). This system comprises a database in its backend and a number of forms in its frontend. Most existing CSISs automate the process of processing services but not utilize the available data to improve the quality of customer service. This paper addressed this gap by proposing a number of data analysis techniques that can be utilized to improve the quality of customer service and enhance the existing services. These data analysis techniques are based on a database structure that are proposed as well in this research paper.

The future work of this research might include statistical analysis of real data collected from Umm Al-Qura University (UQU) in order to give decision makers valuable readings and suggestions to improve the customer service in the university.

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