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John Ryan Dizon   *Editors*

World Congress on Engineering and Technology; Innovation and its Sustainability 2018

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Through its open free membership model EAI promotes a new research and innovation culture based on collaboration, connectivity and recognition of excellence by community.

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Foreword

We are pleased to present to you the proceedings of the first edition of the 2018 European Alliance for Innovation (EAI) International Conference on World Congress on Engineering and Technology; Innovation and Its Sustainability (WCETIS). This conference has become an instrument to gathered researchers from the academe and different field of discipline in engineering internationally, contributing to the enhancement of society through engineering and ICT.

The technical program of WCETIS 2018 consisted of 12 full papers. The conference has only one main track divided into seven general topics as follows: (1) Industrial Engineering and Healthcare; (2) Advanced production, processing, and manufacturing; (3) Sustainable Infrastructure; (4) Water Resources Planning and Management; (5) Heat transfer and fluids; (6) Electronics and Electrical Engineering; and (7) Internet of Things. Together with the high-quality technical paper presentations, the technical program also featured one keynote speech, with two technical talks. The keynote speaker is Dr. Angelo Beltran Jr. from Adamson University, Philippines. The two invited talks were from Prof. Lorena Ilagan and Mr. Rolando Pula of University of Perpetual Help System DALTA, Philippines. Lorena Ilagan discussed Internet of Things (IoT), while Mr. Rolando Pula talked about LiDAR Technology for Resources Mapping. The purpose of the talk is to spread some technological advances happening in the country through the application of latest technology in addressing major challenges.

Regular coordination with the steering chair, Imrich Chlamtac – Bruno Kessler Professor, University of Trento, Italy through the EAI Conference Managers – Radka Pincakova, and Karolina Marcinova was essential for the success of the conference. We sincerely appreciate their support and guidance throughout the process of handling and hosting a conference. This conference will not also be possible without the help of very supportive and dedicated organizing committee team. Particularly, the following individuals: Ronnie Concepcion II – Local Chair, Rolando Pula – Technical Program Committee Co-chair; Sheily Mendoza – Sponsorships and Exhibits Chair, and Cyd Laurence Santos – Web Chair. We also gave our appreciation for those reviewers who take time to review the papers. Additionally, we also want to thank the top management of the University of

Perpetual Help System DALTA in supporting us and, lastly, for all the authors who submitted their works to WCETIS 2018 conference.

We are firmly convinced that WCETIS conference provides a good venue for all different engineering fields in sharing their ideas, researchers, works, and scientific findings that promote advances in the seven major topics of the conference contributing to the betterment of mankind. We also expect that the future WCETIS conference will be much more successful and bigger in terms of number of high-quality papers in different engineering fields surpassing the previous volume.

Lorena Ilagan

Conference Organization

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Part I
Industrial Engineering and Healthcare

A Web-Based "InstaSked" Appointment Scheduling System at Perpetual Help Medical Center Outpatient Department

Sheily Mendoza, Ranzel Cloie Padpad, Amira Jane Vael, Cindy Alcazar, and Rolando Pula

1 Introduction

Philippine health status indicators show that the country lags behind most of Southeast and North Asia in terms of health service outcomes. Since patient satisfaction is important, Philippine hospitals should take it up a notch by improving the current system. To achieve universal healthcare, the capacity of local government units to manage the local health system must be strengthened [1]. There are seven (7) types of waste in services. One of them is delay. Delay refers to customers waiting for service delivery. Currently, hospitals prefer traditional method of appointment – where patients are required to wait for a long time in the hospital before their consultation. The purpose of this research is to know the various causes of the long waiting time experienced by the patients and develop solutions through Industrial Engineering (IE) tools. Based on the study conducted by [2], the outpatient department is the main healthcare service for nonurgent patients, but long waiting time is a common problem for this particular department. Usually, the lack of an effective appointment system is the cause.

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A web-based appointment system could possibly add to patient's satisfaction since it reduces total waiting time effectively compared to the traditional and usual queuing method [3].

The problems of OPDs of developing countries are long queues, inefficient hospital staffs, absence of staffs, etc. The utilization of time in the OPD setting can be studied further by timing the patient flow (TMS) [4]. The patient satisfaction correlates with the waiting time [5]. Thus, long waiting times have an adverse impact upon patients' perceptions of medical care.

OPD is described as the face of any hospital, as it is usually the first point where patients go in a hospital. Patient's impression is often influenced by OPD services [6]. Therefore, it is important that it provides excellent services for customer's satisfaction. It was stated in a study that increase waiting time at OPD causes negative impact on patient's satisfaction; hence, healthcare facility performance can be best defined by measuring the level of patient's satisfaction [7].

Evidently, Six Sigma is an approach for formulating a design and execution of new services, products, or processes [8]. It is an approach that is best for quality improvement that can be used to meet the expectations as well as the needs of the patients to improve profitability in healthcare organizations. In addition, a study has achieved significant reduction in waiting time in the outpatient services using the Six Sigma approach [9].

One of the several advancements that a hospital can use for managing different business-related process is the BPMS which will also be used by the proponents of this study. It is an integrated solution for business processes to meet the customer's needs better [10]. BPM in hospitals proves to be a beneficial methodology to improve both day-to-day and strategic operations [11].

2 Methodology

The research method used in this study was Six Sigma submethodology, DMADV (define, measure, analyze, design, and verify) for the first phase, while another tool, BPM (business process management), was used for the second phase. These two methodologies were used in defining the causes, gathering data, analyzing data, process redesigning, and process configuration, execution, and verification. Shown in Table 1 are the tools to be used in every phase of DMADV and BPM.

3 Results and Discussions

3.1 Define Phase

Determining the current system was the initial task done. This is to know the answers to the following questions: Is adjustment of the existing system necessary? What is the part of the system that needs improvement? Where should the adjustment start?

Table 1 Tools to be used in every phase of DMADV and BPM

Phase	Tools
Define	Process map, VOC (voice of customer), stockholders' analysis, surveys, interviews, CTQ tree
Measure	Arrival rate, waiting time, takt time
Analyze	Ishikawa diagram, data analysis, defects chart
Design/process design	Proposed process flow, diagrams
System configuration	Software requirements, policies, roles, prototype
Process enactment	Advantages vs. disadvantages table, takt time
Diagnosis/verify	Implementation, evaluation

Define phase is very important in conducting the DMADV and BPM Six Sigma submethodology, because this phase will be the guiding path to the direction of the study.

Flow Process Chart (Present System) Figure 1 shows the present system for consultation of patients in the OPD of Perpetual Help Medical Center.

Key Roles (Present System)
- Doctors
- Medical secretaries
- Patients
- Management

Slovin's formula was used in computing for a certain number of patients to be timed according to the population. Researchers takt timed three hundred ninety (390) patients for a month, so results could have a ninety-five percent (97%) confidence level and a margin of error of plus or minus three (±3).

Survey/Questionnaires This study used surveys as a way of obtaining voices, complaints, and suggestions from patients and medical secretaries. For the patient survey, the diversity sampling is used with one hundred (100) patients. For medical secretaries, expert sampling is used in which expert opinion is needed, with fifteen (15) secretaries chosen.

Time and Motion Study Slovin's formula was used in computing for a certain number of patients to be timed according to the population. Researchers takt timed three hundred ninety (390) patients for a month, so results could have a ninety-seven percent (97%) confidence level and a margin of error of plus or minus three (±3).

Critical-to-Quality Tree Based on the article by Team, Mind Tools Editorial, 2015, critical-to-quality (CTQ) trees help to translate broad customer needs into specific, actionable, measurable performance requirements that can then be used to deliver high-quality products and services. Researchers have gathered feedbacks from the management, secretaries, and patients. Through the gathered data, their needs and required performance from the system become known. Shown in Fig. 2 is the critical-to-quality tree analysis for the improvement of the existing system.
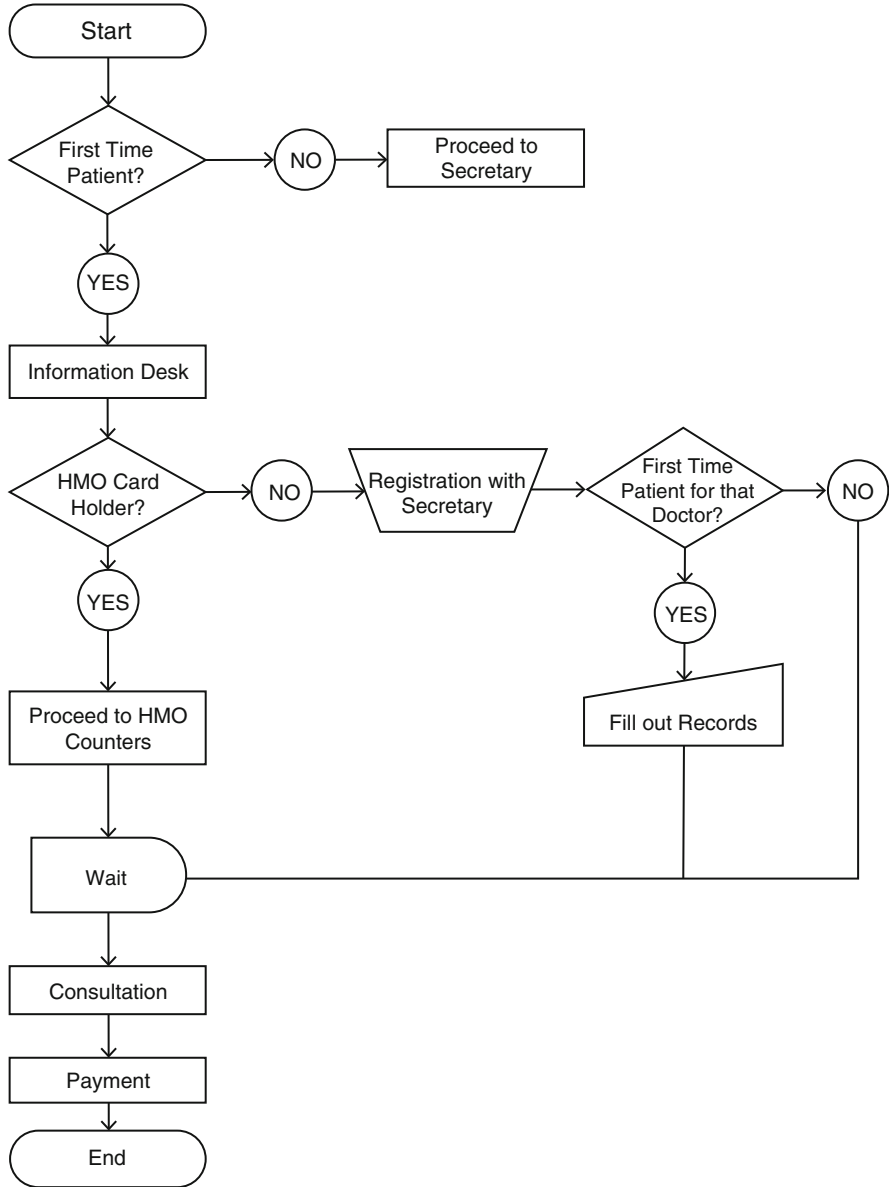
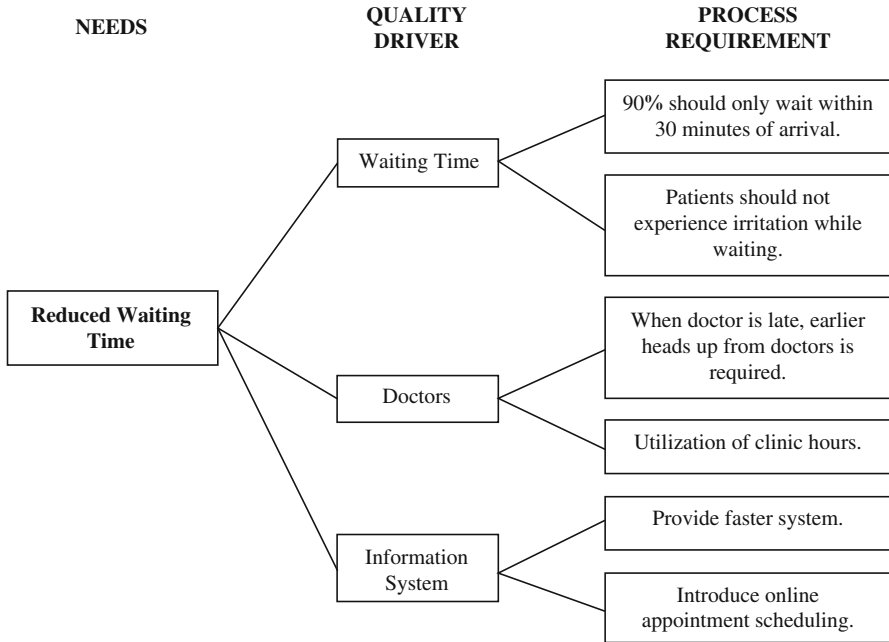**Fig. 1** Present appointment scheduling process for patients

NEEDS	QUALITY DRIVER	PROCESS REQUIREMENT

Fig. 2 CTQ tree

3.2 Measure Phase

According to Business Dictionary, time and motion study is the sequence of movements taken by the employee in performing steps with carefully observation to detect and eliminate redundant or wasteful motion, and precise time taken for each correct movement is measured. Researchers used TMS to measure the service time, waiting time, and arrival rate of patients in UPHDMC. It is a form of direct observation method. The starting point for TMS is when the patient writes his/her name in the schedule notebook, and it ends when he/she pays the bill. Results of the TMS in this study are shown below. All values are in minutes.

Time and Motion Study (Present System) Currently, there are six hundred (600) patients visiting outpatient departments every month. Researchers will takt time three hundred ninety (390) patients for a month, so results could have a ninety-seven percent (97%) confidence level and a margin of error of plus or minus three ($\pm$3).