A DIAGNOSIS FRAMEWORK FOR SELECTING OPERATIONAL IMPROVEMENT OPPORTUNITIES FOR MALAYSIAN INDUSTRIES

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DEDICATION

In the name of

ALLAH

Most Gracious,

Most Merciful

To my loving parents Ramly bin Bachik and Mariah binti Mohd. Dom

My precious wife Rosleena binti Hashim.

And my joyful children Iqmal, Aqmal, Eqma and Eqbal

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ABSTRACT

Organizations need to diagnose their current operation performance and identify the opportunities for improvement in order to stay competitive. However, there seems to be lack of studies that focuses on operation diagnosis that align quality audit, business excellence (BE) assessment and project selection for lean six sigma. Hence, this study was undertaken with the objective to develop, evaluate and refine a diagnosis framework that selects operational improvement opportunities. The operational diagnosis framework which was aimed at identifying and selecting operational improvement opportunities was developed through multiphase mixed methods. Qualitative data was used more dominantly than quantitative data. The first phase of the research was to develop of the conceptual framework. The conceptual framework was formulated based on the literature review and semi-structured interviews. Then, it was included in the case study protocol to conduct the action-based case study. The second phase of the research was to evaluate and refine the diagnosis framework through action-based case study and evaluation survey. Four organizations were involved in the case studies and the results were analyzed. Evaluation survey was conducted to assess the proposed framework in term of design and contents. The final diagnosis framework consists of diagnosis steps and the diagnosis enablers. The diagnosis steps included; 1) evaluate the operational performance through BE categories; 2) determine the ISO9001 elements as the cause of operation performance; 3) determine the available operational improvement tools and techniques, and 4) select the improvement opportunities. The diagnosis enablers include; (1) diagnosis initiation, (2) leadership, (3) person who conducts the diagnosis, and (4) teamwork. Based on the final diagnosis framework, a diagnostic instrument was developed and tested. Hence, both the diagnosis framework and diagnostic instrument can be effectively employed in a wide range of Malaysian industries.

ABSTRAK

Organisasi perlu mendiagnosis prestasi operasi mereka dan mengenal pasti peluang penambahbaikan untuk kekal berdaya saing. Walau bagaimanapun, kajian sedia ada didapati terhad dan tidak menumpukan kepada diagnosis operasi yang sejajar dengan audit kualiti, penilaian kecemerlangan perniagaan dan pemilihan projek untuk *Lean Six Sigma*. Oleh itu, objektif penyelidikan ini adalah untuk membangunkan, menilai dan menambahbaik rangka-kerja diagnosis operasi untuk memilih peluang peningkatan operasi. Rangka-kerja diagnosis operasi untuk mengenalpasti dan memilih peluang penambahbaikan operasi telah dibangunkan melalui kaedah *"multiphase mixed methods"*. Data kualitatif digunakan dengan lebih dominan berbanding data kuantitatif. Fasa pertama penyelidikan adalah untuk membangunkan rangka-kerja konseptual. Rangka-kerja konseptual telah dibangunkan berdasarkan kajian ilmiah dan temubual . Rangka-kerja konseptual disertakan dalam protokol kajian kes untuk menjalankan kajian kes berdasarkan tindakan. Fasa kedua penyelidikan adalah untuk menilai dan menambahbaik rangka kerja diagnosis melalui kajian kes tindakan dan kaji selidik penilaian. Empat organisasi terlibat dalam kajian kes dan keputusan telah dianalisis. Kaji selidik penilaian telah dijalankan untuk menilai rangka- kerja yang dicadangkan dari segi reka bentuk dan kandungan. Rangka-kerja diagnosis yang dihasilkan merangkumi langkah-langkah diagnosis dan faktor pemboleh diagnosis. Langkah-langkah diagnosis merangkumi; 1) menilai prestasi operasi melalui kategori kecemerlangan perniagaan; 2) menentukan elemen ISO9001 sebagai punca prestasi operasi; 3) menentukan peralatan dan teknik penambahbaikan operasi yang ada; dan 4) memilih peluang penambahbaikan. Faktor pemboleh diagnosis melibatkan; (1) Permulaan diagnosis, (2) Kepimpinan, (3) Orang yang menjalankan diagnosis dan (4) Kerja berpasukan. Berdasarkan kerangka diagnosis akhir, alat bantuan diagnosis telah dibangunkan dan diuji untuk memilih peluang peningkatan operasi. Kerangka diagnosis dan alat bantuan diagnosis didapati bermanfaat dan boleh digunakan oleh industri di Malaysia.

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LIST OF ABBREVIATIONS

BE	-	Business Excellence
BEF	-	Business Excellence Framework
CI	-	Continual Improvement
IE	-	Industrial Engineering
MPC	-	Malaysia Productivity Corporation
OE	-	Operational Excellence
OM	-	Operation Management
PDCA	-	Plan – Do – Check – Action
QM	-	Quality Management
QMS	-	Quality Management System
QoS	-	Quality of Service
SAW	-	Simple average weighing
TQM	-	Total Quality Management
UTHM	-	Universiti Tun Hussein Onn Malaysia

LIST OF APPENDICES

Chapter 1

INTRODUCTION

1.1 Introduction of the Chapter

This chapter describe the research background, problem statements, research aim and objectives, research scope, importance of the research and outline of the thesis.

1.2 Research Background

The need to diagnose and improve operation performance has been a major discussion due to the competitive pressure in all industries (Russell, 2004). In order to achieve higher competitiveness level, organizations must be able to identify the current operation performance and realign their strategies in operations and process. This would allow them to improve the quality performance (Mohammad *et al.*, 2011; Foley & Guillemette, 2010). In particular, the "Eleventh Malaysia Plan 2016-2020" outlined that the productivity driven economy growth as one of the main elements of the plan (EPU, 2015). According to the plan, higher productivity growth can be achieved through comprehensive operations improvement initiatives at all levels and championed by industry players. At the same time, Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies to improve the organization velocity, flexibility and adaptability. Since lean manufacturing system

enables the organization to increase the velocity and flexibility, Industry 4.0 should be develop from the basis of lean principles before a "smart factory/ organization" can be created (Kolberg & Zühlke, 2015; Lee *et al*., 2015).

In pursuance towards operation improvement, the organization must be able to identify “Weakness” and “Opportunities”. Similarly, the term diagnosis is define as the process of identifying something, especially on illness (Hornby, 2005). Even though, the definition is more inclined towards medical terms, however it can be accepted that the term illness brings the meaning of weaknesses. Hence, the process of identification opportunities of improvement from the operation weaknesses can be considered as “Diagnosis” process. Once the improvement opportunities are identified, the organization should select the relevant improvement initiatives, approaches, techniques and tools in order to improve and sustain their organization performance.

Based on the extensive literature review, it is evident that approaches such as quality audit for ISO9001 certification, assessment for Business Excellence award and improvement project selection for lean and Six Sigma are common approaches in operational improvement (Manders *et al.*, 2012; Dahlgaard *et al.*, 2013; Slack *et al.*, 2013). Hence the most common and popular operation diagnosis approaches are: 1) ISO9001 Quality Audit; 2) Business Excellence Assessment according to Business Excellence Framework (BEF); and 3) Project Selection for Six Sigma and Lean project. This is due to the trend of industries adopting the TQM by using Quality Management System standard which are on the rise, with more than 1 million organization certified with ISO9001 (Manders *et al.*, 2012). At the same time, Business excellence framework (BEF) have received more attention for past two decade for the organization to pursue for continual improvement (Dahlgaard *et al.*, 2013). BEF utilised the self-assessment to identify the improvement opportunities. In addition, there are also increasing trend on Six Sigma and Lean improvement approaches (Thawesaengskulthai, 2007). In improving operations, Lean and Six Sigma improvement initiatives utilised Project Selection to identify improvement opportunities.

However, issues have been raised in specific diagnosis approaches such as minimum evidence of linking performance improvement and quality audit (Rajendran & Devadasan, 2005), no standardized criteria to identify the project for lean and six sigma (Pakdil & Leonard, 2014), and standard weighing score with less

attention on organization type and level in Business Excellence assessment (Williams *et al.,* 2006). To address this issues, improvement have been made on the new revision of ISO9001 version 2015 (ISO, 2015) and Baldrige Business Excellence Framework (BEF) 2017-2018 (Baldrige, 2017) that link context of organization, organization profile and performance evaluation and results.

Nevertheless, there is no detailed framework in the operational diagnosis that are utilised in all the current best practice in operation improvement approaches such as BEF, ISO9001, Lean, Six Sigma and at the same time provide the guideline on selection of appropriate improvement opportunities and with relevant improvement techniques and tools.

1.3 Problem Statement

Based on the comprehensive literature review, it is evident that all the available diagnosis approaches have their own strengths and weaknesses. Therefore, organization will be able to grasp potential benefit if they are able to align these three diagnosis approaches. And, it is also likely that each of the diagnosis approach will be able to complement to each other. For instance, according to Karapetrovic & Willborn (2001a) quality audit and BE Assessment have clear diagnosis standard requirements and criteria, while six sigma and/ or lean improvement initiative may not have standard criteria. Despite of the weaknesses of lean and/or six sigma, the approaches are excellent waste and variation reduction performance based improvement (Andersson *et al.,* 2006; Singh, *et al.,* 2010), while quality audit has been criticized for less contribution toward performance improvements (Beckmerhagen *et al.,* 2004; Dahlgaard *et al*., 2013; Rajendran & Devadasan, 2005; Williams *et al*., 2006). Hence, by aligning the three approaches organization can benefit through valuable operations improvement.

However, there is a notable paucity of studies which investigates these three diagnosis approaches. Unfortunately, previous studies only attempted to study on one or two operation diagnosis approaches. There were attempts to align two of the diagnosis tools i.e. quality audit and self-assessment (Karapetrovic & Willborn, 2001a), BE Assessment and Lean or Six Sigma (Yang, 2004; Yang & Hsieh, 2009) and Quality audit and Lean Sigma (Simons & Taylor, 2007). However, as to date

there yet to be any attempt made to align the three diagnosis approaches. To support this statement, existing related studies were critically discussed and presented in chapter 2.

In order to align the diagnosis approaches, the main outcome of the diagnosis was to list out operations improvement opportunities. In quality audit, the term non-conformance is commonly used as operations improvement opportunities, while in six sigma and lean, the terms issues or problems is used. Each improvement opportunities may require specific initiatives, techniques and tools to solve the problems effectively (Adebanjo *et al.*, 2015; Tickle *et al.*, 2014). According to Mohammad *et al.* (2010), there are hundreds of improvement initiatives available. It is crucial that relevant improvement initiatives, techniques and/ or tools are selected based on the operation improvement opportunities. Mohammad (2012) has extensively investigated and developed the guidance model to select improvement initiatives. The guidance model is useful for overall organization based on Business Excellence Framework and not specific to operational contexts and issues.

Up to now, most of previous studies focused on selection of business improvement tools and techniques on specific industries, sector and services (Dahlgaard *et al*., 2013; Radnor *et al*., 2015; Spasojevic-Brkic *et al.*, 2012; Tickle *et al*., 2014) and far too little attention was given to link the improvement tools and techniques into operational diagnosis such as tools and techniques for diagnosis and tools and techniques on the operations improvement opportunities. At the same time, there are very little efforts taken to conduct action-based case studies in context of operation diagnosis. Hence, an aligned operation diagnosis and improvement framework is recommended for development due to current trend of organizations adopting multiple management systems and improvement initiatives. The industries need useful and performance based aligned operation improvement diagnosis framework.

1.4 Research Aim and Objectives

The aim of this research is to develop a diagnosis framework to select operational improvement opportunities. The framework assists the organizations to determine improvement opportunities through aligning Quality Audit, BE Assessment and Lean Sigma project selection. Hence, the research objectives are as follows:

(1) To investigate the main steps in diagnosis process;
(2) To determine the enablers for effective diagnosis to select operational improvement opportunities;
(3) To develop, evaluate and refine a diagnosis framework for selecting operational improvement opportunities.

1.5 Research Scope and Limitation

The scope of this research is focused on framework development processes. This research emphases in diagnosis process, listing of improvement opportunities and selecting the improvement opportunities as depicted in Figure 1.1. The scope of this research and the limitations are stated below:

(1) To ensure the research is effective and manageable, this research is based on cross sectional research. Actual implementation and implication is applied for the research validation purpose based on time frame provided. The long term adoptions and maintenance of the operations improvement are beyond the scope of this research as depicted in Figure 1.1.
(2) This research is intended for BE assessors, quality auditors, consultants, six sigma and lean practitioners;
(3) The data collections were collected from experts and four organisations in Malaysia;
(4) The BE framework was based on Balridge 2015-2016 framework and ISO9001 framework was based on ISO9001 version 2015 which are the current edition as and when the case study was conducted.

(5) This research only covers operation function since the operations function is central to the organization because it produces the goods and services. Operation function is one of the three core functions of any organization apart from marketing (including sales) function and product/service development function (Slack *et al*., 2013) which are exclude in this research.

Figure 1.1 : Research scope involving diagnosis and selection of improvement opportunities

1.6 Importance of Research

The operational diagnosis for selecting the operational improvement opportunities is an important area of research due to following reasons:

(1) The diagnosis framework contributes to "Eleventh Malaysia Plan –RMK11" (EPU, 2015) through diagnosis of organisation operations function and selecting productivity related improvement opportunities. The resulting outcomes from the research can be capitalized as guideline to any type and size of organization in productivity improvement;

(2) Implementation of quality audit, BE assessment, lean and six sigma required cost, time, resources and knowledge (Daniels, 2000; Hepner *et al.*, 2004; Williams *et al*., 2006). Aligning of these approaches may save organization time, cost and resources and concurrently improve organization performance, maintain the certification and recognitions;

(3) With more than million organizations certified with ISO9001 (Psomas & Fotopoulos, 2009), and an increasing number of organizations embarking on BE award, Lean and sigma (Behrouzi & Wong, 2011; Pakdil & Leonard, 2014), the

diagnosis framework is expected to provided valuable techniques and guides to quality auditors (internal and external), BE assessor (Self and external examiner), lean and six sigma practitioner, consultants, management and Top Management of organization.

(4) This research also contributes to body of knowledge, since this is the first study and first attempt to align the most popular improvement approaches and diagnosis. Since, little attention is given by academic journal publications on effectiveness of operation diagnosis. Therefore, this research is deemed important so as to enrich the reference materials, case study in operation diagnosis and results.

1.7 Thesis Outlines

In order to achieve the set of objectives, this research employs sequential mixed methods. As such, the whole study is presented in 8 chapters (as depicted in Figure 1.2). The first chapter introduces the research background, problem statements, research aim and objectives, research scope and important of the research. Chapter 2, critically reviews the relevant literatures related to operations improvement and operations diagnosis. Firstly, the literature review focuses on the concept and theoretical evolution of operation improvement from the system theory toward rational decision making. Secondly, literature review identifies the strength, limitations and gaps of each approach, prior framework and identifies gap and opportunities in current knowledge. Chapter 3, describes the research design and methodology. This chapter elaborates and explains the selection of research designs, research procedure data collection methods and ensuring quality of research.

Chapter 4, 5 and 6 consist of data collections and findings of this research. Chapter 4 describes the semi-structured interviews process. It comprises of the planning and implementation of the interviews, profiles of experts, and findings from the interviews. Chapter 5 presents the planning for the action-based case study, the implementation of the diagnosis activities, and implementation of operational activities and reports the findings from the activities. Chapter 6 explains the planning and implementation of the evaluation survey

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