SUSTAINABILITY KEY PERFORMANCE INDICATORS (KPIs) FOR HEALTHCARE INDUSTRY USING ANALYTIC NETWORK PROCESS (ANP)

This report is submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Engineering Management) (Hons.).

by

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Tajuk: **SUSTAINABILITY KEY PERFORMANCE INDICATORS (KPIs) FOR HEALTHACRE INDUSTRY USING ANALYTIC NETWORK PROCESS (ANP)**

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I hereby, declared this report entitled " Sustainability Key Performance Indicators (KPIs) for Healthcare Industry using Analytic Network Process (ANP)" is the results of my own research except as cited in reference.

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Date   : 19th June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Management) (Hons.). The member of the supervisory committee is as follows:

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(PROFESSOR DR CHONG KUAN ENG)

ABSTRAK

Kebelakangan ini, penjagaan kesihatan telah menjadi industri berfokuskan kepada pengguna. Pengguna mempunyai permintaan yang tinggi kepada kualiti rawatan perubatan dan ia mewujudkan tekanan yang besar kepada penyedia penjagaan kesihatan. Dalam usaha untuk melakukan ini dengan berkesan, organisasi penjagaan kesihatan bergantung kepada petunjuk prestasi terkini supaya mereka boleh memupuk perniagaan kemampanan jangka panjang di kalangan pesaing. Secara amnya, objektif projek ini adalah untuk mengkaji amalan kemampanan untuk perkhidmatan dan industri bukan perkhidmatan, menentukan *key performance indicators* (KPIs) bagi industri penjagaan kesihatan dan menduduki KPIs penting bagi industri penjagaan kesihatan. Laporan ini adalah untuk mengkaji dengan menggunakan *Analytic Network Process* (ANP) sebagai alat analisis untuk membina sebuah model penilaian ANP kemampanan KPIs bagi industri penjagaan kesihatan. Melalui kajian lanjutan, KPI industri penjagaan kesihatan umum untuk dimensi berikut: (1) Ekonomi; (2) Alam Sekitar; dan (3) Sosial, termasuk 33 petunjuk prestasi. Kajian ini dijalankan untuk kes syarikat. Menurut penemuan, model yang membantu kes syarikat mengkaji pelaksanaan semasa KPIs dan pendapat responden tentang kepentingan KPIs. ANP telah digunakan untuk menentukan ranking KPIs dengan menggunakan perbandingan dari segi pasangan, analisis konsisten, supermatrix unweighted, supermatrix wajaran dan had supermatrix. Hasilnya, lima KPIs yang terbaik adalah penambahbaikan yang berterusan, kebolehpercayaan perkhidmatan, pengurangan pencemaran bunyi, kesihatan pelanggan dan keselamatan dan pelanggan aduan telah dipilih untuk industri penjagaan kesihatan. Daripada perbandingan yang menyeluruh, lima KPIs ini boleh membantu kes syarikat menubuhkan perancangan strategik yang tepat dan pengagihan sumber untuk meningkatkan prestasi korporat dan daya saing.

ABSTRACT

In recent years, healthcare has become a consumer-centric industry. Consumers have high demand on the quality of medical treatment and it creates a huge pressure to healthcare providers. In order to do this effectively, healthcare organizations rely on latest performance indicators so they can foster a long term sustainability business among competitors. In general, the objectives of this project are to study sustainability practices for service and non-service industry, determine sustainability key performance indicators (KPIs) for healthcare industry and rank the significant KPIs for healthcare industry. This report is to study by using an analytic network process (ANP) as an analytical tool to construct an ANP evaluation model of sustainability key performance indicators (KPIs) for the healthcare industry. Through a review of literature, KPIs of healthcare industry is generalized to the following dimensions: (1) Economic; (2) Environment; and (3) Social, including 33 performance indicators. This research is conducted for a case company. According to the findings, the model helps the case company review its current execution of KPIs and the respondent's opinion of the importance of sustainability KPIs. ANP method was used to determine the ranking of KPIs by using pairwise comparison, consistency analysis, unweighted supermatrix, weighted supermatrix and limit supermatrix. As a result, the best five KPIs that were selected for healthcare industry were continuous improvement, service reliability, reduction of noise pollution, customer health and safety and customer complaint were selected for healthcare industry. From the comprehensive comparison, these five KPIs can help the case company set up precise strategic planning and resource distribution to enhance corporate performance and competitiveness.

DEDICATION

Dedicated to

my beloved father, Toh Kim Siak

my appreciated mother, Cheong Ah Pheng

my adored brothers Toh Sea Ming and Toh Sea Chee

for giving me moral support, money, cooperation, encouragement and also understandings

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LIST OF ABBREVIATIONS

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DfE	-	Design for the Environment
DOC	-	Department of Commerce
EWS	-	Engineering World Health
FAO	-	Food and Agriculture Organization
GDP	-	Gross Domestic Product (GDP)
IUCN	-	International Union for Conservation of Nature
OECD	-	Organisation of Economic Co-operation and Development
UNEP	-	United Nations Environment Programme
UNESCO	-	The United Nations Educational, Scientific and Cultural Organization

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter defines the background study, problem statement, objective, scope, significance of study and organization of report.

1.1 Background of Study

According to Roosa (2007), human history has increased steadily since the late 17th century and the world's population has exceeded 5 billion in 1987. As such, the increasing of population would probably broaden the potential of global resource flow and enlarge the capacity of pollution absorption. Gosh Roy (2011) stated that global sustainability issues come out other challenges. Adjust the utilisation of the energy production will not reduce much of the use of fossil fuels due to the current high-energy demands. Egelston (2013) claimed that at the first environmental conference, it was assumed that conservation of environment will retard the economic growth. Therefore, the idea of 'sustainability' and 'sustainable development' should be understand and practise by all because it gives a major implication. Sustainable development means meeting our own needs without compromising the ability of future generations to meet their own needs.

World Commission on Environment and Development (1987), described sustainable development as "development that meets the needs of the present without comprising the ability of future generations to meet their own needs (Rogers *et al*., 2008). Sustainable development aimed equally with environmental component in sustainable consumption of natural resources, tackling the environmental factors that can harm and do not harm people's

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health, livelihoods and lives, the social side by equality, better standards of education and healthcare, stop the poverty, and sustainable economic growth (Mason, 2015).

This project is a study at a private hospital located in Melaka. This hospital has more than 80 medical specialists and an extensive list of medical services and specialties including dental services, a cancer centre, cardiac catheterisation lab, heart surgery, haemodialysis and emergency department. In order to sustain in the competitive markets, the organization should develop a sustainability practise to enhance its long-term business function that meet with customer's demands all the time. Needs of everyone is different, it is impossible to reach the requirement of all but try to get closest to the ideal needs. Sustainability practise must intertwine with the economic, social and environmental. Significance impacts will be given to the organization that adopting sustainable practices whether large or small in long run.

1.2   Problem Statement

The case organization is currently facing the strong pressure from outside world due to the increasing healthcare expenditure attributed to aging population, contemporary diseases and extensive costly biomedical technology. At the same time, authorities of hospitals have been strongly forced to achieve highly efficient and effective healthcare services. Hence, to achieve the goals of organizational, various operational to strategic management activities must be tackled. Staffs of the organizational want to measure their performance based on the sustainability point of view.

The healthcare services without sustainability key performance indicators (KPIs) is one of the issues that could not sustain its business function to meet the patient demands in the long run. Therefore, the main problems that will be discussed in this study is "How to determine sustainability related the key performance indicators that affect the services of healthcare industry?"

1.3   Objectives

The aim of this project is to determine the significant sustainability key performance indicators that affect the services of healthcare industry.

The objectives of this project are:

1. To study sustainability practices for service and non-service industry.

2. To identify sustainability key performance indicators (KPIs) for the healthcare industry.

3. To compare and rank important sustainability key performance indicators (KPIs) for healthcare industry to strategize sustainability practice.

1.4   Scope

The scope of this project is focused on the sustainability key performance indicators (KPIs) in healthcare industry. The key performance indicators (KPIs) intertwine with the economic, environment and social to form a strategic plan for sustainability evaluation. The KPIs will be only cover on private healthcare sector.

1.5   Significance of Study

The importance of this study is to determine the significance KPIs in healthcare industry. KPIs used to measure the case organization performance to sustain its business function in this competitive market and meet the demand of customers all the time.

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1.6   Organization of Report

This report is constructed as follows:

I.   Chapter 1- Introduction

It introduces the overall report with background study, problem statement, objective, scope, significance of study and organisation of the report.

II.   Chapter 2- Literature Review

This chapters presents the literature review of sustainability, performance measurement, key performance indicators (KPIs) and multi-criteria decision making (MCDM) based on the journal, book, article and other resources. It discusses about how other industry perform sustainability practices as a strategic plan for sustainability evaluation and various approaches used in rank the KPIs data.

III.   Chapter 3 – Methodology

This chapter describes the appropriate methodologies chosen to carry out this study.

IV.   Chapter 4 – Determine the significance KPIs by using ANP techniques

This chapter presents the collection of KPIs in case organization and distribute the KPIs to the CEO, director, senior executive, etc. KPIs data will be ranked by using analytic network process (ANP) approach to determine the highest weightage of KPIs.

V.   Chapter 5 - Results and discussion

This chapters presents the result of significance KPIs determined by analytic network process (ANP) techniques. Analyse and discuss the result at this part.

VI.   Chapter 6 – Conclusions and Recommendation

This chapter will conclude the project and suggest recommendation for the study.

CHAPTER 2
LITERATURE REVIEW

2.0   Introduction

This chapter presents the literature review regarding this project. There is a collection of the searched information from journals, articles, books and other resources that related to the topic. It reviews about the definition of sustainability, sustainable development in service and non-service industries, performance measurement, Key Performance Indicators (KPIs) and different approaches that used in Multi Criteria Decision Making (MCDM) such as Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Weighted Sum Model (WSM), Elimination and Choice Translating Reality (ELECTRE) and Analytic Network Process (ANP).

2.1   Sustainability

The issue of global sustainability is widely probed by world leaders and a common topic of discussion by journalists, scientists, students and citizens in many parts of the world. The idea of sustainability has been investigated by IUCN more than 30 years. Sustainability intended to be yardsticks for measuring improvements in people's life since it was one of eight Goals, correlative with 18 targets and 48 indicators (Adams, 2006). In 1945, UNESCO was established to facilitate the importance of human culture and of science. Today, their remit is "to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the science, culture, communication and information" (UNESCO, 2010). Mason (2015) claimed that sustainability is a core to every strategy, ensuring we link environmental, social and economic elements into our decision making to foster long-term relationships that respect

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local cultures and create lasting benefits. Most of us have only think about the environmental aspect of sustainability as carbon footprints, greenhouse gases and ecosystems. Actually, there are two additional aspects are generally recognised as contributing to sustainability that are economic factors and social factors.

According to the National Research Council (2011) stated that all we need for subsist and well-being depends, either directly or indirectly on our way of life is known as sustainability. To pursue sustainability for present and future generations, we have to create a productive harmony in balance and protecting natural environment from damage and devastation. For years to come, sustainability raising the competitive advantage of the social, economic and environmental value wherever we operate. A key element of the sustainability approach is to measure the ongoing performance after the targets has been set, raising continuous improvement and the efficient use of the resources (BHP Billiton, 2015).

2.1.1 The Three Pillars of Sustainability
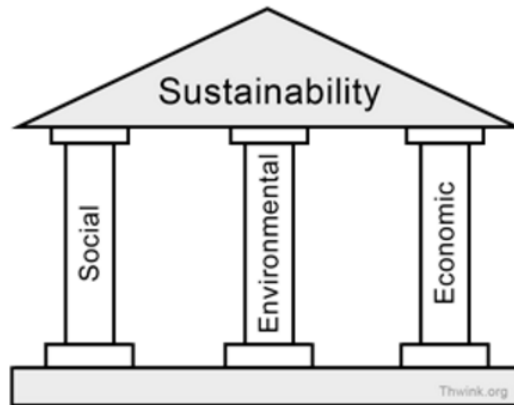
Figure 2.1: Three Pillars of Sustainability

The three pillars of sustainability are a useful and powerful tool for defining the complete sustainability problem. Three interrelated dimensions of sustainability are social, environmental and economic pillars. In general, the three are conceived of and labelled as people, planet, profit or equity, ecology, economy. This system must be regarded as a whole, and any pillars should not be given more or less importance than others. The interdependence between pillars as shows below (Teodorescu, 2015):

a. Environment-Economy: Economic expenses of environmental conservation
b. Economy-Environment: Environmental investment bring the pressure on environmental resources
c. Environment-Social: Enhance human welfare and health care by maintaining pure environment
d. Social-Environment: People's responsibility to ecological and correct consumption patterns on natural assets.
e. Economy-Social: Providing jobs to human to promote a good living and income
f. Social-Economy: Labour quantity and quality

These three "pillars" form the backbone of tackling the core areas that the world now faces and served as a common ground for many sustainability standards and certification systems in recent years (UNEP, 2012). The three 'pillars' cannot be classified as if equality this is due to the society emerge the economy goods or value, but environmental is not created by society. Meanwhile, the environment consolidates both society and economy as human activity limit by the resources that available on earth (Adams, 2006). There are three common principals known as social equity principal, environmental principle and economic principle. (Roy & Goll, 2014) stated that environmental principle refers to the conservation of natural assets, for the social equity principal means that human should be treated equitably, and the economic principle refers to the community maintain a reasonable living standard.

2.1.2 Economic Development

In this developing world, to sustain economic development is about providing human what they need without compromising the quality of livelihood and decreasing the financial burden (Mason, 2015). Economy sector rely on safe and sufficient energy. All the urban and rural development, industrial productivity, major jobs and economic activities are highly affected by energy consumption (Teodorescu, 2015).

According to BHP Billiton Report, (2015) agree on sustainable growth in energy and resources provide an effective response to economic growth and social development, while delivering value to dormant partner and host communities and hence increases the company's competitiveness. Most enterprises have a strong focus on their economic

performance in operating the traditional business. Owner hand their business over to a family member to sustain an income to retirement and aims to increase its value. Financial measures such as cost of materials, quantity of sales, overheads and profit margins are usually being assessed in the business.

Achieving the right balance in economic and social, factor of corruption should be avoided. Corruption decreases economic competitiveness, weaken markets and contributes an erosion of trust in government. There are two dimensions in corruption which are pervasive and arbitrary. Transparency International's (TI) Corruption Perceptions Index (CPI) and World bank used to measure corruption's pervasive (Roy & Goll, 2014). The World Bank recommends four major area of knowledge-based economics to countries. Finland, Ireland and Korea are the clear examples, where strongly focus on this four area (Abu-Goukh *et al*., 2013).

- Education and Training – an educated skilled population
- Information Infrastructure – an evolution information infrastructure
- Economic Incentive and Institutional regime – a regulatory to encourage entrepreneurship
- Innovation systems – absorb a network of research and adapt it to local needs

2.1.3   Social Development

There are many facets to be discussed in social pillar. Social is interrelated with environmental resources and economic growth. The natural assets have been exploited by human to support quality of human life without considered the needs of present and future generation (Adams, 2006). According to Duraiappah et al. (2005), 75% of the habitable land on earth estimated to have been exploited by human activity in 1994. From the assessment, poverty issues are profound and persistent in sub-Saharan Africa, to reduce the level of poverty many countries like India and China skewed by rapid economic development to provide more job opportunities to the citizens.

To sustain a social development, human capital need investing in education, information, knowledge, health and nutrition to reduce poverty in developing countries.

Firms and organization need to consider their effect on society and contribute social value in developing markets to assure their firms are at competitive advantage (Roy & Goll, 2014).

As mentioned before the World Bank proposes four knowledge-based economics, they encourage people to use knowledge to develop their own country. As such, knowledge, skills, competencies and values should be provided to people in order to ensure sustainability and flourishing economy in the country (Abu-Goukh *et al.*, 2013). Moreover, the World Bank (2006) comments the idea of social capital as a norms, social networks and relationships, it is important to societies to sustain economically development. Social Capital is about to share the values that foster social cooperation and social relationships (Ahmad *et al.*, 2013).

2.1.4   Environmental Protection

Many sustainable factors such as pollution control, human resources development, natural resources management and economic growth have been taking into account by governments and authorities. According to Adams (2006), the United Nations Conference on the Human Environment in Stockholm claimed that the key theme of sustainability concept was coined clearly to suggest that it was possible to achieve economic development and industrialisation without environmental damage and destruction. United Nation is a well-known international organization with their peacekeeping role that established in 1945, one of the goals of the organization is foster a healthy living and generative life to the world, almost 70 percent of their work is fulfil the mission. Impact of environmental is characterized by pollution, population and aggression (Abu-Goukh *et al.*, 2013).

Numerous organization seeks to improve human welfare by protecting the physical and biological environment over the long run. They are emphasizing their responsibility to sustain a company by adopting sustainable practises with the objectives of sustainable world (Roy & Goll, 2014). According to Coca-Cola Company Sustainability Report, all the business strongly in integrating sustainability into the heart of the enterprise and create value for shareholders. They reinforce the view that sustainability spurs innovation, just as innovation spurs sustainability. One of the example is EKOCYCLE, which encourages

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