CONFIRMATORY FACTOR ANALYSIS FOR LEAN HEALTHCARE PRACTICES IN MALAYSIAN HEALTHCARE INDUSTRY

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Abstract

Healthcare industry itself is moving forward toward preparing lower cost of material, cheaper price, JIT deliveries, and elimination of waste and defects in many aspects of the activity or operation, and strengthening relationships with vendors, and ultimately producing high quality products and customers services better than competitors. A survey through questionnaire was conducted to determine the level of lean healthcare practices. 128 sets of questionnaire were successfully collected that brought to 40.4% response rate. Structural equation modeling technique was adopted to analyze the data gathered from the survey. Hence, this study produces implications on theory and management and provides a practical guide for healthcare practitioners to enhance their organizational performance through the implementation of lean healthcare practices. This paper presents finding of Exploratory Factor Analyses (EFA), Confirmatory Factor Analysis (CFA), and reliability analysis empirically verified and validated. The results indicate that four LH constructs are acceptable for further analysis. The paper with a proposed future direction ends of this research.

Keywords Lean healthcare, quality initiatives, structural equation model, confirmatory factor analysis, healthcare industry.

INTRODUCTION

Recently, healthcare costs are increasing rapidly. The cost of providing care is going up, but the payers do not always want to increase reimbursements. Patient injuries and deaths due to preventable errors occur far too often throughout the world. In response

to rising costs, payers (the government or private players) often propose cutting reimbursements in an attempt to control costs, in doing so, they are changing the price paid, but not the underlying costs in the system. Cutting prices without corresponding cost reductions will hurt hospital margins, which can slow future investment for hospital's financial future (Graban, 2009). While there are differences in the healthcare systems across different countries, there are some universal problems that concern patients' preventable errors that lead to injury and death. Instead of focusing solely on the problem of patient access to care, lean also gives us tools for improving the delivery of care. It is imperative that we examine and understand the details of how healthcare is delivered, implementing processes that support safe, efficient, and high-quality care. Lean provides the best way to accomplish this.

Lean is toolset, a management system, and a philosophy that can change the way clinics are organized and managed. Main principle of lean is to reduce waste, reduce costs, and improve quality and timely delivery of products and services. Modeled by the Toyota Production System (TPS), although health care differs from manufacturing, hence it makes it more vital as life is something irreplaceable. In any healthcare service centre, (e.g: clinics and hospitals), the stakes are high, any small mistakes or failure can cause fatalities. As it is a matter of life and death.

Today, the development and the number of quality initiative programs have increased over the years. But of late, many healthcare companies decided to move from the existing quality initiatives to the Lean Healthcare (LH) initiative as a business strategy to improve the smoothness of business operations and organizational performance. The development of this lean has spread to various industries, which has started by Toyota in the automotive sector to other sectors such as healthcare, education, banking, and public organization.

Healthcare industry itself is moving forward toward preparing lower cost of material, cheaper price, JIT deliveries, and elimination of waste and defects in many aspects of the activity or operation, and strengthening relationships with vendors, and ultimately producing high quality products and customers services better than competitors. Therefore, the LH initiative should be integrated and interdependently linking all aspects of human, technical, process, culture, and result so that it becomes an effective and systematic strategic business system.

LITERATURE REVIEW

Overview of Malaysian Healthcare

Health is an aspect that should be seriously takes into account. Healthcare in Malaysia is divided into private and public sectors. With a rising and aging population, government has improve in many areas including the refurbishment of existing hospitals, building and equipping new hospitals, expansion of the number of polyclinics, and improvements in training.

The norm in Malaysia, every company provides medical benefits for their employees. One of it, is each employees are entitle to obtain medical services from their company's panel clinics, which mostly are privates. In Malaysia, there are many clinics available, therefore consumer can easily make comparison, in terms of service

and quality. As for that, it is important for the management of the clinics to improve or sustain its quality practice and services.

Thus, in view of the importance of health to the people, Malaysian government has introduced the concept 'Clinic 1 Malaysia'. The concept of 'Clinic 1 Malaysia', the government implemented to ensure quality health services in this country can be enjoyed in a fair, equitable, and inclusive to all people, in line with government wishes.

The number and range of specialist hospitals, clinics, and dental surgeries have increased tremendously all over the nation in the last decade. The health care services throughout the country, is of world class standard and the medical cost in Malaysia is one of the most competitive in the world.

Lean Healthcare

The concept of Lean Production (LP) is a comprehensive approach for continuous manufacturing improvement based on the notion of eliminating waste in the internal process (Sakakibara *et al.,* 1993). Apart from that, the objective of lean practice is to ensure smooth internal flow by upgrading productivity to the level of quality products/service, utilization of production labor, reduced delivery time, and effective manufacturing cost through continuous improvement process. Consequently, it helps organizations in improving the targeted performance and gaining benefit from the environment (Womack *et al.,* 1990; Liker, 2004; Doman, 2007; Forrester *et al.,* 2010).

Lean principles are to specify value, identify the value stream, make the value-creating step flow, promote a pull culture, and pursue perfection (Womack and Jones, 1996). Furthermore, they are also to add in a few initiatives that encompasses a wide variety of operation and management practices such as Total Quality Management (TQM), Human Resource Management (HRM), and Total Productive Maintenance (TPM) (Shah and Ward, 2007). Most importantly, the readiness toward change for continuous improvement should be maintained and strengthened. The reason is that transformation to lean system requires a radical change that involves the overall system formation and organizational culture (Nordin *et al.,* 2010).

Several previous researchers have strongly argued that if an organization neglects lean initiatives, it will face obstruction in the capability of global competition that desires quality products, high level of service, and fast delivery with low cost (Flott, 2002; Srinivasaraghavan and Allada, 2006). This statement is also supported by Oliver *et al.,* (1996) who proves that implementation of lean initiatives raises the performance of an organization. In recent years, research on lean has focused on the relationship between implementation of lean with multiple performance measurement.

Lean management principles have been used effectively in manufacturing companies for decades, however, more service organization or industry shift to lean operation in order to improve business process and performance. For example in healthcare industry, lean strategy are benefit to reduced medication errors, redesigning work flow, improved patient safety, and reduced cycle time (Venkateswaran, 2011).

Virginia Mason Medical Centre in Seattle, Washington, has been using lean management principles since 2002. Staffing trends at Virginia Mason show a decrease in 2003 and 2004, after six years of annual increases in the number of full-time equivalents

(FTE). Using lean principles, staff, providers, and patients have continuously improved or redesigned processes to eliminate waste, requiring fewer staff members and less rework, and resulting in better quality. All of their employees are required to participate in Rapid Process Improvement Weeks (RPIW). It is an intensive week-long sessions in which teams analyze processes and propose, test and implement improvements (Institute for Healthcare Improvement, 2005).

Forecasting techniques may not prove to be worthy due to it nature of uncertainty and seasonal demand. Healthcare industry can only project production outputs based on their daily schedule data (Jarrett, 2006). Beside that, inventory management control, forecasting techniques may not prove to be worthy due to its nature of uncertainty and seasonal demand. Running out of supplies may produce adverse effects in providing care to a patient.

Koning *et al*., (2006) described that one of the significant contributor to healthcare cost is operational inefficiency, such as medical service delivery and operation of healthcare delivery system. Endsley *et al*., (2006) considered output (wrong process, over-production, delay, large variation in output rate and demand) and flow (waiting, duplication of process, rework, work interruptions, and non-standardized work) as two main categories for problems in medical practices.

Venkateswaran (2011) study in Ochsner health system that possesses 8 hospitals and 35 clinics in the state of Louisiana hospital warehouse was facing problems such as; over/under stocked supplies, increase in time due to look-up of supplies, space constraints, and no standardized process in the arrangement of supplies. In order to contribute on this issues, their study explore to applied the Hybrid 5S which integrated with inventory management techniques and process improvement tools. The finding results showed that higher improvement with increased of 5.9% in inventory turnover and 15.7% space saved (Venkateswaran, 2011).

Recently, even with costs have increases in healthcare, it seems there is a need to improved healthcare delivery and lean methods may be one way to improve healthcare operation and performance.

Lean Healthcare Constructs

Implementation of the LH requires development and definition of the important elements. These important elements are described and defined as below.

Leadership

The Leadership addresses the critical role to provide training and development, allocating financial and resources, encouraging culture sharing knowledge and experience, and involving in problem solving and decision making to achieve quality initiatives and organization strategy (Flynn *et al.,* 1994). Leadership effectiveness allows employee involvement in continual improvement activity, effective communication and collaboration, and better dissemination of operation information and organization strategy in managing quality improvement.

Based on previous research in lean practices, the emphasis on the critical role of leadership drives the overall lean implementation in the organization (Boyer 1996). In addition, Wang and Chen (2010) opined that the critical success of lean implementation requires commitment from all level of managers in order to provide training, resources,

knowledge and authority to solve problem. Empirical research has supported the link between leadership and performance (Lee, 2004).

A case study Shivaji and Subramaniam (2009) at Jefferson County Hospital (JCH) located in Fairfield, Southeast Iowa also implemented lean methods. The primary motive was to reduce the waiting time of the patients and provide them with timely information and service. The top executive wanted to introduce lean and arranged for training from a community college nearby. The first training session was held with department managers and lean leaders and trainers.

In the Virginia Mason Medical Centre case, to get all the senior leaders immerse themselves in lean principles, in 2002 Virginia Mason sent all its senior executives to Japan to see with their own eyes how lean management really works. In the production line of Hitachi Air Conditioning plant, executive leaders recorded workflow, measures cycle times and documented process flow. Senior leaders developed the Virginia Mason Production System (VMPS), the idea behind this is to achieve continuous improvement by adding value without adding money, people, large machines, space and inventory, all toward a single overarching goal with no waste (Institute of Healthcare Improvement, 2005).

Employee Involvement

In addition to leadership, teams are also a focus for generating change in organizations. Balle and Regnier (2007) suggest that proactive training, staff empowerment and appropriate implementation of 5S to standardized nurses' practices can lead to improvements in the quality of care.

Sobek and Jimmerson (2003) present the results obtained in a pharmacy department by using structured lean approach. It is reported the staff involvement to drive the changes and achieve a 40 percent decrease in missing medication.

ThedaCare Inc., is a health care institution, based on Wisconsin is a very similar to Virginia Mason's. Like Virginia Mason, ThedaCare engages staff in intensive process improvement efforts, which they call Event Weeks. Participation in at least one Event Week is mandatory for all staff members – staff can choose from six different event week topics each week. According to one of ThedaCare leader, teaching through experience is important because people learn best when they are directly involved. With about six rapid improvements Event Week topics every week, by the end of 2004 ThedaCare had involved more than 600 employees directly in learning about lean thinking (Institute for Healthcare Improvement, 2005).

Employee's time is important aspect in the requirement for the lean program. Most of the employees have their own day to day activities in addition to participating in lean implementation like attending training session, studying current system, which may not be reasonable to most people (Shivaji and Subramaniam, 2009). This maybe can be solve with the management employs part time staff for work, as they should be aware of the cost element in initial period for such process improvement techniques.

In lean implementation in manufacturing, the gains are quantified and the concerned employees get monetary incentives. This can be applied in healthcare industries as well, by rewarding it staffs when target is achieved.

In the United States nursing vacancy rates average 13% and 7.4% of pharmacist positions are unfilled. In the United Kingdom as well, their National Health Service (NHS) trusts in London spend $260 million a year on agency nurses. Nursing shortages

can lead to overworked conditions that harm employee satisfaction and morale. Highlighting the connections among employees, patients, and quality, studies show that overworked, tired, or stressed employees are more likely to make mistakes that could harm patients.

Quality Information and Analysis

The application of SPC provides information that helps to control management by process and decision making through the use of statistical tools and techniques (Basu and Miroshink, 2009).

Recently, companies are in need for a comprehensive database composing of current quality performance, customer need and expectation to achieve organizational performance. Previous studies also demonstrated significant impact of quality information analysis and performance (Prajogo, 2005, Zakuan *et al.,* 2009). The information facilitates management to make effective decision in managing quality.

Supplier Relationship

Effective supplier relationship should have long term and cooperative relationship between organization and suppliers (Li *et al.,* 2005; Zakuan *et al*., 2009). This construct is important to improve quality design product, improve purchasing order system and management, improve long term cooperative relationship and improve strategic partnership (Gunasekaran *et al.,* 2001; Monczka *et al*., 2002; Li *et al.,* 2005; Zadry and Yusof, 2006). In relation to this, healthcare firm should have sustainable and continuous improvement efforts on their relationship with the supplier in order to improve competitive advantage (Lee, 2004).

Supplier management is limited to a few suppliers (Shah and Ward, 2007), products conformed to the specification and standard (Ahmad *et al.,* 2007), long term relationship (Shah and Ward, 2007), close collaboration (Basu and Miroshnik, 1999), supplier selection based on quality performance and quality certified within the healthcare firms. In addition, Tracey and Tan (2001), in their finding suggested that there is an impact of supplier selection and involvement on customer satisfaction and firm performance. Other study by Kuei *et al.,* (2001) also advocated that supplier management and supplier selection process has positive impact on the company performance.

Customer Relationship

Another key to successful LH implementation is customer relationship. Focusing on customer need and satisfaction should be the most important practice for implementing lean healthcare. Therefore, organizations must be aware and responsible about listening to the voice of the customers (Ahmad *et al.,* 2007; Snee and Gardner, 2008), fulfill customers' need and expectations (Fullerton and Wempe, 2009; Sodikoglu and Zehir, 2010), and predict customer demand (Shah and Ward, 2007). In doing so, customer relationship is measured by basing on customer database, establishing customer relationship management, conducting regular customer satisfaction measurement, resolving all customer complaints quickly and effectively, and ensuring that all employees are aware of the feedback from customers.

Continuous Improvement

In implementing quality initiatives, a methodology of improvement and problem solving method is required to achieve organizational goal (Snee, 2010). Towards achieving the organization strategy, organization can implement structured improvement procedures as formal paradigm of conducting improvement project, team assistant in learning and knowledge acquisition, quality problem solver in order to increase productivity (Linderman *et al*., 2003; Choo *et al*., 2007a, b; Zu *et al.,* 2008).

METHODOLOGY

In this study, one of the objectives was to investigate the instrument of LH. A survey is considered as the most economical among methods available for data collection due to its ability in performing efficient data collection (Moser and Kalton, 1971). In general, a survey typed questionnaire approach is relatively low cost of money, time saving, and simple approach. Moreover, by using survey methods, it can clarify the question the survey respondents and recording their responses to be used as data for analysis (Chang, 2002). Therefore it had been used by the authors.

Data Collection

During the data collection period between February 2011 and July 2011, as many as 317 questionnaire were distributed to top management in Malaysian healthcare industry and 128 completed from received giving the response rate of 40.4%.

Validity and Reliability

SEM is method of data analysis method which is increasingly used in operation management empirical studies (Shah and Goldstein 2006). Exploratory Factor Analysis (EFA) with varimax rotation was performed on LH construct. At a minimum, 0.4 loading of each item on its respective factor are considered adequate for that factor. The EFA of 28 items of LH were explaining 66.638% of the total variance. The result indicates that LH have been identified 6 factor with 24 items are compared to original questionnaires which are 28 items.

The Cronbach's Alpha measure of reliability of LH construct was between 0.784 and 0.912. Nunnally (1978) allowed a slightly lower minimum limit such as 0.6 for exploratory work involving the use of newly developed scales. Since, Cronbach's Alpha value for each factor above 0.70, all factor are accepted as being reliable for the research. Table 1 shows the result of EFA and reliability analysis.

Table 1 EFA and Reliability analysis of the LH constructs

Factor	Number of items	First Eigen value	Percentage of variance explained	Cronbach Alpha
LH		1.139	66.638	
Leadership	4			0.784
Employee Involvement	4			0.861

Supplier Relationship	4	0.912
Customer Relationship	4	0.872
Quality Information and Analysis	4	0.738
Continuous Improvement	4	0.847

RESULT AND ANALYSIS: CONFIRMATORY FACTOR ANALYSIS (CFA)

The next analysis involves testing the measurement model, where LH constructs on single factor and multiple factor.

CFA - single factor

Refer to Table 2, the $\chi 2$/df ratio having range from 2.133 to 2.948 that is less than 3.0. Joreskog and Sorbom (1993) suggested that it should be between 0 and 3 with smaller values indicating better fit. Regarding the factor loading, the standardized coefficient estimate is between 0.68 and 0.88. All these are considered good which is above the acceptable level of 0.3. The goodness fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), and Tucker-Lewis coefficient (TLI) more than 0.9. Values are more than 0.8 indicate marginal fit (Handley and Benton, 2009), whereas value more than 0.9 presenting good fit (Hu and Bentler, 1998, 1999). Next, the root mean square error of approximation (RMSEA) also shows s good fit with value less than 0.08. Browne and Cudeck (1993) proposed that values less than 0.08 indicates good fit, and values high than 0.08 represent reasonable errors of approximation in the population.

CFA for LH constructs – multiple factor

LH Model with six factors manifested an adequate fit outcome as shown in Figure 1. $\chi 2$ statistics was 316.718 (degree of freedom = 237, p <0,001), with ratio of $\chi 2$/df value being1.336 less than 2.0 thus exhibiting a good fit. Goodness Fit Index (GFI) was 0.837 and Adjusted Goodness of Fit (AGFI) was 0.795 which was moderate fit. The comparative fit index (CFI) was 0.950, Tucker Lewis coefficient (TLI) was 0.942. The score greater than 0.9 indicated excellent fit. The value of (RMSEA) was 0.051 less than 0.08 and with that it displayed a good fit. All canonical correlation (rc) showed values of less than 1.0 signaling that discriminant validity was tested and acceptable.

At factor loading, the standard coefficient estimated at 0.563 (QIA2) and 0.861 (SR1) was good as it surpassed the accepted level of 0.3 with p-value <0,001 as presented in Figure 1 and Table 3 with that, it is suggested that these seven construct as applicable for measuring the LH implementation.

Table 2 CFA: Single factor for LH constructs

Factor	$\chi 2$	df	$\chi 2$/df	p-value	GFI	AGFI	CFI	TLI	RMSEA
LH									
Leadership	2.263	2	1.132	.322	.991	.955	.998	994	.032
Employee Involvement	2.452	2	1.726	.178	.986	.931	.994	981	.076

Customer Relationship	2.819	2	1.409	.244	.989	.943	.997	.990	.018
Supplier Relationship	2.344	2	1.172	.310	.991	.953	.999	.997	.037
Quality Information and Analysis	2.948	2	1.478	.229	.989	.946	.991	.972	.061
Continuous Improvement	2.133	2	1.066	.344	.992	.958	.999	.998	.023

Note: χ2= Chi-Square, df= Degree of freedom

Table 3 CFA: multiple factor for LH

Factor	χ2	df	χ2/df	p-value	GFI	AGFI	CFI	TLI	RMSEA
LH	316.718	237	1.336	. 000	.837	.795	.950	.942	.051

Note: χ2= Chi-Square, df= Degree of freedom

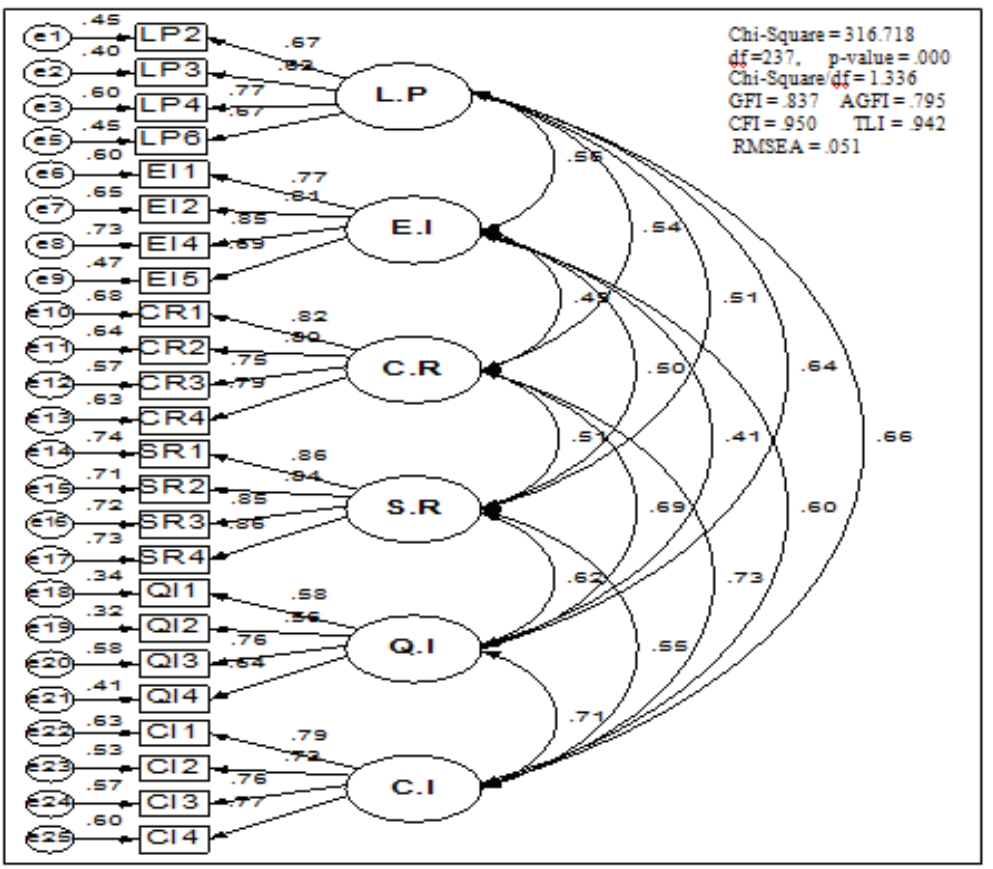

Figure 1 The output path diagram for two factors LH model

CONCLUSION AND FUTURE RESEARCH

LH practices become most important quality initiatives in healthcare industry to enhancing the organization ability to improve business operation, customer and employee satisfaction and organizational performance. Data for the study were collected from a sample of 128 Malaysian healthcare industries and the research model was tested using Structural Equation Model (SEM). Based on EFA CFA, and reliability, the results of six factors showed that the measurement model for LH constructs had a good fit and the model valid and reliable for Malaysian healthcare industry. Agenda for future research, the authors are interested to study the structural relationship between LH practices and Balanced Scorecard (BSC) measurement have an impact on the performance improvement performance in Malaysian healthcare industry.

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