

Inventory Performance Development in Private Hospitals: a Case Study in Thailand.

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Abstract

The healthcare industry in Thailand has two main sectors: the government and the private sector. The private hospitals focus on providing service quality; it makes the customer satisfaction at high level. As a result, it leads the number and income of private hospitals to increase continuously. Therefore, private hospitals focus on improving both financial and non-financial strategies.

For the products, they are the main drivers of the healthcare business which are medicines and medical supplies; both types of products have different handling complexities. For the safety of the patient's life and a competitive advantage, therefore, it is necessary to manage such products effectively and appropriately. This research aimed to develop operational guidelines and inventory strategies including the development and prioritization of indicators for measurement of product performance accurately. This research uses data from directly interview with private hospital experts. For the beginning, it started by reviewing SCM indicators, applying them to the BSC perspective, then prioritizing the BSC perspective and sequence of the performance indicators within each viewpoint. The method of hierarchical analysis (AHP) is applied in both quantitative and qualitative integration which is under the complex context of the SCM system to be able to bring conclusions or strategies to practices. It was conducted through a literature review and confirmed through questionnaires with experts from private hospitals in Thailand. The study found that the most important management aspect is the financial perspective. The most important inventory management performance measurement indicators are medication error, inventory turnover, and management cost.

Keywords

Private hospital, Hospital supply chain, Inventory performance indicators and Medical supply.

1. Introduction

Generally, private and public hospitals clearly differ with some contexts or even characteristics. For the classification of hospitals, they lead to different goals and strategies of the organization for ownership and funding sources (Krichanchai and MacCarthy 2016) (Ouédraogo et al. 2020). Private hospitals focus on providing high-quality services and customer satisfaction, which is an important part. As public hospitals emphasize standards and easily accessible so that, private hospitals compete under management with high costs and service fees for competitive advantages (Kaya et al. 2020) (Swain 2019). However, both types of hospitals have common processes or goals to emphasize patients' safety as a top priority (Rodríguez and Svensson 2020).

In Thailand, the number of private hospitals is increasing steadily in each year because there are more service users, both Thai and foreign patients. As the number of patients increases, the hospital's income also increases greatly

(Ministry of Public Health 2019). The main things that are delivered to service users are medicines, medical supplies, and good service. Private hospitals in Thailand have about 40% of their main income coming from product groups of medicines and medical supplies (National Statistical Officer survey 2016). However, in Thailand, there are still problems with access to medicines and medical supplies, such as no products and expired products (Naruemit 2013).

In hospitals, there are many groups of products. Logistics management for each group is different, which also means between medicines and medical supplies. The medicines group has a well-organized and standardized process and management, from the import process to the follow-up of their use (Joint Commission International. Accreditation standards for hospitals 2017) (Steckowych and Smith 2019). The medical supply has a more complex and diverse approach for both import and individual selection (Bendavid et al. 2010), which makes the logistics of the hospitals have diversity in product management; there are no clear policies or certification system to manage the logistics process clearly. Therefore, the hospital industry should have good and appropriate inventory management and measurement indicators for each product to increase efficiency in the logistics process of the organization (Moons et al. 2019) to develop inventory management practices and strategies, as well as to develop and prioritize performance measurement indicators of products effectively and appropriately.

However, performance measurement and appropriate measurement indicators determination; they should be rigorously reviewed by experts and corporate executives both in theory and practice because they depend on many factors. Therefore, this study aims to prioritize new proposed effective performance measurement indicators for implement to medical supply products in private hospitals, develop a set of performance measurement indicators for Supply Chain Management (SCM) of private hospitals, and develop inventory practices and strategies for groups of private hospitals in Thailand by using the method of Analytical Hierarchy Process (AHP) to simplify decision-making on complex problems by combining performance measurement indicators (KPIs with the four perspectives in Balanced Scorecard (BSC) management, help to apply the strategies into the practice (Yaghoobi and Haddadi 2016).

2. Literature Review

A. Hospital Supply Chain

Supply chain processes take up about 40% or more of hospitals' budget. The key steps to improve strategy of supply chain management in healthcare industries are the right supply chain key performance indicators (KPIs). A well planning and managing of the coordinate supply chain can reduce the overall costs of supply chain (Moons et al. 2019). Supply chain management is integrative and it has been mentioned from various perspectives. The different perspectives cause the unclear decision on what is significant to measure in supply chain (Papakiriakopoulos and Pramatarı 2010).

Nowadays, there are private hospitals that use many types of technology and innovation that decrease cost-effective strategies, including the use of third party logistics service provider (3PL). Although 3PL is a specialist in logistics management, there are still limitations on the unpredictable functional issues of each item in inventory. Therefore, the hospital should find the suitable SCM indicators to help solve controllable problems (Senarak and Kritchanchai 2019). Products in the hospital have several characteristics. Inventory items in the hospital have several demand characteristics, and the inventory policy should be customized as presented because one policy cannot be applied to all commodity groups.

B. Inventory Management

Inventory management is one of business management's planning and controlling inventories concerned. It has a significant role in supply chain, it is aimed at lower cost while improving customer services and also concentrating on customers' demand. Supplies insufficiencies are a significant issue in hospitals since they could imperil patients' life. Comparing to the other industries, having stock-out in hospital's inventory is more serious. However, not only there were the problems with a shortage of medical supplies but also an oversupply of stocks was one of the problems that contribute to hospitals' financial problems (Moons et al. 2019). "The things that should be further studied are which factors affect the ability to medicine management and medical supplies in hospitals in order to be able to correctly solve the problems that are most relevant to the cause and contributes to the effectiveness of treatment and the further benefits of the people" (Rohaning 2015).

C. Performance Measurement

The process of hospital care involves in a variety of operational activities including inventory management and distribution of many products to many service points. Therefore, there should be an aid to assess and measure in order to distribute products to various points and monitoring effectively.

KPI is a system that has been discussed a lot. Even though KPIs are very meaningful, almost no one has given them a clear definition. Mostly, the use of KPI is based on finance and rarely applied to non-financial goals (Neely et al. 1995). Measuring the performance of the supply chain is fundamental to identify and address deficiencies in the logistics activities, and it serves as a good input for managerial decision-making (Moons et al. 2019).

D. Balance Score Card

The BSC produces an idea that provides performance measurement and also aids plan makers to recognize things that should be done or measured (Grigoroudis et al. 2012)

There are a lot of factors that are used to evaluate supply chain performance. For these factors and measures of SCM, they are outlined in the literature review as theoretical for specifying the efficiency measures of supply chain in accordance with the BSC guidelines. Proposing and developing of a relationship between SCM and BSC to discuss measures and metrics of SCM. The Balanced Performance of SCM (BSC) allows organizations to check their operations faster and broader (Shafiee et al. 2014)

The hospital supply chain is characterized by many special features. Furthermore, hospital supply chain is complicated and has operational challenges that relate to both inside and outside the organization. Inventory management is one of the administrative processes of corporate executives in order to plan and control inventory for allowing the organization to achieve its targets. While still having to focus on the needs and requirements of each customer, this results in material instability as a major problem in hospitals such as insufficient, over-needed, or misuse and various factors that can be life-threatening to the patient. Therefore, hospital procedures are associated with a wide range of activities for both medical care and management services, including managing inventory with several types of products for sending to many service points. There should be a helper in management and evaluation to follow and control the flow of each type of product appropriately to be developed more efficiently. Therefore, the use of BSC as development tools for the organization to be successful for a financial perspective and do not use business finance and can help link high-level policy perspectives to the practice of agency.

3. Methods

This research is an applied research that aims to develop and investigate the inventory management of medical supplies. The attributes were analyzed by using mathematical methods according to the principles of AHP, the summarized research process as shown in Figure 1.

In 1970, Saaty helped to develop a multi-criterion decision-making approach to help solve complex decision-making by dividing complex problems into hierarchies, which was one of the weighted scoring decision processes that was the most efficient and flexible. For these, they helped people to identify priorities and make the best decisions that reduced biased decision-making, and were also a relatively easy-to-understand guideline. Furthermore, one of the strongest qualities of AHP is the prioritization (Dweiri et al. 2016).

AHP is the best tool for prioritizing and selecting the best BSC's perspective in SCM operation. The result of AHP helps to prioritize the most important aspects of the assessment of SCM (Sharma and Bhagwat 2007). AHP is often used to prioritize the importance of alternatives in complicated decision by knowledgeable people that involved in the work. This paper strives to demonstrate a ranking analysis of KPI by grouping together with the perspective of BSC.

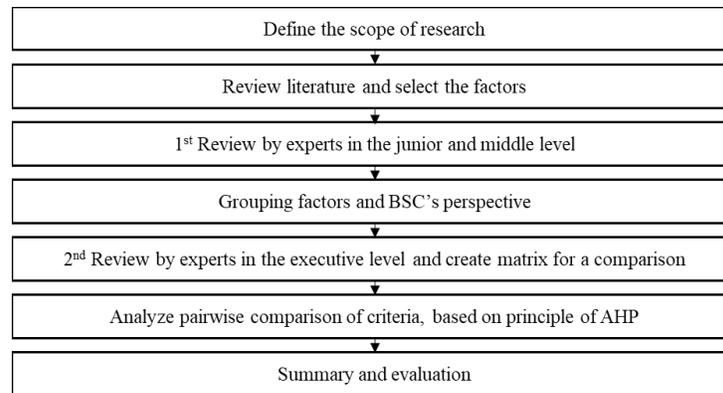


Figure 1. Research methodology

- 1) *Define the Scope of Research*: This research focus on Private hospital and medical supply commodity group only.
- 2) *Review Literature and Select of Factors*: Literature review focuses on important perspectives that performers are interested in inventory management, a significant improvement of measuring famous processes and KPI in inventory. As a result of the literature review, KPI can be used in 4 perspectives as said in BSC in Chapter 2. For the provided factors in this study, they were obtained from reviewing the literature, moreover, provided factors also got an interest and focused on inventory management development.
- 3) *1st Review by experts in the junior and middle level*: Gathering information, most hospitals focus on, and confirm hospital's KPI in the present day in this process. Reviewing literature finds KPI which can be used in a real operation field.

The data were collected from proposing open-ended questions as the questionnaire. Experts need to have experiences and be responsible in that field for at least 10 years in the position as head of the department, supervisor, manager, and deputy manager.

In this research, there are 10 experts as the junior and middle-level, who had experiences and responsibility in term of supply chain management from private hospitals to answer open-ended questions.

- 4) *Grouping Factors*: Arranging factors and the results from reviewed literature compare with answers from experts who work in the related field in private hospitals. Whereupon, creating and grouping suitable factors of key performance indicators for the real operation of medical inventory management, based on the concept of BSC.

- 5) *2nd Review by experts in the executive level and create matrix for a comparison*: Gathering information from grouping factors and analyzing the relationship of each factor to get KPI which have perspectives in management levels. Also, to confirm the issue that should be important issues and improve the area for hospital's management team in the future.

The questions in form of questionnaire will be distributed to management; they are needed to have experiences and responsibility in term of supply chain management for at least 10 years in the related position such as Hospital director, Logistic director, etc.

In this research, there are five experts who are in high-level executives of the organization, who are responsible for logistics management or related works from private hospitals to answer the questionnaire.

- 6) *Analyze pairwise comparison of criteria, based on principle of AHP*: In this research, analyze of pairing relationship by using super matrix, ranking importance of factors in performance perspective and determining the score of KPI to show the importance of each topic.

- 7) *Summary and Evaluation*: Collecting and evaluating of important features in term of KPI use AHP method to show the result that follows the BSC's principle.

Lastly, this research summarizes and gives suggestions about key performance indicators in hospital inventory management which suitable for each group of products for private hospitals.

4. Data Collection

The objective of this study aimed to develop a set of measurement indicators and prioritize measurement indicators for the inventory management of medical supply and develop guidelines and strategies in term of product inventory for private hospitals in Thailand.

A. Respondents Profile

The results from the profile of respondents are as follows;

For round 1 of the data collection, the proportions of respondents were junior and middle-level executives management who directly had experiences and responsibility in term of supply chain management in the private hospitals.

For round 2 of the data collection, respondents were high-level executives of the organization, who responsible for logistics management or related works.

B. Data collection

The First Set of Questionnaires

The questionnaires have been distributed to 10 targeted private hospitals by the first group of experts, as the junior and middle-level executive management who directly had experiences and responsibility in term of supply chain management in the private hospitals. The experts of 10 targeted private hospitals were asked to select 16 factors of performance measurement indicators and be able to add additional factors. For 16 provided factors, they were obtained from reviewing the literature, moreover, provided factors also got an interest and focused on inventory management development.

Moreover, there were two additional factors (items 17 and 18) were proposed by experts. For data collection in the first round, there were 18 factors, which were detailed in the table 1 as follows;

Table 1. Inventory management performance indicators

No	Performance measurement indicators	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	Total
1	Management cost				x	x	x	x			x	5
2	Inventory Turnover or Inventory day on hand (DOH)	x		x			x		x	x	x	6
3	Carry cost		x									1
4	Stock value amount				x	x	x		x		x	5
5	Stock accuracy	x		x	x	x	x	x	x	x	x	9
6	Stock non-movement value & items			x	x		x		x		x	5
7	Stock damage value (Scrap)		x	x	x	x				x		5
8	Stock un-replenish			x					x			2
9	Picking error (Medication error)	x		x	x		x	x			x	6
10	Stock visibility											0
11	Customer satisfaction index						x			x	x	3
12	Stock out to Patient & service	x	x	x	x	x			x	x		7
13	Order Cycle Time, Process lead time						x				x	2
14	Document accuracy				x	x			x			3
15	Demand forecasting				x		x				x	3
16	Stock nearly expired		x	x	x	x	x	x			x	7
17	Cost effectiveness, Cost saving	x		x		x						3
18	%cost of poor quality from any action										x	1

The consistent factors were selected by using the theory of Mary & Hamman, 1995 and Schumacker & Lomax 2004 (Sharma and Bhagwat 2007) (Anjomshoae et al. 2019). A total of 13 factors that met the criteria were selected.

For the obtained data of the experts, it was applied to the research of Shafiee et al. (2014), based on the presentation for efficiency assessment of supply chain, together with the management perspective of the Balance score card. The measurement indicators were grouped in each perspective as the following table 2;

Table 2. Grouping inventory management performance indicators with BSC

Goal	The performance measurement indicators of inventory management development			
Level1; Criteria	Finance perspective (P1)	Customer perspective (P2)	Internal process perspective (P3)	Learning & Growth perspective (P4)
Level2; Alternative	-Management cost (F1) -Inventory turnover or DOH (F2) -Cost saving, Cost effectiveness (F3)	-Picking error (Medication error) (F4) -Customer satisfaction index (F5) -Stock out to Patient & service (F6)	-Stock value amount (F7) -Stock accuracy (F8) -Stock non-movement value & items (F9) -Stock damage value (Scrap) (F10)	-Document accuracy (F11) -Stock nearly expired (F12) -Demand forecasting (F13)

The Second Set of Questionnaires

The second set of questionnaires was used to ask the senior executives. The questionnaires consisted of 5 specific questions, in the form of prioritization of importance in the range of 1 to 9 points. All of the data which is collected from all experts' questionnaires will be analyzed by using AHP. This part shows the results of the prioritization and the significant factors of performance measurement indicators for medical supply management in private hospitals.

5. Results and Discussion

In the research study, the first set of questionnaires was distributed to the junior and middle-level executives, and the second set of questionnaires was distributed to the group of experts in targeted private hospitals, which are classified as high-level executives of the organization as described earlier, all of the data which is collected from all experts' questionnaires will be analyzed by using AHP. This part shows the results of the prioritization and the significant factors of performance measurement indicators for medical supply management in private hospitals. The results are shown in the following picture;

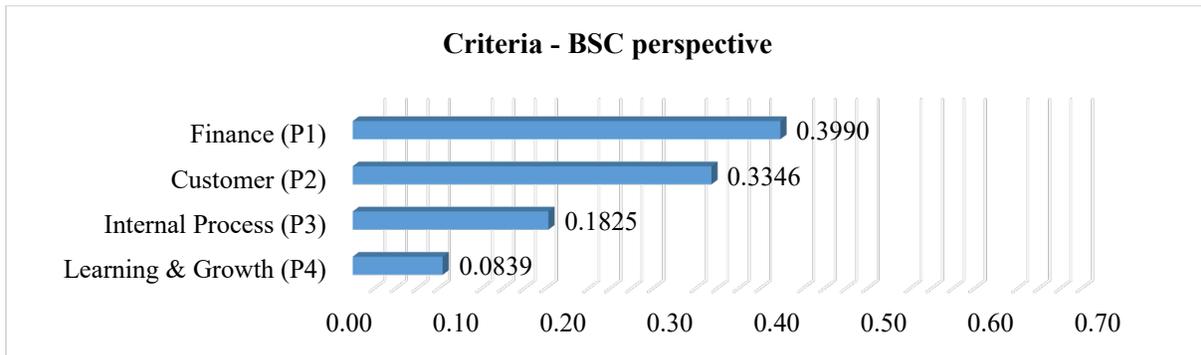


Figure 2. The Criteria Weight of BSC Perspective for Medical Supply Management

As can be seen in figure 2, the most significant performance measurement indicator for medical supply management was item P1 "Finance Perspective" (Criteria Weight = 0.3990). It was followed by item P2 "Customer Perspective" (Criteria Weight = 0.3346) and item P3 "Internal Process Perspective" (Criteria Weight = 0.1825). However, the least significant performance measurement indicator for medical supply management was item P4 "Learning and Growth Perspective" (Criteria Weight = 0.0839). Furthermore, the picture 4.1 showed that the consistency ratio of the prioritization of performance measurement indicators for medical supply management is acceptable (consistency ratio (C.R.) = 0.0572).

The overall of private hospitals, in this research were all large private organizations that listed on the stock exchange. The ultimate goal is the revenue and profits of the organization. The results and numbers of various budgets that reports to the Stock Exchange, therefore, the important for both the accuracy and credibility of the shareholders and interested parties. For the health industry, the goal of safety for the life of its users is an equally important goal consistent with the viewpoint obtained from the research. The most important management perspective is the finance perspective, since being a self-managed organization has no budget support and must strive to earn income and profit in order to improve quality and continue the business. Another important aspect of is customer focus. Providing quality service to our customers is the most important because it affects customer satisfaction, image, being sued, and reliability which is an important variable for choosing the service directly affecting operating results and survival in the business industry, both of which are in line with the context of private businesses in Thailand. In particular, the healthcare sector considers the safety of patients' lives to be of paramount importance.

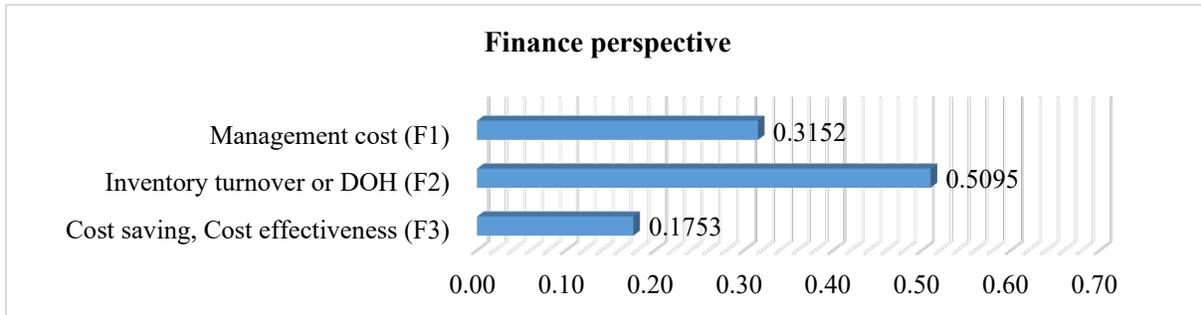


Figure 3. The Factors of Performance Measurement Indicators in term of Finance Perspective for Medical Supply Management

As shown in figure 3, the most significant factor of performance measurement indicators in term of finance perspective for medical supply management was item F2 “Inventory Turnover or DOH” (Criteria Weight = 0.5095). However, the least significant factor of performance measurement indicators in term of finance perspective for medical supply management was item F3 “Cost Saving, Cost Effectiveness” (Criteria Weight = 0.1753). For the acceptable C.R., the results in this study showed that the consistency ratio of performance measurement indicators in term of finance perspective is acceptable (C.R. = 0.0003).

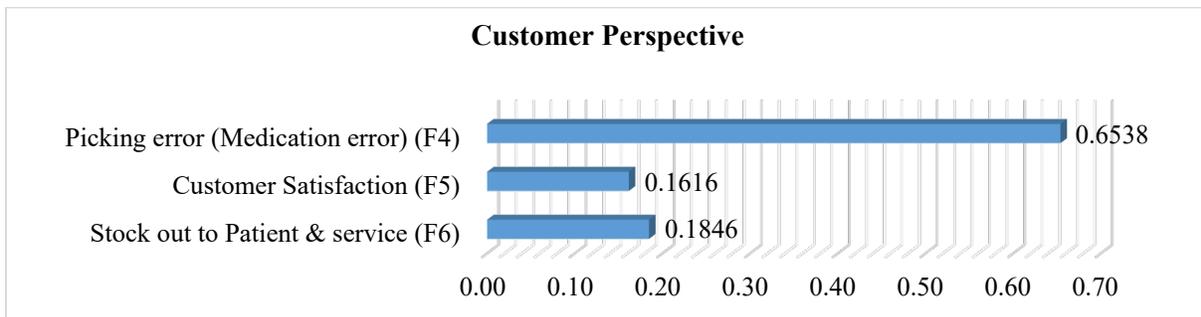


Figure 4. The Factors of Performance Measurement Indicators in term of Customer Perspective for Medical Supply Management

According to the figure 4, the most significant factor of performance measurement indicators in term of customer perspective for medical supply management was item F4 “Picking Error (Medication Error)” (Criteria Weight = 0.6538), whereas item F5 “Customer Satisfaction Index” was found to be at criteria weight 0.1616 which is the least significant factor of performance measurement indicators in term of finance perspective for medical supply management. As shown in picture 4.3, the consistency ratio of performance measurement indicators in term of customer perspective is acceptable (C.R. = 0.0013).

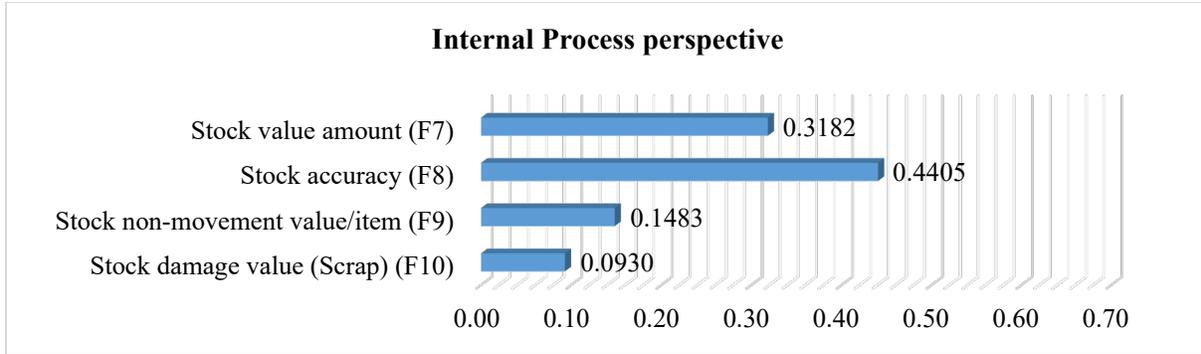


Figure 5. The Factors of Performance Measurement Indicators in term of Internal Process Perspective for Medical Supply Management

As indicated in figure 5, the most significant factor of performance measurement indicators in term of internal process perspective for medical supply management was item F8 “Stock Accuracy” (Criteria Weight = 0.4405). On the other hand, the least significant factor of performance measurement indicators in term of internal process perspective for medical supply management was item F10 “Stock Damage Value (Scrap)” (Criteria Weight = 0.0930). For the acceptable CR, the picture 4.4 showed that the consistency ratio of performance measurement indicators in term of internal process perspective is acceptable (C.R. = 0.0138).

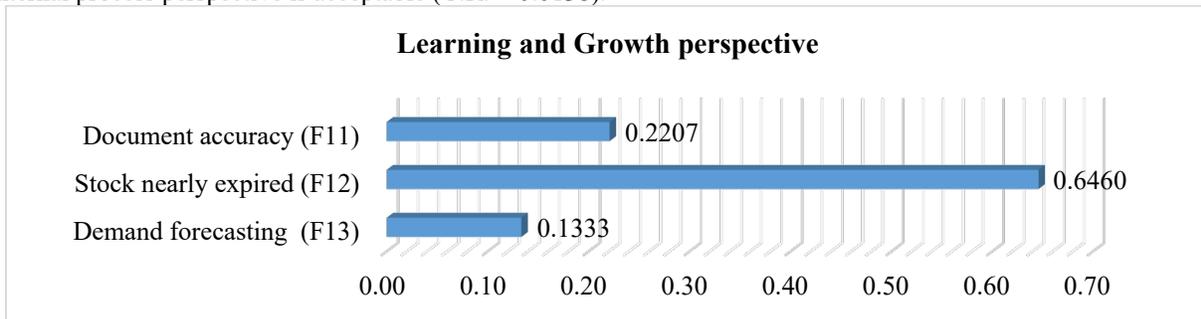


Figure 6. The Factors of Performance Measurement Indicators in term of Learning and Growth Perspective for Medical Supply Management

The figure 6 presents that the most significant factor of performance measurement indicators in term of learning and growth perspective for medical supply management was item F12 “Stock Nearly Expired” (Criteria Weight = 0.6460). However, the least significant factor of performance measurement indicators in term of learning and growth perspective for medical supply management was item F13 “Demand Forecasting” (Criteria Weight = 0.1333). According to the picture 4.5, the consistency ratio of performance measurement indicators in term of learning and growth perspective is acceptable (C.R. = 0.0317).

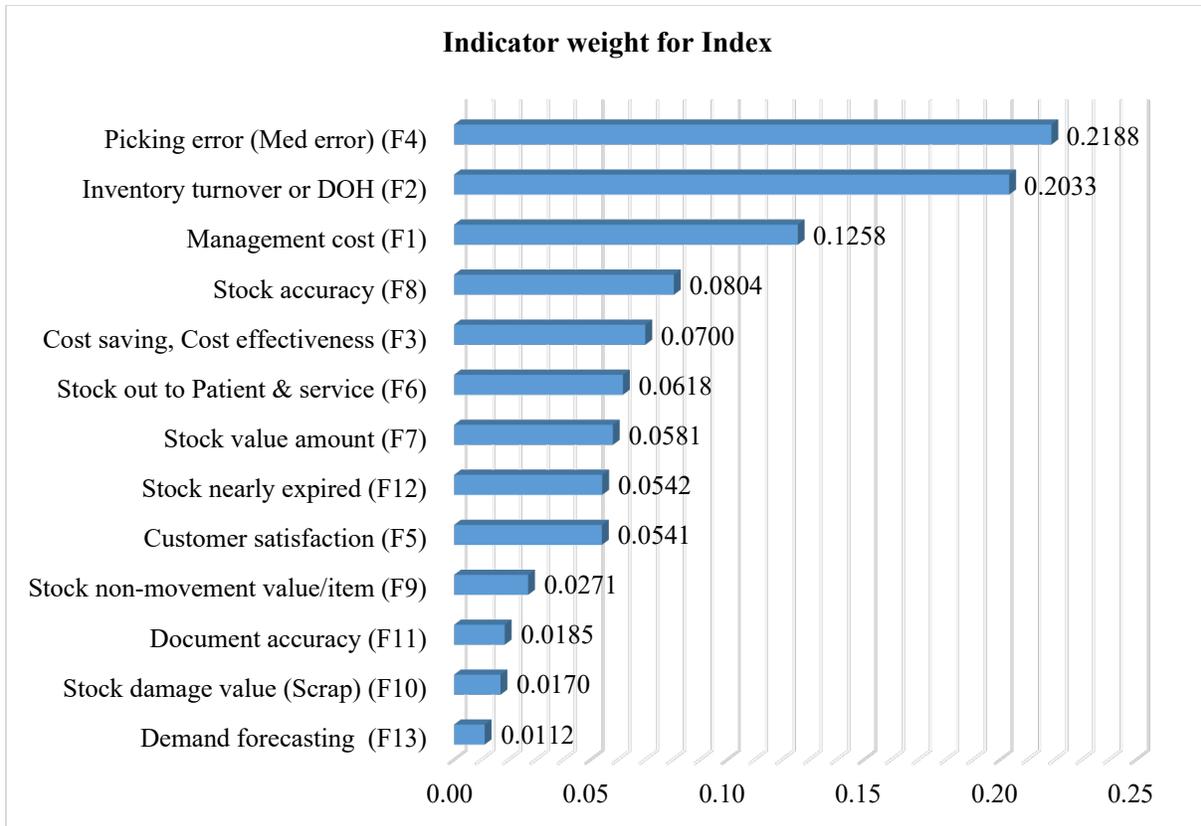


Figure 7. The Overall Prioritization of All Performance Measurement Indicators for Inventory Management Development of Medical Supply in Private Hospitals.

As can be shown in figure 7, the result shows the first three significant performance measurement indicators that contributed to inventory management development of medical supply in private hospitals were “Picking Error (Medication Error)”, “Turnover or DOH”, and “Management Cost” (Total Criteria Weight = 0.2188, 0.2033, and 0.1258 respectively).

However, the results also indicated that the least significant performance measurement indicator that contributed to inventory management development of medical supply in private hospitals was “Demand Forecasting”, “Stock Damage Value (Scrap), and Document Accuracy”. (Criteria Weight = 0.0112, 0.0170, and 0.0185 respectively).

From no set of inventory management indicators of private hospitals has ever been surveyed; this research proposes a set of necessary indicators that are in line with the SCM and logistics management goals of private organizations because in addition to taking into account the financial, the customer side is equally important which usually comes out in the form of building credibility by private hospitals, so they try to make the organization certified in various fields both treatment and service by gathering information from the involved hospitals that can be divided into 3 types as follows:

1. It should be applied continuously for the use of providing services and affecting the sustainability of the organization. The 1 to 3 indicators should be applied that are Picking error, Inventory turnover (DOH), and Management cost; each indicator is important as follows:

Picking error is an important indicator that directly affects patient safety. There are more details on the steps of the drug administration process and an indicator that indicates the quality of the organization and satisfaction service and loyalty of user and be an indicator of the survival of the organization as well.

Inventory turnover provides an overview of inventory management, whether it is cost-effective, high-volume, or low-volume than what the organization wants. The organization was able to manage the waste, availability, and logistics costs efficiently.

Management cost is the overall view of the hospital's supply chain system in order to provide a suitable overview and the highest benefit; this may return in the form of either monetary or mutual support.

2. It should be applied and continued to help the management more effective, the 4 to 9 indicators can be applied to suit the situation and goals of the organization that are namely stock accuracy, cost saving, stock out to patient, stock value amount, stock nearly expire, and customer satisfaction, which every item will help to be an important variable for the development.

3. It should be applied as needed in order to solve or develop problems in term of the specific aspect to meet the goals of SCM and reduce the negative impact on the organization, i.e., stock non-movement, document accuracy, stock damage and demand forecast.

Private hospitals are interested in developing an inventory management system for the organization's policy. There are policies that mainly focus on the results and benefits of the organization, with the most important perspectives that are financial and customer for private hospitals. In contrast, the management of government hospitals emphasizes the policy of cost and bargaining power; this makes it necessary to order in large quantities at a time which affects management costs and efforts to develop an inventory management system incurred.

The important things of the application of a set of indicators; it should consider the data source, storage tool, and the correct calculation formula to minimize bias or mistakes that can be fundamental to senior management's wrong analysis and decision-making.

By the studied group of hospitals, the findings were found that the characteristics of inventory management with different points were the hospitals that managed inventory by themselves (In-house) such as BH, THG, RAM, and the hospitals that managed by third-party logistics provider such as BDMS and PRINC as follow in figure 8;

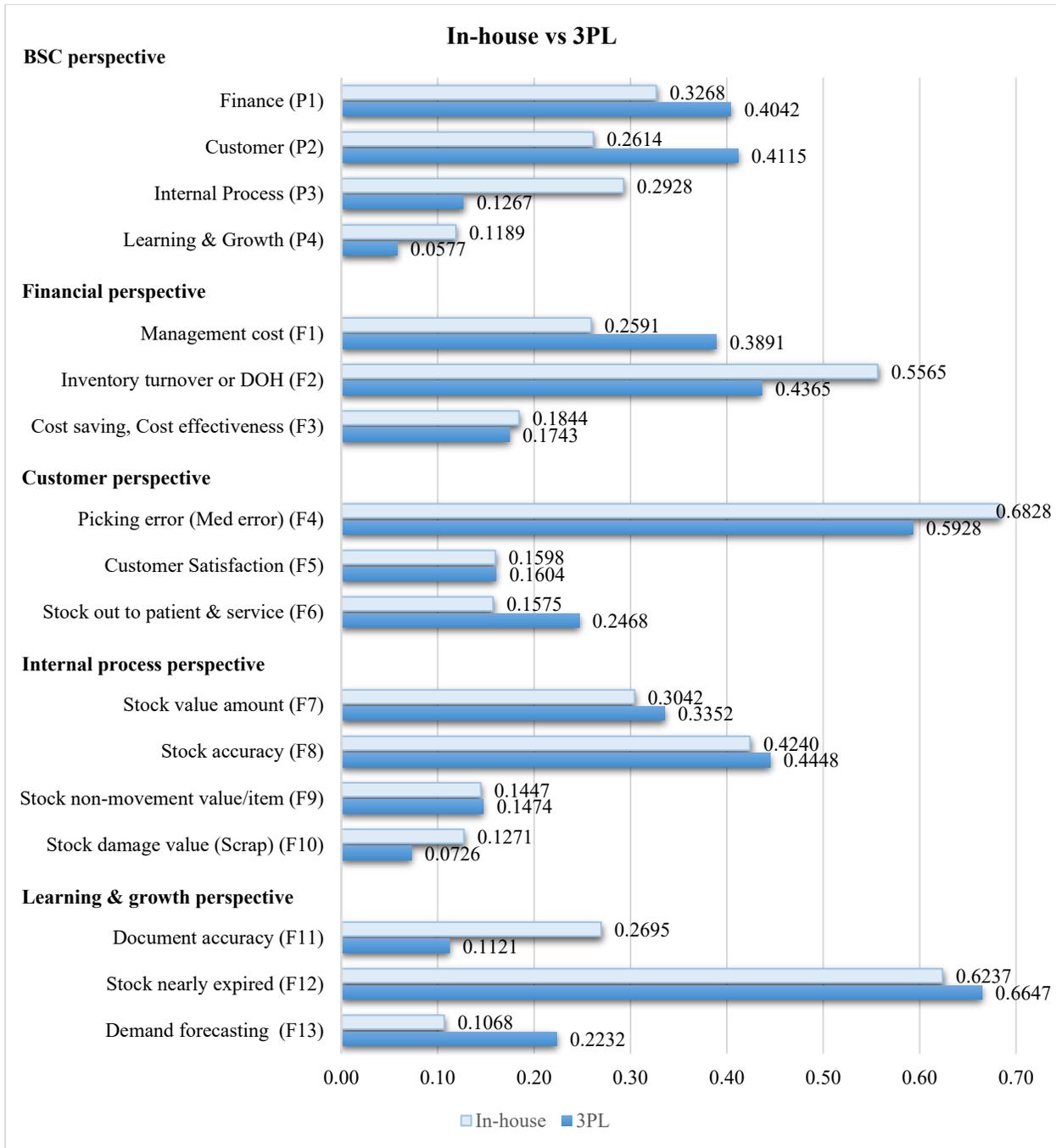


Figure 8. Inventory management perspective comparison between themselves and 3PL

For management perspective, based on the principles of BSC, total overview and hospitals that managed inventory by themselves (In-house) focused on finance perspective, whereas the hospitals that were managed by third-party logistics provider closely pay attention to two perspectives: finance and customer.

For finance perspective, total overview and hospitals that managed inventory by themselves (In-house) focused on the indicator in term of inventory turnover or DOH, whereas the hospitals that were managed by third-party logistics provider closely pay attention to two indicators: inventory turnover or DOH and management cost.

For customer perspective, the total overview and the hospitals that managed inventory by themselves (In-house) and the hospitals that were managed by third-party logistics provider focused on the same indicator, which is picking error (Med error).

For internal process perspective, total overview, the hospitals that managed inventory by themselves (In-house) and the hospitals that were managed by third-party logistics provider focused on the same indicator, which is stock accuracy.

For learning and growth perspective, total overview and the hospitals that managed inventory by themselves (In-house) and the hospitals that were managed by third-party logistics provider focused on the same indicator, which is stock nearly expired.

6. Conclusion

Private hospitals are business entities that are owned by individuals or groups by management budgets and expenses by themselves; there is no government budget to help support them. Therefore, private hospitals try to develop their potential to have the best medical care and service systems to be able to compete in the market, which is the main goal is profit and user safety. The main product is the driving force to achieve the goals of private hospitals which are medicine and medical supplies. However, there is a tendency to increase continuously both the number and revenue of the hospital which demonstrate the efficiency and value that customers choose to use the service.

This paper surveys the top 10 private hospitals listed on the Stock Exchange of Thailand (SET), which emphasizes the need to develop inventory management performance indicators to suit the context of each product category, e.g. medicines, pharmaceuticals, operation room, and x-rays in order to assess and manage to achieve the organization's goals effectively. This document is considered one of the priorities and practices of the BSC theory applied policy, which has developed and organized the prioritization of inventory management performance indicators in the medical supplies group to be practical on the policy of perspectives linked to a set of indicators.

The results of the inventory management performance indicators focus on a financial perspective that follows the principle of BSC. However, the performance indicators focus on the customer, which emphasizes the highest safety of customers. From this point of view, this is consistent with the context and management practices of private hospitals that attach great importance to income and financial statements to increase the credibility of shareholders and customers.

This set of inventory performance indicators can help government and non-governmental organizations interested in the development of SCM and Logistics to apply them to the real benefits and results in the form of financial and non-financial. However, it is important to realize the goals of the organization to be able to adjust the agency's strategy appropriately and another thing is effective cooperation and communication with external organizations.

This research has the scope of the development of the indicator set in private hospitals only to get a more comprehensive view or to be able to analyze the results in practice. It would be better to apply it to both public and private hospitals. Therefore, it will be interesting for future research to develop a set of indicators for the healthcare industry at all levels, including the manufacturing industry and pharmaceutical distribution as well. Another important thing is that before applying the set of indicators from this research, the organization or agency must be a tool or channel in order to collect and retrieve data for analysis properly.

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