

Supply Chain Model for Curriculum Management Based on Thailand Qualifications Framework for Higher Education with the Internet of Things

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Abstract— The research aimed is to develop and to evaluate the supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things. The research sample totaling ten experts consisted of three experts on supply chain , two experts on information technology and three experts on electrical engineering and two expert on curriculum . All of them must have more than five years' experience The employed research instrument is a questionnaire. Data analysis was the average mean and standard deviation. The research was found that supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things consists of main components: namely main components Suppliers, University (Manufacturer), Education Customers, Consumer, Data from sensors and devices, Connectivity, cloud & server and mobile app. The results from experts agreement of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things was a high level. It showed that the supply chain management model could may be apply in support the tasks.

Keywords— *supply chain model, curriculum management, internet of things*

1. Introduction

Thai government has realized the importance of adjusting the country to increase its capability to compete with other countries in every aspect. Especially in educational development that leads to development of quality of the people, the government has formulated the following policy: "To develop quality of people, as the people are human resource of the country and the key component in all aspects of development, to reform the whole system of education, to expand education and modify educational structure, to decentralize educational administration to the provinces so that educational management becomes more thorough and responsive to the local needs." [11]. This policy also includes the establishment of private and public higher education institutions to meet the needs for national development and development of

individuals who want to further their studies. Many countries have increased their competitive ability by developing education to equip them with knowledge. One of their strategies is the application of the supply chain management and internet of things in human resource development in order to increase competitive ability. As Thailand is a part of world community, it needs to urgently develop its education system for development country and enhance academic excellence. Thai government has formulated an important policy that "The creation of a stable knowledge-based economy and environmental factors must support Thailand to be a centre of goods and service production in the region based on creative thinking, creation of innovations, and extension of the body of knowledge in order to support the adjustment of the structure of production. supply chain and internet of things system are manage economic risks, and investment inclusive of the development of new entrepreneurs, The researcher has realized the importance of research development in order to cope with economic, social and political changes. In the business and industrial sector the changes have included the movement toward more and more application of the concept of supply chain management and internet of things . This is because the business and industrial sector needs to be highly competitive due to increasingly high competitions The organizations, therefore, need to have sufficient information and resources to increase their values and respond to the demand of their clients. Thus, the supply chain management process is a key process to support the organization's whole activities system from upstream to downstream. [1] supply chain and Internet of Things devices are an effective way to track and authenticate education and shipments using global positioning System and other technologies. They can also monitor the storage data conditions of products which enhances quality management in education throughout the supply chain.. Thus the researcher has decided to develop

supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things for adding value to society.

2. Literature Review

In education systems, the Internet has rooted itself deeply. The internet of things, which is a new technology, is expected to make more important changes in the education sector. Many internet of things devices can be utilized in education including, digital highlighters and Interactive boards. In the learning experience, the text is digitally transferred to smartphones with the assistance of digital scanners. Students can interact with educators, peers, and experts across the world, while they are sitting in their classroom by using these devices.[8],[13],[14]

Asset supply chain management process with the internet of things for good governance for higher education institutions .It found that supply chain and internet of thing can help to manage the available assets accurately, for example, the inspection of asset status, monitoring, asset age analysis and reported assets. That is why information technology is a vital tool to facilitate operations and information exchange. The more exchanged information is updated, the higher efficient operations within the supply chain will be, because all parties in the chain will perceive accurate information. In the end, the flow of accurate assets and information generates transparency, value (man, money, materials, and management) and accountability grounded on good governance.[10]

Supply chain and Internet of things will provide manufacturers with a lot of information and new education insights about their supply chain and will help them drive operational efficiencies. Supply chain and Internet of things shows its potential to the fullest in processes like supply chain. Management, forecasting, and oversight applications help fleet managers improve the operational efficiency of deliver and add transparency for effective decision making decision-making.

3. Research Methodology

3.1 Study and analyse related documents and research to the components supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

3.2 Defind research framework of conceptual framework of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things setting.

3.3 Design supply chain model for curriculum management based on Thailand qualifications

framework for higher education with the internet of things . using data collected from studies and analysis of relevant documents and research.

3.4 Propose the models to consultants and experts for consideration by in-depth interviews.

3.5 Create an instrument for assessing the suitability of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things.

6, Data collection and develop questionnaire are sent to the experts in order to ask their opinions on appropriateness of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things using the arithmetic mean and standard deviation as the following criteria : 4.51-5.00 at highest of appropriate suitability 3.51-4.50 at a high of appropriate suitability 2.51-3.50 at moderately of appropriate suitability 1.51-2.50 at a low of appropriate suitability 0.00-1.50 at lowest of appropriate suitability [2] ,[3] [4],[5] and [6].

7 To Review and edit supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things on suggestions from the experts.

4. Results

4.1 Research results about supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things were presented in figure 1 .

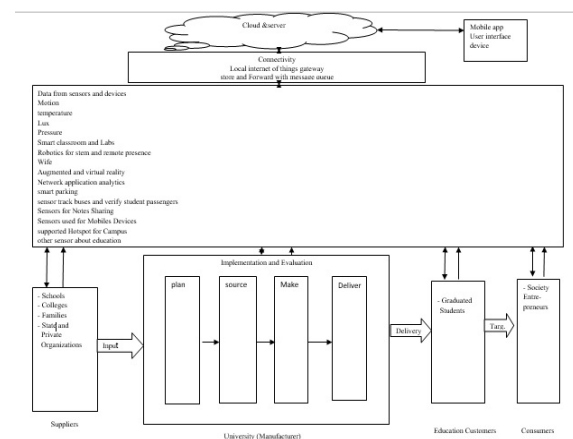


Figure 1. Supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

Table 1. Component of Suppliers, with Its Stakeholders, Activities, and Needs for data

Suppliers	Activities in supply chain	Needs for data
Stakeholders: 1. School 2. College 3. Family 4. State and Private Organizations	- Supplying graduated high school students - Supplying self-supported students - Providing funding support for study - Providing educational scholarships	Real-time data visibility

Table 2. Component of University (Manufacturer) with Its Steps of Curriculum Implementation and Evaluation, Activities, and Needs for data

University (Manufacturer)	Activities in supply chain	Needs for data
2. university Implementation and Evaluation 1 Plan	- Staff recruitment and student admission. (MKA 1) - Planning for and development of the curriculum and subject	- To stored systematically
2. Source		Automate attendance

Table 2. (Continued)

University (Manufacturer)	Activities in supply chain	Needs for data
2. university Implementation and Evaluation 2 Source	Development of curriculum documents, instructional media and certificates. (MKA 2) - Provision of course materials including texts, study guides, printed and electronic learning media, and equipment. (MKA 3)	- To facilitate speedy and accurate data
3 Make	- Provision of fieldwork experience training including training places, supervising staff and mentors, training handbook and materials, and seminars on training experience. (MKA 4) - Reporting of learning outcomes in each domain including the knowledge	Record a student location on campus

Table 2. (Continued)

University (Manufacturer)	Activities in supply chain	Needs for data
2. university Implementation and Evaluation 3 Make	, intellectual skill, attitude, morality, interpersonal relationship, numerical analysis, information technology usage, etc. (MKA 5) - Reporting of fieldwork experience training outcomes in terms of performance based on the rating scores of 1 – 5 according to evaluation criteria. (MKA 6) Reporting of curriculum implementation as following: - Number of students who graduate before the completion of curriculum implementation. - Number of students who graduate according to the curriculum. - Number of students who graduate in each major field of study.	Real-time data visibility
4. Deliver		Up-to-date evaluation reports.

Table 2. (Continued)

University (Manufacturer)	Activities in supply chain	Needs for data
2. university Implementation and Evaluation 4. Deliver	- Occupations taken up by graduate students from the university - Level of satisfaction of final year students with the curriculum. (MKA 7)	Up-to-date evaluation reports.

Table 3. Component of Education Customers, with Desirable Qualities, and Needs for data

Education Customers	Desirable Qualities	Needs for data
Graduated students	1. Having good knowledge in their field of study. 2. Having work performance skills. 3. Having all desirable characteristic	- Data that is easy to gather, to process and to retrieve.

Table 4. Component of Consumers, with Activities and Needs for data

Consumers	Desirable Qualities	Needs for data
Entrepreneurs	Receiving and/or employing graduated students with desirable characteristics including good virtues and morality, good knowledge and	- Questionnaires to assess the

Table 4. (Continued)

Consumers	Activities in supply chain	Needs for data
Entrepreneurs	intellectual skills, good human relationship skills, good responsibility, good numerical analysis skill, good communication skill, and good information technology usage skills, etc.	with the employed graduated student on various aspects of desirable characteristics.

MKA stands for Mo. Ko. Ao. (in Thai language) which means “Qualification Standards for Higher Education”. There are seven qualification standards for higher education: MKA1 – MKA 7

4.2 Explanation on elements of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

1 Suppliers

Suppliers of the student (High school/college) , Supplies of the family (Parents, Siblings), relatives, etc. government and private organizations (Scholarship).The suppliers mean the organizations that supply raw materials to the manufacturer. Raw materials in this case are students who graduated from high schools or two-year colleges, or students who receive special quotas for admission.

2 University

Manufacturer mean the university is regarded as a service provider university that produces graduated students. It performs the duty to transform raw materials, or entering students, into the finished products of qualified graduated students. The university will perform its duty of student Implementation and evaluation based upon National Qualifications Framework for Higher Education (MKA 1 – MKA 7) of each activity, namely, recruitment of instructors and admission of students, curriculum planning, curriculum development, provision of learning activities for student development, provision of fieldwork experience training, evaluation of learning

outcomes, and reporting of curriculum implementation results, the final outcomes of the university

3 Education Customers

Education customers mean graduate student with desirable quality from the university.

4. Consumers

The consumers mean society as the end customer or the consumer in this educational supply chain. As universities are the part of the society.

5. Data from sensors and devices

Sensors or devices help in collecting very minute data from the surrounding environment. All of this collected data can have various degrees of complexities ranging from a simple temperature monitoring sensor or a complex full video feed.

A device can have multiple sensors that can bundle together to do more than just sense things. For example, our phone is a device that has multiple sensors such as global positioning system, accelerometer, camera but our phone does not simply sense things. The most rudimentary step will always remain to pick and collect data from the surrounding environment be it a standalone sensor or multiple devices.

6.Connectivity

Collected data is sent to a cloud infrastructure but it needs a medium for transport. The sensors can be connected to the cloud through various mediums of communication and transports such as cellular networks, satellite networks, Wi-Fi, Bluetooth, wide-area networks (WAN), low power wide area network and many more. Every option we choose has some specifications and trade-offs between power consumption, range, and bandwidth. So, choosing the best connectivity option in the internet of things system is important.

7.Cloud&server

The data is collected and it gets to the cloud, the software performs processing on the acquired data. This can range from something very simple, such as checking that the temperature reading on devices such as heaters is within an acceptable range. It can sometimes also be very complex, such as identifying objects using computer vision on video.

8.User interface device

The information made available to the end-user in some way. This can achieve by triggering alarms on their phones or notifying through texts or emails. Also, a user sometimes might also have an interface through which they can actively check in on their inter of things system. For example, a user has a camera installed in his classroom or Lab. A user might have an interface that allows them to

proactively check in on the system For example, a user might want to check the video feeds on various properties via a phone app or a web browser.[1],[2],[3],[4],[5],[6][7]and[9]

4.3 Results on Evaluation of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

Table 5. Appropriateness of main components of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

ITems	\bar{X}	S.D.	Suitability
Suppliers	3.80	0.70	High
University	3.70	0.42	High
Education Customers	3.60	0.67	High
Consumers	3.70	0.84	High
Data from sensors and devices	3.60	0.48	High
.Connectivity	3.60	0.96	High
Cloud&server	3.70	0.84	High
User interface device	3.70	0.82	High
Total	3.67	0.08	High

From Table 5, it can be seen that all of the main components of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things are rated to be appropriate at the high level. The total rating mean is 3.67 and standard deviation of 0.08.

Table 6. Appropriateness of Sub-components of the Suppliers

ITems	\bar{X}	S.D.	Suitability
School	3.70	0.48	High
College	3.60	0.84	High
Family	3.60	0.69	High
State and Private Organizations	3.70	0.48	High
Total	3.65	0.62	High

From Table 6, it can be seen that suppliers component are rated to be appropriate at the high level. The total rating mean is 3.65 and standard deviation of 0.62.

Table 7. Appropriateness of Sub-components of university

ITems	\bar{X}	S.D.	Suitability
plan	3.60	0.84	High
Source	3.70	0.67	High
Make	3.60	1.17	High
Delivery	3.60	0.84	High
Total	3.62	0.88	High

From Table 7, it can be seen that the sub-component in terms of university implementation and evaluation process of is rated to be appropriate at the high level, with the rating mean of 3.62 and standard deviation of 0.88.

Table 8. Appropriateness of Sub-components of education customers

ITems	\bar{X}	S.D.	Suitability
Graduated students	3.60	0.84	High
Total	3.60	0.84	High

From Table 8, it can be seen that education customers component are rated to be appropriate at the high level. The total rating mean is 3.60 and standard deviation of 0.84.

Table 9. Appropriateness of Sub-components of consumers

ITems	\bar{X}	S.D.	Suitability
Entrepreneur	3.60	0.84	High
Total	3.60	0.84	High

From Table 9, it can be seen that consumers component are rated to be appropriate at the high level. The total rating mean is 3.60 and standard deviation of 0.84.

Table 10. Appropriateness of Sub-components of data from sensors and devices

ITems	\bar{X}	S.D.	Suitability
Data from sensors and devices	3.60	0.84	High
Total	3.60	0.84	High

From Table 10, it can be seen that data from sensors and devices component are rated to be appropriate at the high level. The total rating mean is 3.60 and standard deviation of 0.84.

Table 11. Appropriateness of Sub-components of connectivity

ITems	\bar{X}	S.D.	Suitability
Connectivity	3.80	1.22	High
Total	3.80	1.22	High

From Table 11, it can be seen that connectivity component are rated to be appropriate at the high level. The total rating mean is 3.80 and standard deviation of 1.22.

Table 12. Appropriateness of Sub-components of cloud&server

ITems	\bar{X}	S.D.	Suitability
Cloud&server	3.70	1.05	High
Total	3.70	1.05	High

From Table 12, it can be seen that cloud&server component are rated to be appropriate at the high level. The total rating mean is 3.70 and standard deviation of 1.05.

Table 13. Appropriateness of Sub-components of user interface device

ITems	\bar{X}	S.D.	Suitability
User interface device	3.60	0.51	High
Total	3.60	0.51	High

From Table 13, it can be seen that user interface device component are rated to be appropriate at the high level. The total rating mean is 3.60 and standard deviation of 0.51.

Table 14. Results of appropriateness evaluation of supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things

ITems	\bar{X}	S.D.	Suitability
Main components	3.67	0.84	High
Suppliers	3.65	0.62	High
University	3.65	0.88	High
Education Customers	3.60	0.84	High
Consumers	3.60	0.84	High
Data from sensors and devices	3.60	0.84	High
.Connectivity	3.80	1.22	High

Table 14. (Continued)

ITems	\bar{X}	S.D.	Suitability
Cloud&server	3.70	1.05	High
User interface device	3.60	0.51	High
Total	3.65	0.77	High

From Table 14, Expert agreed supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things is high appropriate, with the total rating mean of 3.65 and standard deviation of 0.77.

5. Discussion

Supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things is considered to be highly appropriate and the model design was relevant to Kaewngam, Chatwattans and Piriyasurawong [9] and the study of chansamut[2],[3],[4],[5] and [6] recommended that supply chain and information technology.

6. Conclusion

According to evaluation by ten experts consisted of three experts on supply chain , two experts on information technology and three experts on electrical engineering and two expert on curriculum supply chain model for curriculum management based on Thailand qualifications framework for higher education with the internet of things is considered to be high appropriate, that mean supply chain model could may be applie in support the tasks..

7. Recommendations

There should be case studies of higher education institutions that develop the model effectively, if any

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Reference

- [1] Chansamut, A., Piriyasurawong., P. Conceptual Framework of Supply Chain Management Information System for Curriculum Management Based on Thailand Qualifications Framework for Higher Education. International Journal of Managing Value and Supply Chains (IJMVSC) . Vol 5 No 4 , 33-45. 2014
- [2] Chansamut, A Supply Chain operation Model in Digital for Curriculum Management Based on Thailand Qualifications Framework for Higher Education. International Journal of Supply Chain Management (IJSCM). Vol 10 No 4 , 71-75. 2021.
- [3] Chansamut, A An Information System Model for Educational Management in Supply Chain According to Career standards on Thailand Qualifications Framework for Vocational Education International Journal of Supply Chain Management (IJSCM). Vol 10 No 4 , 51-55. 2021.
- [4] Chansamut, A Synthesis conceptual framework of Supply Chain Business Intelligence for Educational Management in Thai Higher Education Institutions International Journal of Supply Chain Management (IJSCM). Vol 10 No 5 , 25-31. 2021.

- [5] Chansamut, A Supply Chain Business Intelligence Model for Quality Assurance in Educational Management for ASEAN University Network Quality Assurance International Journal of Supply Chain Management (IJSCM). Vol 10 No 5 , 40-49. 2021.
- [6] Chansamut,. A. ICT System in Supply Chain Management for Research in Higher Education Institute.University of the Thai Chamber of Commerce journal humanities and social sciences. Vol 36 No 2, 112-121. 2016.
- [7] Data Flair.2022.Internet of things Tutorials. Available at <https://data-flair.training/blogs/how-iot-works/>.
- [8] He, J., Dan Lo, C-T,Xie, Y.2016. Integrating Internet of Things (IoT) into STEM undergraduate education: Case study of a modern technology infused courseware for embedded system course Available at https://www.researchgate.net/publication/311317848_Integrating_Internet_of_Things_IoT_into_STEM_undergraduate_education_Case_study_of_a_modern_technology_infused_courseware_for_embedded_system_course
- [9] Kaewngam, A., Chatwattans, P., Piriyasurawong,P , Supply Chain Management Model in Digital Quality Assurance for ASEAN University Network Quality Assurance(AUN-QA): Canadian Center of Science and Education. Vol 9 No 4, 12-20. 2019.
- [10] Kuandee,W.,Nilsook,P.,Wannapiroon,P. supply chain management process with the internet of things for good governance for higher education institutions. International Journal of the Computer, the Internet and Management. Vol 26 No 2, 72-80.2018.
- [11] Office of the National Economic and Social Development Board, Office of the National Economic and Social Development Board,2021. The Eleventh National Economic and Social Development Plan (B.E. 2017 – 2021) Available at <http://www.nesdb.go.th/Default.aspx?tabid=395>.
- [12] Office of the Commission on Higher Education.2009. National Qualifications Framework for Higher Education, Available at <http://www.mua.go.th>.
- [13] Ralhan, B D.2017. How internet of things is Tranforming. The education sector. Available at <https://inc42.com/resources/iot-transforming-education/>.
- [14] Sami Abd-Ali,R.,Abbas Radhi,S.,Ibrahim Rasool, Z. A survey: the role of the internet of things in the development of education. Indonesian Journal of Electrical Engineering and Computer Science. Vol 19 No 1, 215-221.2020.