

QUALITY FUNCTION DEPLOYMENT FOR SERVICE QUALITY IMPROVEMENT IN CO-
WORKING SPACE DESIGN



A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering in Engineering Management
(CU-Warwick)

FACULTY OF ENGINEERING

Chulalongkorn University

Academic Year 2019

Copyright of Chulalongkorn University



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

การประยุกต์ใช้เทคนิคการกระจายหน้าที่การทำงานเชิงคุณภาพสำหรับการพัฒนาคุณภาพในการ
ออกแบบพื้นที่การทำงานร่วมกัน



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
สาขาวิชาการจัดการทางวิศวกรรม ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2562
ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

Thesis Title	QUALITY FUNCTION DEPLOYMENT FOR SERVICE QUALITY IMPROVEMENT IN CO-WORKING SPACE DESIGN
By	Miss Patcharin Tanuphol
Field of Study	Engineering Management
Thesis Advisor	Professor PARAMES CHUTIMA, Ph.D.
Thesis Co Advisor	Associate Professor Chuvej Chansa-ngavej, Ph.D.

Accepted by the FACULTY OF ENGINEERING, Chulalongkorn University in Partial
Fulfillment of the Requirement for the Master of Engineering

..... Dean of the FACULTY OF ENGINEERING
(Professor SUPOT TEACHAVORASINSKUN, D.Eng.)

THESIS COMMITTEE

..... Chairman
(Associate Professor JEERAPAT NGAOPRASERTWONG)

..... Thesis Advisor
(Professor PARAMES CHUTIMA, Ph.D.)

..... Thesis Co-Advisor
(Associate Professor Chuvej Chansa-ngavej, Ph.D.)

..... External Examiner
(Associate Professor Vanchai Rijiravanich, Ph.D.)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

พัชรินทร์ ทนุผล : การประยุกต์ใช้เทคนิคการกระจายหน้าที่การทำงานเชิงคุณภาพสำหรับการพัฒนาคุณภาพในการออกแบบพื้นที่การทำงานร่วมกัน. (QUALITY FUNCTION DEPLOYMENT FOR SERVICE QUALITY IMPROVEMENT IN CO-WORKING SPACE DESIGN) อ.ที่ปรึกษาหลัก : ศ. ดร.ปารเมศ ชุตินา, อ.ที่ปรึกษาร่วม : รศ. ดร.ชอุเวช ชาญสง่าเวช

การออกแบบบริการหมายถึงการบูรณาการการศึกษา การออกแบบและการดำเนินการของระบบบริการ กิจกรรมที่เกี่ยวข้องกับการบริการถือเป็นตัวขับเคลื่อนสำคัญในการส่งเสริมความเชี่ยวชาญขององค์กรและพนักงานผ่านการประยุกต์ใช้เทคโนโลยีและข้อมูลเพื่อสร้างและส่งมอบคุณค่าต่อลูกค้าและผู้มีส่วนได้ส่วนเสีย ดังนั้นการทำความเข้าใจความต้องการเพื่อส่งมอบความพึงพอใจจึงมีความจำเป็นต่อองค์กรใด ๆ

งานวิจัยนี้มีวัตถุประสงค์เพื่ออธิบายการประยุกต์ใช้เทคนิคการกระจายหน้าที่การทำงานเชิงคุณภาพสำหรับการพัฒนาคุณภาพในการออกแบบพื้นที่การทำงานร่วมกันในหน่วยงานรัฐวิสาหกิจด้านพลังงานไฟฟ้าแห่งหนึ่งในประเทศไทย เพื่อเป็นกรอบในการออกแบบและระบุสิ่งอำนวยความสะดวกที่จำเป็นและบริการที่พึงมีในพื้นที่การทำงานร่วมกันภายในองค์กร โดยขั้นแรกของงานวิจัยได้แก่การสำรวจความต้องการของพนักงานเกี่ยวกับมุมมองและความต้องการในการใช้พื้นที่ส่วนรวมสำหรับการทำงานร่วมกัน จากนั้น นำข้อมูลตอบกลับมาสรุปและประยุกต์ร่วมกับโมเดลของคาโนและสร้างเป็นบ้านคุณภาพ ความต้องการของพนักงานจะถูกนำไปใช้ในการคำนวณค่าน้ำหนักความสำคัญของแต่ละองค์ประกอบ และสรุปผลในขั้นตอนสุดท้ายของการออกแบบการบริการ รวมถึงการเรียงลำดับความจำเป็นขององค์ประกอบใด ๆ นำเสนอเป็นการออกแบบเชิงแนวคิดสำหรับการพัฒนาพื้นที่ทำงานร่วมในองค์กร



สาขาวิชา การจัดการทางวิศวกรรม
ปีการศึกษา 2562

ลายมือชื่อนิสิต
ลายมือชื่อ อ.ที่ปรึกษาหลัก
ลายมือชื่อ อ.ที่ปรึกษาร่วม

5971230921 : MAJOR ENGINEERING MANAGEMENT

KEYWORD: Quality Function Deployment, Service Design

Patcharin Tanuphol : QUALITY FUNCTION DEPLOYMENT FOR SERVICE QUALITY IMPROVEMENT IN CO-WORKING SPACE DESIGN. Advisor: Prof. PARAMES CHUTIMA, Ph.D. Co-advisor: Assoc. Prof. Chuvej Chansa-ngavej, Ph.D.

Service is defined as the integration of the study, design and execution of service systems. Furthermore, the service-related activities are significant drivers in encouraging organization's expertise as well as bringing together the mesh of organization, people, technologies and information in order to create value both to and with customers and stakeholders. Therefore, it is necessary for any organizations to understand the needs and provide satisfaction. This research aims to describe the application of quality function deployment for service quality improvement in co-working space design in an organization. The expected outcome of the research is the design framework which strategically specifies the required facilities and recommended services in the co-working space. The researched organization in this research study is the power utility state enterprise in Thailand. First, to identify the employee requirement, the online questionnaire is conducted asking the employees about their perspective on having the co-working space in their organization and what elements to be provided. Then, the combination of kano model and the quality function deployment principle is conducted using the house of quality. The preference of each employee requirement is translated into importance weight, as well as the relationship matrix, described in the house of quality. Next, the technical requirements are separated into four categories according to the kano model of customer satisfaction following by the specification of k-value and importance weight. Finally, the adjusted importance weight is calculated by multiplying the k-value with original importance weight. At the end of the research, the design of service and the ranking of element's necessity are summarized and introduced as a conceptual design for the development of co-working space in the organization.

Field of Study:	Engineering Management	Student's Signature
Academic Year:	2019	Advisor's Signature
		Co-advisor's Signature

ACKNOWLEDGEMENTS

The accomplishment of this research project could be contributed to several people. First of all, I would like to express gratefulness to my advisor and co-advisor, Prof. Parames Chutima, Ph.D. and Assoc. Prof. Chuvej Chansa-ngavej, Ph.D. for their support and guidance throughout the research study.

Secondly, I would like to express my gratitude to the chairman of the committee, Assoc. Prof. Jeerapat Ngaoprasertwong and the external examiner, Assoc. Prof. Vanchai Rijiravanich, Ph.D. for their great valuable advice during the stage of proposal and final thesis examination.

Thirdly, I would like to express my gratefulness to the researched organization, Electricity Generating Authority of Thailand or EGAT, and EGAT staffs for their assistance and supports on the insight information about the organization and its employees as well as library statistics.

Fourthly, I would like to express thankfulness to my colleague, Miss Nicharee Chatchavalkijkul, for her great support and advice in architectural concerns and designs.

Lastly, I would like to thank my parents, family, friends and all others who encouraged and guided me throughout this research.

Patcharin Tanuphol

TABLE OF CONTENTS

	Page
.....	iii
ABSTRACT (THAI).....	iii
.....	iv
ABSTRACT (ENGLISH).....	iv
ACKNOWLEDGEMENTS.....	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
Chapter 1 Introduction.....	1
1.1 Broad view of the general research area.....	1
1.2 Explanation of how the research fits into this broad area.....	2
1.2.1 Recent trends and strategic reactions.....	2
1.2.2 About the organization.....	3
1.3 The statement of the problem, research question, hypothesis, specific objectives of the research, scope of the research and expected outcomes and benefits.....	5
1.3.1 Statement of the problem.....	5
1.3.2 Research question.....	5
1.3.3 Research hypothesis.....	5
1.3.4 Specific objectives of the research.....	5
1.3.5 Scope of the research.....	6
1.3.6 Expected outcomes and benefits.....	6

Chapter 2 Review of Literature.....	7
2.1 Overview of the researched organization.....	7
2.1.1 Competitive business position.....	9
2.1.2 EGAT’s demographics.....	10
2.1.3 EGAT business.....	12
2.2 Importance of good infrastructure in a workplace.....	12
2.3 The co-working space in an organization.....	13
2.3.1 PEA innovation hub co-working space.....	13
2.3.2 BOT learning centre.....	14
2.3.3 Chula Engineering library.....	15
2.3.4 Krungthai bank.....	15
2.4 The customer journey maps.....	16
2.5 The Kano model.....	16
2.6 The quality function deployment (QFD).....	20
2.7 The quality function deployment applied in service design.....	21
2.7.1 Quality function deployment in design improvement.....	21
2.7.2 Quality function deployment in housing design.....	23
Chapter 3 A Justification of the Research Methods Used.....	24
3.1 Research subject.....	24
3.2 Research methods.....	24
3.3 Data collection.....	24
3.4 Phases of the research study.....	25
3.4.1 Background information and statistical facts.....	25
3.4.2 Strategy and concepts definition.....	29

3.4.3 Application of kano model with quality function deployment (QFD) principle in co-working space design.....	29
3.4.4 Conceptual design.....	33
Chapter 4 Results	35
4.1 Voice of customer	35
4.2 Customer requirements.....	37
4.3 Technical requirements.....	38
4.3.1 Kano model.....	38
4.4 House of quality.....	41
4.5 Conceptual design.....	43
4.5.1 Facility	44
4.5.2 Service	47
Chapter 5 Analysis.....	49
Chapter 6 Discussion.....	52
Chapter 7 Conclusions.....	56
7.1 Conclusion of the research.....	56
7.2 Future work.....	58
REFERENCES	60
Appendix A.....	64
Appendix B.....	73
VITA.....	82

LIST OF TABLES

	Page
Table 1 EGAT's SWOT analysis.....	9
Table 2 Summary of EGAT's demographics (EGAT HR, 2019).....	11
Table 3 Evaluation table of customer requirement (Tontini, 2000).....	19
Table 4 Evaluation table of customer requirement (Tontini, 2000).....	31
Table 5 House of quality template.....	33
Table 6 Demographic characteristic of respondents.....	35
Table 7 Customer requirements (What's).....	37
Table 8 Technical requirements (How's).....	38
Table 9 Evaluation table of customer requirements (Tontini, 2000).....	39
Table 10 Kano category per technical requirement.....	40
Table 11 Kano category per technical requirement and the k-value.....	41
Table 12 House of quality for co-working space design.....	42
Table 13 House of quality for co-working space design.....	43
Table 14 Prioritization of required components in the co-working space.....	43
Table 15 The importance of each room type.....	44
Table 16 The importance of each room type.....	50
Table 17 Prioritization of required components in the co-working space.....	50
Table 18 Prioritization of required components in the co-working space.....	53
Table 19 The importance of each room type.....	54

LIST OF FIGURES

	Page
Figure 1 EGAT's organizational chart (EGAT, 2018).....	4
Figure 2 Thailand structural flow of electric power.....	8
Figure 3 EGAT's strategic map (EGAT, 2017).....	9
Figure 4 EGAT's demographics (in percentage) (EGAT HR, 2019)	10
Figure 5 EGAT's demographics (in number) (EGAT HR, 2019)	11
Figure 6 PEA innovation hub co-working space (PEA Innovation Hub, 2019)	14
Figure 7 BOT learning center (Leelavansuk, 2018)	14
Figure 8 Chula Engineering library	15
Figure 9 Krungthai bank (Money & Banking Online, 2019)	15
Figure 10 The customer journey map structure (Richardson, 2010).....	16
Figure 11 Two-dimensional recognition of quality (Kano, n.d.)	17
Figure 12 Kano model diagram (Qiting et al, 2013).....	17
Figure 13 Kano model diagram (Qiting et al, 2013).....	19
Figure 14 The House of Quality Structure (Sharma, 2012; Govers, 1996).....	20
Figure 15 EGAT library floor plan	25
Figure 16 EGAT library visitors per day.....	26
Figure 17 Customer journey map	27
Figure 18 Purpose of library use	27
Figure 19 The QFD principle	30
Figure 20 The house of quality structure (Govers, 1996).....	32
Figure 21 Employee satisfaction on their current office	36

Figure 22 Employee satisfaction on having a co-working space in the organization .. 36

Figure 23 Suggested co-working space open hours 47

Figure 24 Advantages of having co-working space in the organization..... 49

Figure 25 Purpose of library use 54



Chapter 1 Introduction

This chapter represents the introduction to the research project including the needs for establishing the research project, its significance of research area, background of the organization and division in this research and the overview of a research's problem statement together with the hypothesis development, research objective, scope of study, assumption of the research, and expected outcomes.

1.1 Broad view of the general research area

The service science and service-related activities are significant drivers in encouraging organization's expertise as well as bringing together the mesh of organization, people, technologies and information in order to create value both to and with customers and stakeholders. The term service science is described as the integration of the study, design and execution of service systems. (Huo and Hong, 2013) In the era of complex business where high competition is recognized across every industry, challenge founded in any organizations is to survive in this fast-growing world and jump into the service economy. Since the service systems are initiated from the change of people's mind and the shift in people's behaviour, it is essential for the organization to understand the needs of customers as well as to efficiently provide satisfaction. Hence, service management and design are not the new theory that would replace the existing managerial theory and conventional operation process. They are the additional key methodology in strengthening organization's competitiveness in this complicated business environment.

The service systems and activities could be done by the improvement of backstage processes including the application of technologies coupling with supportive facilities. In addition, the enhancement of the value propositions and relationships among listed stakeholders; clients, suppliers, partners and employees are also concerned. (Hefley and Murphy, 2008) It could not be denied that the service is all about dealing with people physically and mentally. Since all the activities operated in the organization involve people and people are parts of the service, every business is in a service.

Some experts have said that the disruptive era has completely done but such innovations and technologies would still rapidly grow with the speed which no one has

expected. The application of artificial intelligence with the big data analytics will lead to the real-time flow of information within and among the supply chains. Moreover, new working trends including mobility and flexibility of working and worldwide connection also influence on the future environment. Furthermore, ratio of generations in the workforce market is shifting as generation-z entering to the market. This leads to the changes in nature of entry-level jobs. Design thinking and critical thinking will become the key successes in this circumstance as well as the true understanding of human's behaviours via the analysis of customer's journeys. As a result, the organization has to foresee the emerging trends, provide proper strategies and build skills for the future which will further encourage the multi-tasking of employees. As being an organization, one of the stakeholders is the internal employees who either work for or gain experiences from the organization. So, any organization or corporations must boost the innovation culture through research, workshop and experiment projects as well as collaboration within a team in order to create valuable experiences. (PMAT, 2018)

1.2 Explanation of how the research fits into this broad area

This research project contributes to the service science through the application covering the perspectives of service management, service design and support technologies as well as individuals' performance in a state power utility organization in order to strategically address its encountering challenges caused from the disruptive technologies and trends in new way of working as well as the shift in human behaviours. It is expected that the outcomes of the research would be useful and valuable for all involved parties in this era of service economy.

1.2.1 Recent trends and strategic reactions

In any corporations, employees need to have a life-long learning since education supports the personal development. Nowadays, the authority has to continuously promote the knowledge sharing between groups of employees as well as to take advantages from new emerging technologies and to put more effort in individual's needs and interests. (CTDM, 2015) In addition, five trends that shape the future work environment are listed as (1) new behaviours shaped from social media, (2) the arising of disruptive technologies, (3) the increase in millennial workforce who introduce the new way of working, (4) the mobility to work anytime, anywhere on any devices and (5) the worldwide connection lead to the change in working environment. (Morgan, 2018) From such reasons and trends, some of the existing authorities have adapted

themselves to these new things through the implementation of quality services and products that will satisfy their stakeholders.

In the business perspective, customer could be divided into two types listed as an internal and an external customer. External customer is defined as the people who purchase company's products or services. In contrast, internal customer is those who have relationship with the organization, for example, owners and employees. Although the internal customer is not the one who pays for the organization, they deliver other kinds of benefits. (Kidd, 2018) Neither external nor internal customers should be left behind, they should be paid attention to.

1.2.2 About the organization

The researched organization is a Thailand's leading state enterprise in power utility, known as EGAT which stands for Electricity Generating Authority of Thailand, established in 1969, under the administration of Ministry of Energy with the Ministry of Finance as the major shareholders. Located near Chao Phraya River next to Rama VII Bridge, the authority is responsible for electric power generation, acquirement and transmission across Thailand. The authority has its headquarter in Nonthaburi and many other country-wide operating sites including transmission system operation offices and power plants. The organization generates electricity power using coal, natural gas, diesel, fuel oil and other renewable sources including hydro, solar and wind power. In addition, the organization is also responsible for electricity-related businesses in forms of by-products and services through the subsidiary firms known as EGAT Group. (EGAT, 2017) Over fifty years, EGAT has been alongside with Thai society in maintaining electricity security system, developing innovations, driving economy and improving quality of life for the people of Thailand.

According to the vision of "Innovate Power Solutions for a Better Life" and the mission of "Be the country's main organization to secure the power reliability and enhance competitiveness of the nation through innovation for Thai happiness," the organization sees the application of technology and innovations as well as the utilization of research and development programs as necessity. (EGAT, 2018)

EGAT organizational chart is shown in figure 1. The organization is governed by one governor and consists of eight functional deputies with the total employees of 18,908 across the country.

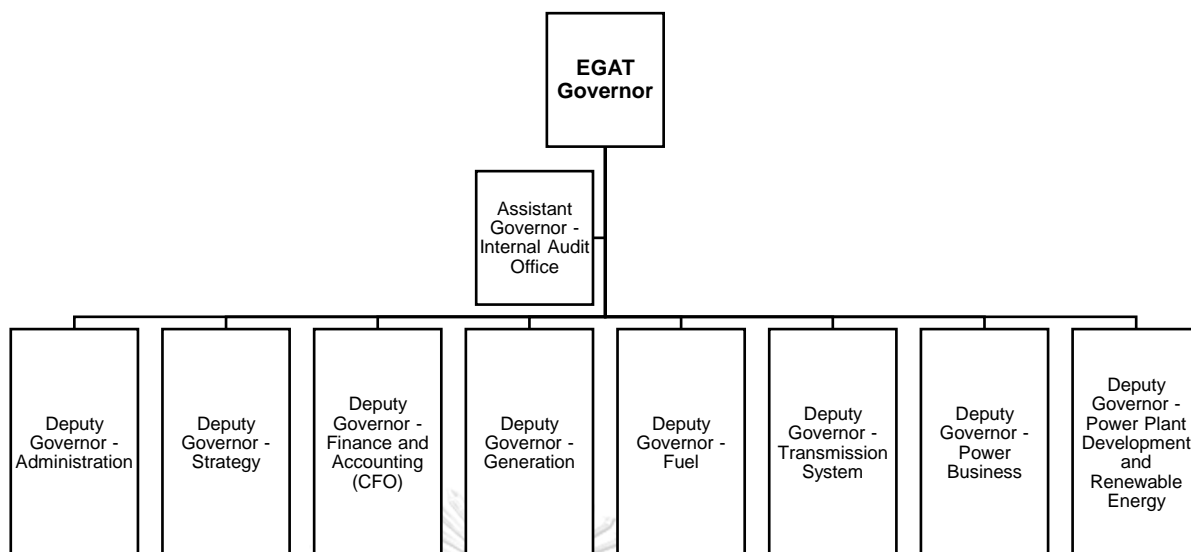


FIGURE 1 EGAT'S ORGANIZATIONAL CHART (EGAT, 2018)

It could be said that EGAT is one of the large organizations operated in Thailand. With this huge number of employees and a lot of departments located across the country, EGAT's working process is not as flexible and agile as it should be due to the complex hierarchies. This, sometimes, leads to the low capability and delayed response of the authority in handling the recent emerging trends.

Roles of EGAT has been disrupted during the past years due to the arising of new digital technologies, platforms and automation systems as well as the new workers' experiences. Since there are a lot of new technologies that are being applied in generating and supplying electricity nowadays, EGAT who is familiar with conventional plant and distributing sub-stations has to speed up itself to cope with the business environmental changes. Despite the fact that the raise of the new technologies will surely impact the EGAT's traditional operations, it comes with business opportunities. Thus, this is one of the challenges for the authority to provide the supportive programs purposing to strengthen employees' performance and widen employees' skill in order to capture arising opportunities. The co-creation is applied by the divisions allowing all the stakeholders to involve in driving the organization towards business goal. Good service quality turns into one of the significant keys in fulfilling both organization's and employees' capabilities. The process reflects the customer-oriented mindset of the whole organization.

1.3 The statement of the problem, research question, hypothesis, specific objectives of the research, scope of the research and expected outcomes and benefits

1.3.1 Statement of the problem

Most organizations are strengthening their competitiveness by focusing on providing good working facilities that fit to employee's needs aiming at offering good experiences to the users. The new form of work organization which enables collaboration opportunities and brings together employees from different background as well as encourages a sense of community is highlighted. (Leclercq-Vandelannoitte *et al*, 2016) Even EGAT's performance is on the top rank among all the state enterprises, continuous improvement is also taken in account aiming at promoting electrical sustainability of the country. It is opportunity for the organization to optimize available resources, build engagement and bring out employees' potentials in creating valuable outcomes for the business together. At the same time, the organization could also provide its valuable employees a motivative working atmosphere, supportive technology and well-designed backend operation. This comes in a form of a corporate co-working space or a co-working space within the organization.

1.3.2 Research question

This research sets out to answer the following research question: "What facilities should be provided in co-working space in a state enterprise, EGAT, and what are the recommended services in order to strategically fit to the employee's needs and the emerging trends?"

1.3.3 Research hypothesis

To underpin the above question, the hypothesis is developed as "the design of co-working space service quality is successfully improved accordingly to the employee's requirements and meet their expectations through the renovation of the available area in the organization.

1.3.4 Specific objectives of the research

The objective of this research is to identify a strategic guidance for service quality improvement of the existing library through the establishment of co-working space by providing the recommended conceptual design and services.

1.3.5 Scope of the research

This research project focuses on the service quality improvement in co-working space design in one of the state enterprises, EGAT. The research involves the introduction of infrastructure and operation management according to the voice of customer which would further lead to better service quality.

1.3.6 Expected outcomes and benefits

The followings are the summary of the expected outcomes and benefits:

- The understanding of employee's needs.
- The recommended design for co-working space within the organization.
- The effective strategy in offering quality services.



Chapter 2 Review of Literature

This chapter represents existing literatures covering various topics, including (1) Overview of the researched organization, (2) Importance of Good Infrastructure in a Workplace, (3) The Co-Working Space in an Organization, (4) The Customer Journey Maps, (5) The Kano's Method, (6) The Quality Function Deployment (QFD), and (7) The Quality Function Deployment Applied in Service Design.

2.1 Overview of the researched organization

Electricity Generation Authority of Thailand or EGAT is a Thailand state enterprise under the Ministry of Energy and the Ministry of Finance. Having been established since 1969, EGAT has been one of the biggest power producers in the country. EGAT generates and distributes electricity to the distributors which are Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA.) The total of fifty electricity generating plants including three thermal power plants, six combined cycle power plants, four diesel power plants, twenty-seven hydropower plants, nine renewable energy power plants and one other power plant country-wide have the total production capacity around 15,789.58 MW. Aside from power plants, EGAT also owns and operates the high voltage transmission lines across the country. Throughout past years, the authority has paid attention to new electrical technology including the transmission management system, renewable energy data management model, battery energy storage system and other essential tools. (EGAT, 2018)

Governed under the Enhanced Single Buyer (ESB) model of Thailand's electricity supply industry, EGAT has been the only buyer in the country who purchases bulk electricity from domestic private power producers and from neighbouring countries, then, sells a whole lot of electric energy to two national distributing authorities (PEA and MEA) and small direct industrial customers, as well as the power utilities in neighbouring countries. (EGAT, 2013) Figure 2 simplifies the structural flow of electric power in Thailand.

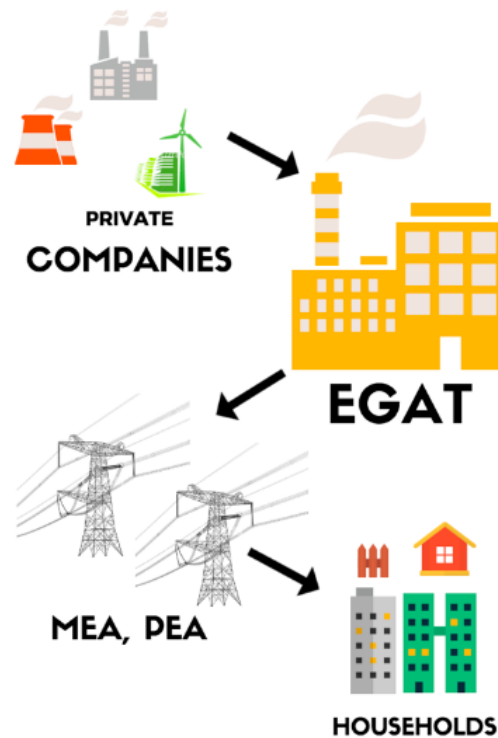


FIGURE 2 THAILAND STRUCTURAL FLOW OF ELECTRIC POWER

Not only the electric generating, which is the core business, but EGAT also runs the service businesses related to electric industry including operation and maintenance for private segments, engineering and power plant construction, and coal mining. Furthermore, the specialist and professional organizations, under the name of EGAT Group, were established to support the growth in energy-related businesses both in Thailand and in neighbourhood countries. (EGAT, 2013) The EGAT's affiliates are listed as Ratchaburi Electricity Generating Holding Public Company Limited (RATCH), EGAT International Company Limited (EGATi), EGAT Diamond Service Company Limited (EDS), Electricity Generating Public Company Limited (EGCO) and District Cooling System and Power Plant Company Limited (DCAP.) (EGAT, 2018)

To become the leader in electric industry, EGAT considers four development dimensions which are E: Electricity Innovation, G: Growth for Sustainability, A: Administration Excellence and T: Trust and Pride of the Nation with the five supportive core values listed as S: Sense of Belonging, P: Performance Excellence, E: Ethic and Integrity, E: Enthusiasm for Innovation and D: Devotion to Society as illustrated in figure 3. These aspects must be aligned towards the vision of the organization which is to innovate power solutions for a better life.

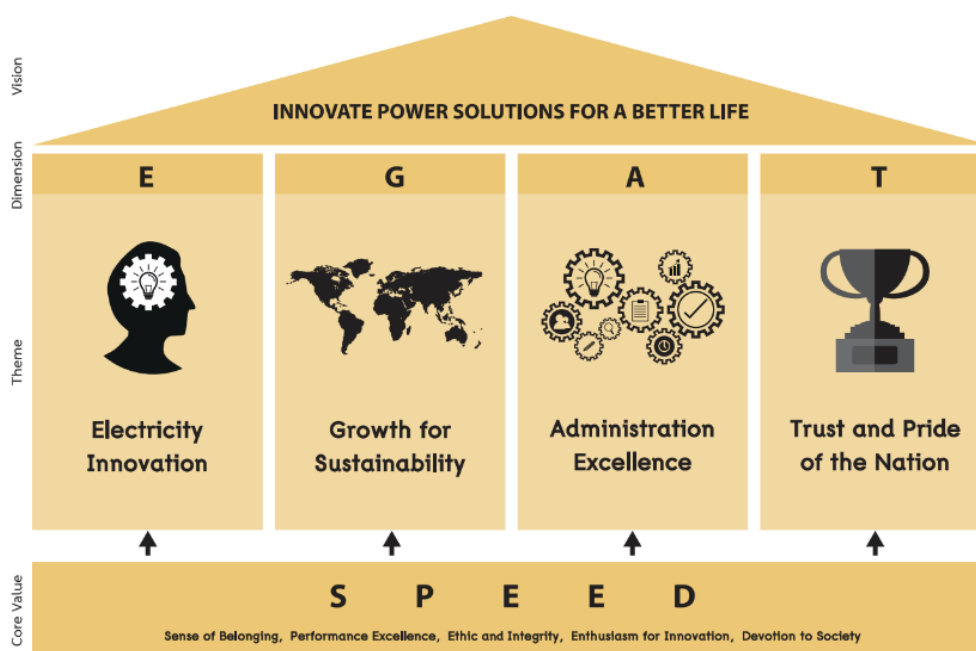


FIGURE 3 EGAT'S STRATEGIC MAP (EGAT, 2017)

In order to efficiently cope with the changes and effectively support future mission, all EGAT employees strongly respond to the vision, strategy and the core values.

2.1.1 Competitive business position

External and internal factors impacting on the EGAT's operation are described using the SWOT Analysis in table 1. As a result, from all factors, the organization has to adapt itself by providing new products or better services in order to create sustainability.

Table 1 EGAT's SWOT analysis

S - Strength	W - Weakness
<ul style="list-style-type: none"> ▪ Well-recognized knowledge and experiences ▪ High-skill employees from various background ▪ Knowledge management is available to collect useful knowledge and knowhow ▪ More young-generation employees are recruited into the organization ▪ Own a lot of assets including power plants and transmission systems country wide 	<ul style="list-style-type: none"> ▪ Employee generation gap leads to some conflicts within and across divisions ▪ Complicated bureaucratic working process ▪ Out-of-date internal policies and regulations ▪ Less collaboration among internal employees ▪ No clear policy and strategy are cascaded ▪ High operational expenditure ▪ Slow response to upcoming trends and technology

O - Opportunity	T - Threat
<ul style="list-style-type: none"> ▪ The emerging trend in electrification in which electric power is being used as the main source of energy ▪ The regional energy cooperation ▪ EGAT is responsible for national power sustainability according to the PDP2018 ▪ Government policy in free energy trading ▪ The application of digital transformation, IoT and big data analytic in energy sector ▪ Well-recognized organization which other external authorities want to partner with ▪ The shift in human's behaviours and the emerging of new working trends 	<ul style="list-style-type: none"> ▪ The promotion of renewable energy, solar rooftop and the expansion of other independent power suppliers ▪ External environmental changes impact on the current operation and working atmosphere ▪ Government policy in free energy trading ▪ More high potential power producers are entering to the industry ▪ Bad perceptions from some local communities

2.1.2 EGAT's demographics

By the end of 2019, after the retirement period, EGAT's number of employees would decrease to become 18,908 in total. Figure 4, figure 5 and table 2 show the summary of EGAT's staffs divided by categories separately. About 44% of the total amount are the employees who have location base in the headquarter in Nonthaburi province. While the other 56% are working in various power plants and sites across Thailand as well as in Laos PDR and other countries. In term of employees' age, the majority of the EGAT's staff are generation Y at the percentage of 40%. In contrast, the lowest number of employees is generation Z at the rate of 3%. However, the generation-z is significantly increase as they are hired into the organization while the baby-boomer are getting retired from the organization.



FIGURE 4 EGAT'S DEMOGRAPHICS (IN PERCENTAGE) (EGAT HR, 2019)

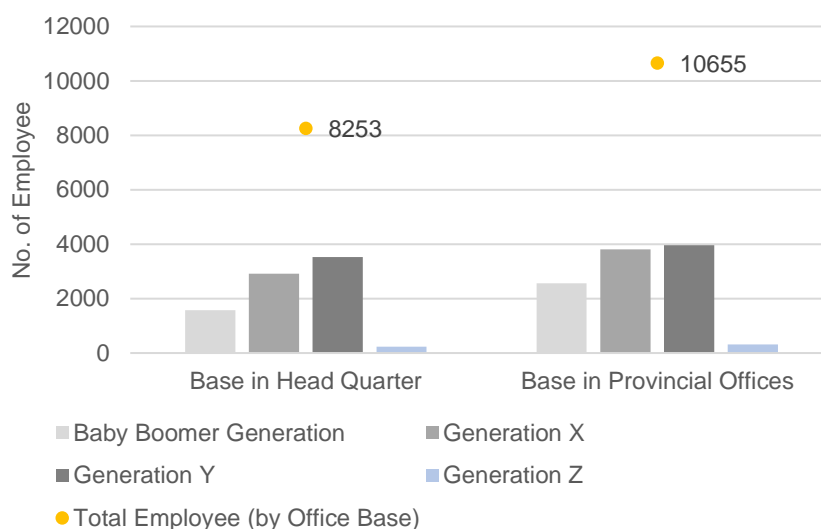


FIGURE 5 EGAT'S DEMOGRAPHICS (IN NUMBER) (EGAT HR, 2019)

Table 2 Summary of EGAT's demographics (EGAT HR, 2019)

	In headquarter	In provincial offices	Total employee (by Generation)
Baby boomer generation	1,573	2,563	4,136
Generation X	2,913	3,814	6,727
Generation Y	3,528	3,964	7,492
Generation Z	239	314	553
Total employee (by office base)	8,253	10,655	18,908

Considering the portion of current employees, the data of employee by age are disclosed. The employees in the authority could be separated into four groups accordingly to their year of birth listed as the baby boomer generation, the generation-x, the generation-y and the generation-z who were born from 1946 to 1963, 1964 to 1978, 1979 to 1993 and 1994 to present, respectively. Within the next five years, almost all the baby boomer, which is accounted to be one-third of the total employees, would all get retired. The ratio of other three generations are assumed to be equally distributed. (EGAT HR, 2019)

2.1.3 EGAT business

EGAT's core business could be found in three main operations. The first one is electricity generation. There are fifty power plants located country-wide generating electricity into system. The fuel consumption is varied depended on potential of resources in each location. The second one is electricity purchase. Currently, EGAT owns the total power capacity around 43,372.50 MW consisting of 15,789.58 MW from EGAT's power plants and the left over from independent power producers (IPPs), small power producers (SPPs) and imported power. The last core business is electricity transmission. Transmission lines with different voltages listed as 500kV, 230kV, 132 kV, 115 kV and 69 kV belong to EGAT. The lines are used in distributing electric power to distributors, MEA and PEA, and retail customers as well as power utilities of neighbouring countries.

In addition, EGAT also provides related services such as power plant engineering and construction, operation and maintenance service, telecommunication service and academic service both in Thailand and in ASEAN. (EGAT, 2018)

2.2 Importance of good infrastructure in a workplace

In the working age, office is the place where employees spend almost 50% of the daily time at. The traditional office atmosphere which has four-walled infrastructure is founded to be old fashioned. A lot of global company and start-ups like Google and Facebook have significantly emphasized the design of infrastructure by focusing on the needs and requirements of its staffs. The companies consider the influence of infrastructure on their employees. Good infrastructure helps reducing employee's stress and boosting the work productivity. In addition, the introduction of employee-friendly comfortable stuff and furniture helps promoting more creativity comparing to the traditional ones. The consequence results of the mentioned advantages of good infrastructure include the more profitability of the business and the guarantee of happy workplace. By taking ergonomics into consideration, the infrastructure and surroundings must be designed to fit with everyone's needs. The application of colourful wallpaper encourages the better creativity and intention to work with high morale. To sum up, the good infrastructure plays an important role in satisfying employees who are the most valuable assets of the company. (Singh, 2018)

2.3 The co-working space in an organization

Co-working space was first established in 2005 in the United States from the changes in population in the workforce market and the shift in human behaviours. The young generations value personal experiences than working steadily in an inflexible environment. In addition, they have an attitude that performance is evaluated from the results of work instead of the total hours spent in the office. As a result, they can work wherever they want as long as the place is internet accessible. Most co-working space has the uniqueness in being a sharing space which gathers a number of creative ideas allowing people to create connection and have interpersonal activities. (Laksanasamrith, 2018) There are a lot of co-working founded in Bangkok such as NapLab, HUBBA Thailand, Too Fast To Sleep, Glowfish, Open House and a lot more places either organized by public or private sectors.

In the current environment, the workplace is neither the general office nor intellectual production. It has become more functional and productive as well as encouraged socialization and people's interaction. In the disruptive era, office layouts have to be changed in order to transform traditional organizational culture into innovative culture which promotes collaborative work. Not only in a form of open-plan offices, but the authority also needs to have a space for idea-sharing, community building and collaborating. Although the term "co-working" was initially applied as a shared area for any freelancers, it could be used by any organizations in order to boost creativity and innovation. It could not be denied that interactions, impromptu meetings and informal chats between groups of people are the key factors behind the successful innovation, the organizations have to provide the proper encouraging working environment. (Fuzi *et al*, 2014)

2.3.1 PEA innovation hub co-working space

PEA Innovation Hub Co-Working Space is the co-working space owned by Provincial Electricity Authority or PEA. (PEA Innovation Hub, 2019) The authority is responsible for distributing electric power to 74 provinces, except Bangkok, Nonthaburi and Samutprakarn which belong to the Metropolitan Electricity Authority (MEA). Its mission is to standardize electricity services and related business in order to satisfy customers and develop quality of life through the continuous corporate development and innovation. As the organization aims to modernize itself using digital technology and innovations, it promotes and creates research and development of innovations within the organization covering the main business and related ones.

One of the methods is to create innovation via knowledge management and innovation management processes. Furthermore, the PEA Think Tank project is introduced in order to offer a space encouraging the exchange of knowledge. (PEA, 2017) In 2019, PEA opens the new workspace called PEA Innovation Hub Co-Working Space located at the headquarter in Bangkok, shown in figure 6. Moreover, the authority also organizes the innovation bootcamp for its employees aiming at igniting the internal innovators to create the idea of promoting the organization to become a digital utility. (PEA Innovationhub, 2019)

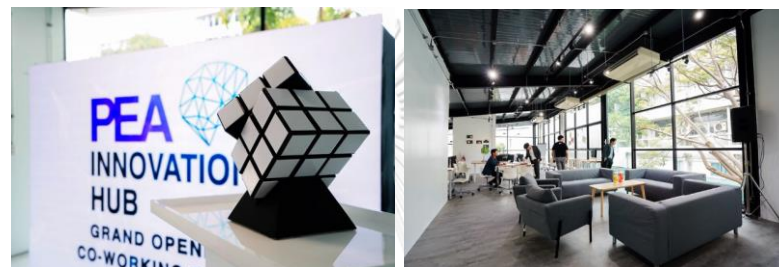


FIGURE 6 PEA INNOVATION HUB CO-WORKING SPACE (PEA INNOVATION HUB, 2019)

2.3.2 BOT learning centre

BOT learning centre is the co-working space owned by Bank of Thailand (BOT). According to BOT's management levels, Bank of Thailand had done the feasibility study prior to the establishment of this learning centre. Finally, the bank decided to renovate the area within its headquarter to become a learning centre providing services to everyone where customers can use co-working space and meeting rooms, visit the museum and study in the library. (Leelavansuk, 2018) Some of the atmospheres are shown in figure 7.

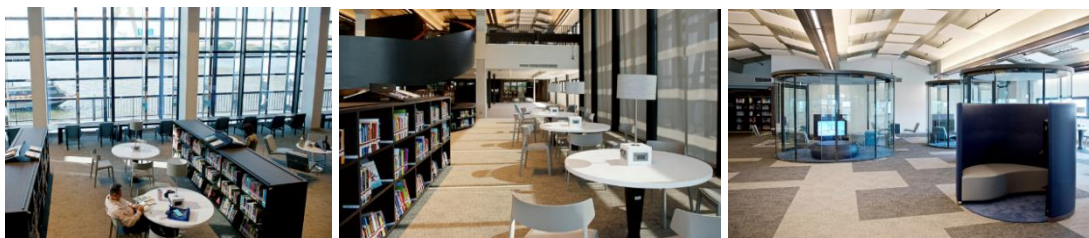


FIGURE 7 BOT LEARNING CENTER (LEELAVANSUK, 2018)

2.3.3 Chula Engineering library

Chula Engineering library was renovated few years ago in order to provide that meet the requirements of customers. It provides various services including E-Books, books, various types of study spaces and seats, room reservations and updated news to faculty members, staffs and students. (Chula Engineering Library, 2018) Figure 8 illustrates the atmosphere within the library.



FIGURE 8 CHULA ENGINEERING LIBRARY

2.3.4 Krungthai bank

Krungthai bank is one of the banks in Thailand that has adjusted itself to cope with the global changes. Currently, the bank puts its focus on ‘customer experience’ via the application of financial technology, the modernization and the business professional. Bank’s five branches, settled in ICONSIAM, Singha Complex, ThaiBev, Thammasat University – Rangsit Campus and Burapha University, have been renovated in attempt to serve their customers good experiences. These branches are promoted through different themes depending on customer’s lifestyle in the area. Furthermore, the bank has planned to introduce two new branches in Siriraj Hospital and Metropolitan Electricity Authority – Ploenchit. However, the shared concept is to connect people as the bank offers free WI-FI and co-working space within its area as illustrated in figure 9. (Money & Banking Online, 2019)



FIGURE 9 KRUNGTHAI BANK (MONEY & BANKING ONLINE, 2019)

2.4 The customer journey maps

A customer journey map is the diagram used in describing the steps an individual customer goes through in associating with the business or organization. The map would be more complicated as there are more touchpoints. As a result, the map is also known as customer-company interaction. Components appear on the map include the timeline, actions, motivations, questions, and barriers as illustrated in figure 10. (Richardson, 2010)

Actions: What do the customers do at each process?

Motivations: Why are the customers motivated to keep going to the next stage in the timeline?



Questions: Lists of the uncertainties as well as how to prevent losing existing customers.

Barriers: What are the barriers obstructing the customer's path to the next process?

FIGURE 10 THE CUSTOMER JOURNEY MAP STRUCTURE (RICHARDSON, 2010)

2.5 The Kano model

The theory of attractive quality in describing the relationship between subjective aspect and objective aspect was proposed by Kano and the team. The subjective aspect of quality focuses on how people think, feel and sense. All these perceptions are described and separated into three level listed as satisfied, neutral and dissatisfied. Whereas, the objective aspect of quality reflects the quality of a thing. This physical state is expressed as sufficient and insufficient. The cross of these two aspects leads to the development of the recognition of quality which is shown in figure 11. (Kano, n.d.)

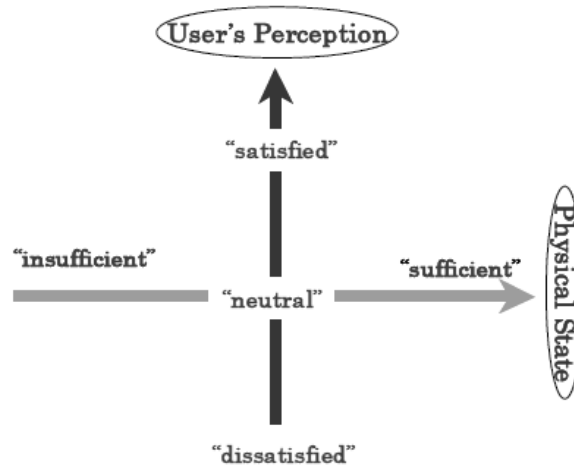


FIGURE 11 TWO-DIMENSIONAL RECOGNITION OF QUALITY (KANO, N.D.)

The kano model was developed by Mr. Noriaki Kano in 1984. The model aims to reveal the relationship between customer requirements and customer satisfaction. (Qiting *et al*, 2013) Because of the customer satisfaction level turns out to be one of the factors effecting on business operation and competitiveness, it is very important for the business owner to determine what product or service's features satisfy its customer the most. Kano model helps identifying attractive, must-be and one-dimensional features to meet customer requirements, as illustrated in figure 12, but not the degree of satisfaction or dissatisfaction. (Tontini, 2000)

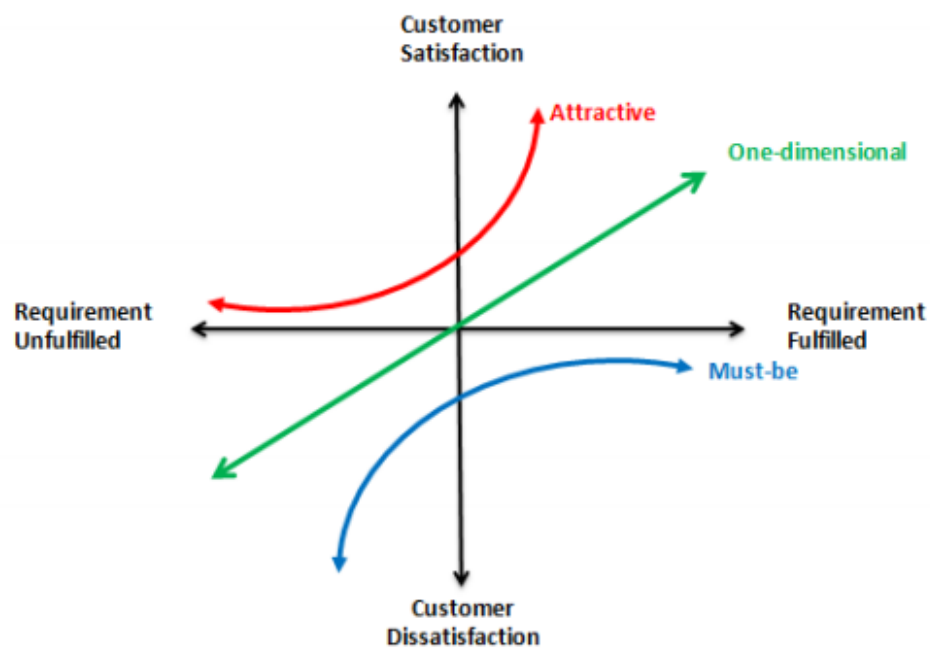


FIGURE 12 KANO MODEL DIAGRAM (QITING ET AL, 2013)

Three types of requirements are explained by Tontini (2000) according to kano model listed as:

- Must-be requirements: the basic criteria of a product or a service. Customer would dissatisfy if they are not fulfilled. However, its existing does not bring satisfaction to the customer. The requirements are rarely demanded explicitly.
- One-dimensional requirements: Regarding these requirements, the more level of fulfilment of a product or a service directly relates to the higher customer satisfaction. So, the requirements need to be significantly highlighted in the product or service design process. Furthermore, the requirements are usually demanded explicitly by the customer.
- Attractive requirements: If these requirements are fulfilled, they exponentially satisfy the customer. On the other hand, the customer would not dissatisfy if they are not existed. They are neither explicitly asked for nor expected by the customer.

In 2013, Qiting and his colleagues had described the advantages of kano model. First, the model takes a role in prioritizing all available requirements in product and service development. The must-be requirements have the highest priority, while, the attractive requirements are the lowest priority to consider. Second, the model is applied in the analysis of customer needs and satisfaction which encourages the better understanding of each requirement. This further leads to effective market segmentation. Last, the model supports the design trade-off process resulted from known constraints.

The Kano's methodology starts with a questionnaire surveying targeted customer about their perspective on a product or a service. Questions are positively asked. (Qiting *et al*, 2013) Recommended questions include asking "what customer feels" and "what customer would like" about the provided product or service. The customer has to choose one of the following answers: satisfied, in should be that way (must-be), indifferent, dissatisfied and other. (Tontini, 2000) The necessity of having "other" as one of the choices is to guarantee the reliability of the questionnaire. If "other" is answered more than 10%, the questionnaire is unbelievable. The survey result is confident when the percentage of people choosing "other" is less than 1%. (Kano, n.d.) Moreover, it is not recommended to use the negative words such as "not" or "do not." In addition, features must be clearly defined in order to avoid customer's

misunderstanding. (Tontini, 2000) Then, the answers would be translated into Kano's methodology as shown in table 3 and figure 13.

Table 3 Evaluation table of customer requirement (Tontini, 2000)

Insufficiency \ Sufficiency	Satisfied	Must-be	Indifferent	Dissatisfied	Other
Satisfied	Q	A	A	O	Q
Must-be	Q	Q	N	M	Q
Indifferent	N	N	N	M	Q
Dissatisfied	R	R	R	Q	Q
Other	Q	Q	Q	Q	Q

Customer requirements:

A: Attractive, O: One-dimensional, M: Must-be, N: Indifferent, R: Reversal and Q: Questionable result

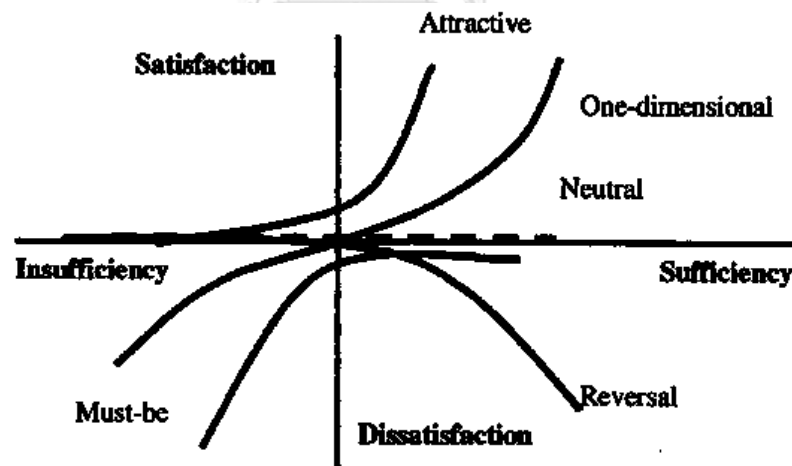


FIGURE 13 KANO MODEL DIAGRAM (QITING ET AL, 2013)

The priority of each requirement, according to Kano's methodology, is listed as must-be, one-dimensional, attractive and indifferent, respectively. (Kano, n.d.)

2.6 The quality function deployment (QFD)

The quality function deployment or QFD is described as a process which has essential characteristics listed as: (1) customer oriented, (2) team approach, (3) concise structuring communications and (4) connecting information. It encourages designers and managers the conceptualization, creation and realization process of either new products or services through a structured developing way. In addition, QFD helps organizations to make the key trade-offs between what customers exactly want and what the organization can afford. (Govers, 1996)

Having been applied in managing various industries include manufacture, service and strategic planning, the house of quality is one of the conceptual design tools, a part of QFD, which provide inter-functional planning and communication. The QFD focuses on the collaboration within the organization in order to design, then, produce or provide products or services that the customers want and would continue to purchase. The house of quality reflects the organization's attitude in offerings either products or services accordingly to the customers' desires. In addition, it requires people in charge to work closely together since in the beginning phase of any projects. Benefits from using this tool including the ability to prioritize processes through the referring to the evidence stated on the house's grid. Since the higher number of customers, the more dimensions to what quality means, challenges in introducing the products and services that satisfy all at once display. As a result, the authority has to learn from customer experiences coupled with the technical fit. (Hauser and Clausing, 1988) Components of the house (Sharma, 2012) are shown in figure 14.

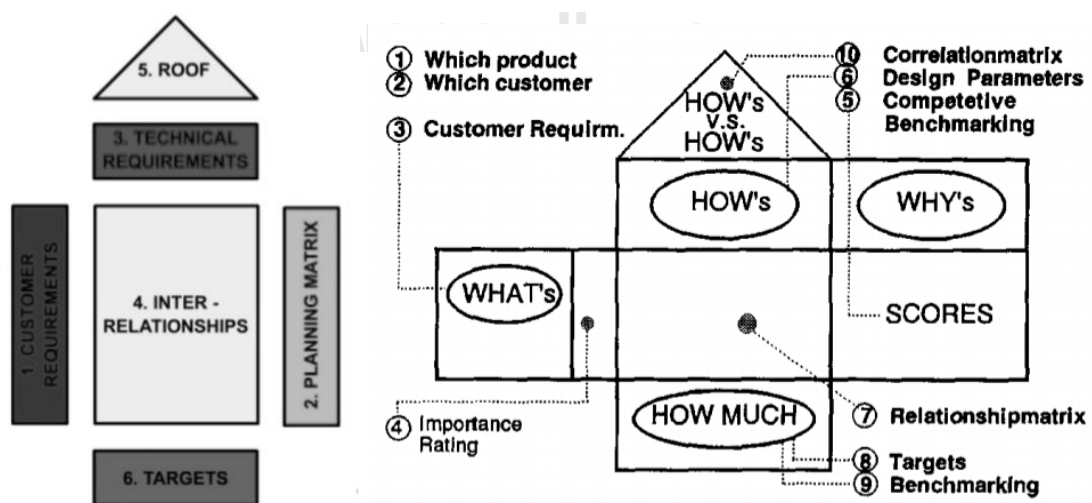


FIGURE 14 THE HOUSE OF QUALITY STRUCTURE (SHARMA, 2012; GOVERS, 1996)

Steps in building the house of quality are listed as:

- (1) Identify what are customers' desire and collect customers' requirements according to voice of the customers.
- (2) Identify technical requirements and how the product or service satisfy the customers referring to voice of the engineers.
- (3) Form a planning matrix to identify weighted importance and the relationships between each relationship comparing to competitors.
- (4) Conduct the interrelationship matrix to see the linkage between customer's requirements and a performance measure which will later be used in product or service improvement and evaluation.
- (5) Develop the technical correlation matrix, which is the roof part, to see the connections between customer's and technical requirements using the basic symbols to indicate the levels of impact: strong positive, positive, negative and strong negative. The outcome of the matrix would be used in summarize the integration area of activities and where in the matrix in which there are possibilities for conflicts to occur.
- (6) Do the competitive assessment both in terms of customer and technical. The final outcome is the set of target values that would meet to the new design. However, due to the budgeting and technology constraints, the final decision made might not be the most optimized design. (Master of Project Academy, n.d.)

2.7 The quality function deployment applied in service design

The QFD is applied for product or service design by various industries. Below are the examples of the QFD application in a school workshop improvement and a housing design improvement.

2.7.1 Quality function deployment in design improvement

The QFD, combined with kano model, were applied in the ergonomic design improvement by Hashim and Dawal in 2012. Their consideration was found in the field of ergonomic design improvement in a school workshop workstation. The research site was at one of the secondary schools in Klang district of Selangor, Malaysia, which taught technical and vocational education classes. Workshop was organized in the school in order to support practical

activities as well as be an alternative course for students. Therefore, good furniture and comfortable seats and tables were essential during teaching and learning processes. Since most of the students had complained about their back and muscle pain caused from using the workstation, the study was conducted. The study used kano model applied with the house of quality matrix in prioritizing the modification elements, then, introduced the ergonomically designed workstation.

The methodology included the kano model and QFD application. According to Kano, there are three categories of requirements influencing on customer satisfaction listed as:

- Must-be: Customer expects quality on this and would be dissatisfied if it does not exist.
- One-dimensional: Customer would be satisfied if a thing is provided and vice versa.
- Attractive: Somethings that are beyond customer expectation. Customer would not be dissatisfied if it is not fulfilled.

While kano model revealed the categories of requirements from customer perspective, the QFD was used in translating the voice of customer into engineering design quality. Benefits of using QFD were described as the effectiveness in evaluating the impact values of design requirements characteristics by the prioritization referring to the important rating in order to satisfy customer expectation. Nevertheless, by using these tools, some limitations were found, e.g. cost constraint and design constraint. It is not recommended to maximize customer satisfaction, but, to optimize through available resources. (Hashim and Dawal, 2012)

In 2012, Hashim, with his colleague, started their study with kano questionnaire and direct interview in order to get customer feedback on the existing workstation. The targeted participants were the student at the age between fourteen to fifteen years old. The collected data were statistically analysed using a computer software, then, summarized into qualities classification listed as Must-be, One-dimensional, Attractive, and Indifferent. In the questionnaire, questions about user importance were also conducted where students were asked about the importance of each quality. Then, the house of quality was developed integrating the data gained from the kano questionnaire with technical elements. Finally, the conclusion of how the

new design should look like and a clear understanding of customer requirements were successfully identified.

2.7.2 Quality function deployment in housing design

In 2017, Moghimi, and his colleagues, concerned about the development of quality housing in Iran through the incorporation of user values with housing design. Since customer became a key player in value creation, the researchers saw a translation of end user values into living environment was necessary and had to be taken into consideration. To provide quality housing design, closing the gap between external customer value and internal production quality was a must.

First, few apartment occupants were interviewed prior to the survey distribution as the survey would facilitate the occupant involvement and expression on the perspectives of housing design and living environment. The researchers applied the means-end chain (MEC) and quality function deployment (QFD) models in gathering user requirements and values. The MEC model was used during the requirement gathering phase by asking the respondents about their feeling on a product or a service. Meanwhile, the QFD model was used in designing a customer-driven product or service. Then, architects took part in developing design strategies using the QFD combined with the data collected from the survey. The house of quality (HOQ) of QFD was the powerful tool in developing design attributes based on voice of customer followed by weight assessment and information analysis. Last but not least, the proposed design strategies were introduced described by four main categories listed as building organizational, interior design, exterior design and indoor environmental.

Chapter 3 A Justification of the Research Methods Used

This chapter explains and justifies the research methodology of how the research project was conducted including research subject, research methods, data collection, and phases of the research study.

3.1 Research subject

The case study business unit for this research project is the utility state enterprise named Electricity Generating Authority of Thailand or EGAT whose main responsibility includes electric power generation, acquirement and transmission across Thailand as well as electricity-related businesses in forms of by-products and services. This research is set out to answer the question of “what facilities should be provided in co-working space in a state enterprise, EGAT, and what are the recommended services in order to strategically fit to the employee’s needs and the emerging trends?”

3.2 Research methods

The research project relies on both qualitative and quantitative research methods due to the following reasons.

(1) One of the research inputs come from the studies on user requirements, human behaviours and the journey maps. However, different people usually have different attitude and feeling on the same exact thing, so, these inputs have to be collected and analysed qualitatively.

(2) Then, the quantitative aspect is introduced from the translation of qualitative data facts on different aspects such as the number of users and the purposes of use into measurable units.

3.3 Data collection

The input data are collected from the available organization database, for example, the number of users as well as the current area utilization rate. The market research, then, is conducted to get the insight information from direct customers. The other inputs are collected via an online questionnaire. The questions cover the purposes of use of the users as well as the satisfaction. Later, all dimensions of data would be altogether analysed.

3.4 Phases of the research study

According to 3.2 and 3.3 in this chapter, the research is founded in the pattern of four consecutive phases: (1) background information and statistical facts (2) strategy and concepts definition, (3) application of Kano model with quality function deployment (QFD) principle in co-working space design and (4) conceptual design.

3.4.1 Background information and statistical facts

3.4.1.1 Internal factors

EGAT currently operates the library which has the total area around 1,000-square-meters located at the headquarter. The area is considered as a huge area. However, the utilization rate of the library area is extremely low due to the low-quality facilities and the unsupportive atmosphere to the emerging trends and customer's desires. More than 50% of the area is bookshelves and the other 50% is a reading zone where only tables and uncomfortable chairs are provided as a service. In addition, no electric outlet and other facilities are installed. Figure 15 displays the current floor plan.

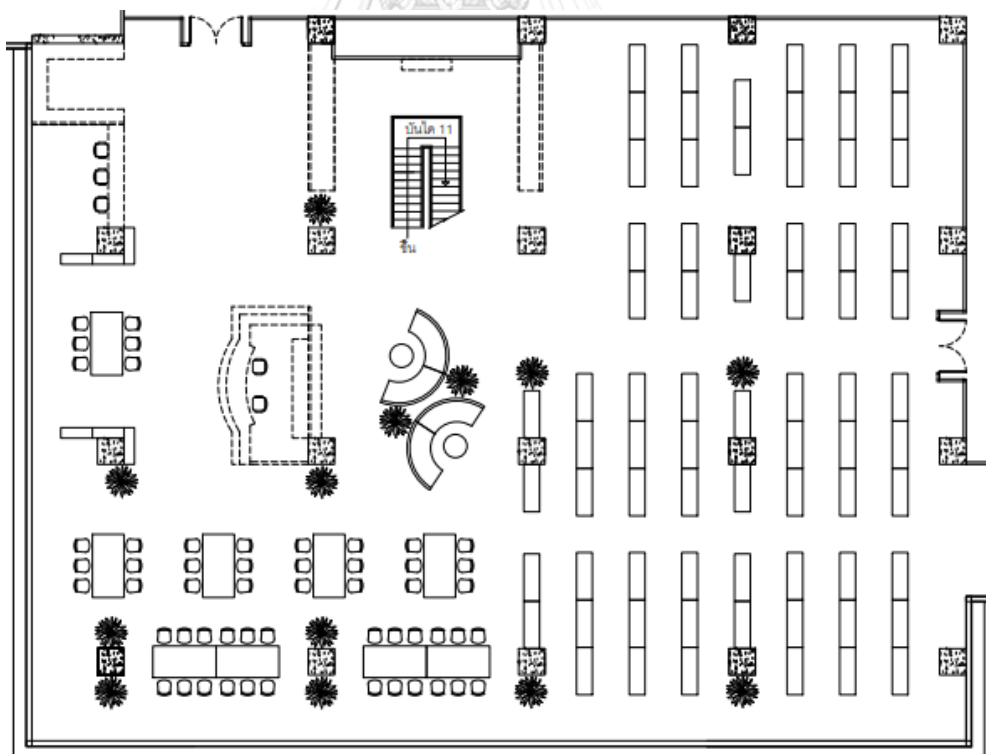


FIGURE 15 EGAT LIBRARY FLOOR PLAN

The study of space users is conducted using the counter at the entrance door and registration profile. It is found out that the number of visitors who visit the library is on the average at 420 persons per day consisting of headquarter employee, provincial employee, employee's family member, retired employee and guest at the amount of 355, 40, 18, 5 and 2, respectively as shown in figure 16.

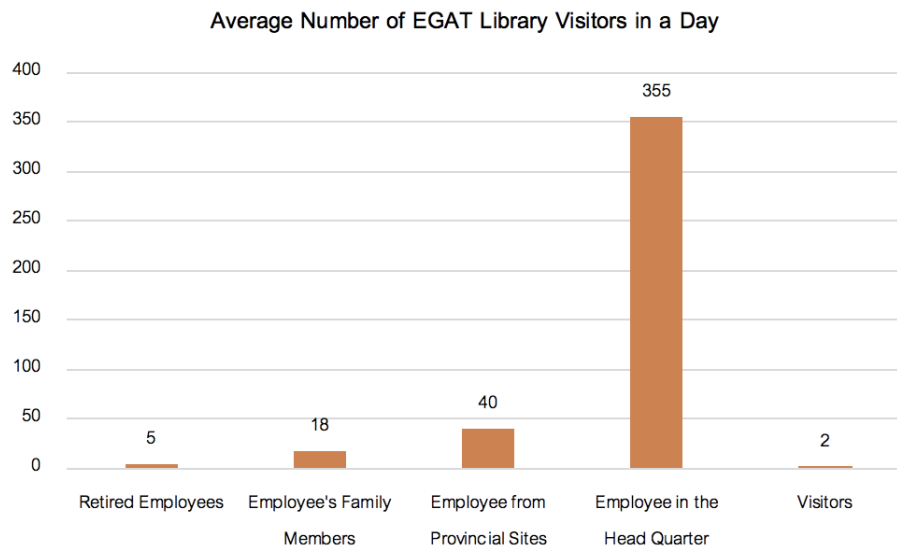


FIGURE 16 EGAT LIBRARY VISITORS PER DAY

So, the calculated utilization rate by dividing number of daily visitors by total amount of employees at the headquarter is as less as 5.09%.

The customer journey map, displayed in figure 17, is applied at this stage to see the activities done by the visitors.

Actions: What do the customers do at each process?

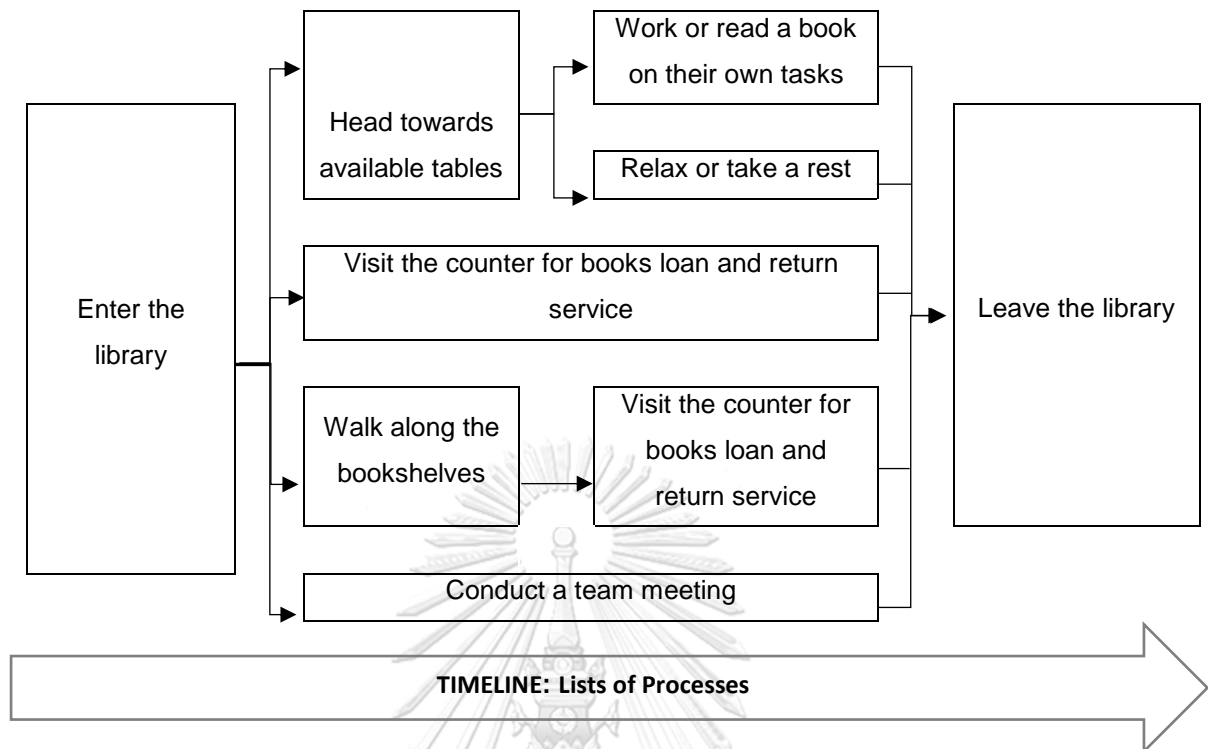


FIGURE 17 CUSTOMER JOURNEY MAP

However, the activities done by these group of visitors are collected as a next step. The statistic, illustrated in figure 18, shows that 63% of the visitors spend around ten to fifteen minutes in the library wandering around, borrowing and returning books, another 20% spend the whole day (eight-hour working time) either reading books or working on their own tasks and the other 17% use the library’s service in providing meeting room.

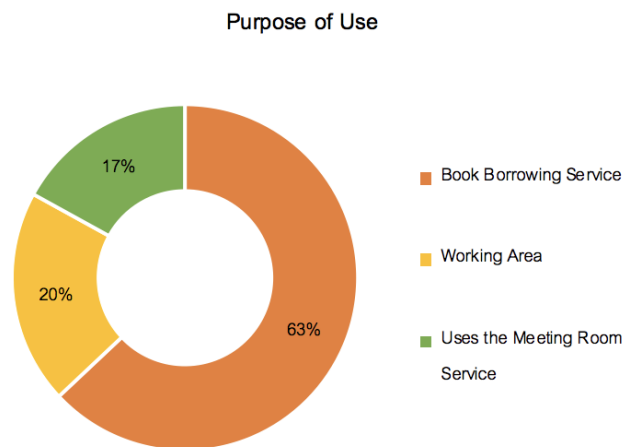


FIGURE 18 PURPOSE OF LIBRARY USE

3.4.1.2 External factors

Co-working space was first established resulted from the shift in human behaviours. According to 2.2 and 2.3, considering staff's requirements and providing proper infrastructure are highlighted by most companies. In the disruptive era, office layouts have to be changed in order to transform traditional organizational culture into innovative culture which promotes collaborative work. The global companies see the influence of infrastructure on their employees as necessity. They believe that good infrastructure helps the companies in term of employee stress reduction and work productivity increasing. Especially in the creative organizations, the introduction of employee-friendly comfortable stuff and furniture helps promoting more creativity comparing to the old fashioned four-walled infrastructure. Because people in the working age spend more than 50% of their daily time at the office, it is suggested that all the authorities should consider the advantages of having good infrastructure in the office and turning themselves into a happy workplace. The application of colourful wallpaper as well as the decorated wall with inspired quotes are the example things that are done by most companies. The surrounding infrastructure must be designed to suit with the employee requirements. People, nowadays, prefer inflexible work environment than a steady one. Furthermore, they see connection across professionalism and interpersonal relationship as necessity. The co-working space is well-known for its advantage in boosting up creativity and innovation. To sum up, it could not be denied that interaction, collaboration, and socialization are the impactful factors in driving the organization towards the successful innovation and performance. The proper working environment combining with good infrastructure play such important role in satisfying employees who are the most valuable assets of the company.

As a result, it is a challenge for the EGAT to increase the space utilization rate of this one thousand square meters space by providing the services that meet employee's desires, fit with the upcoming trends in working behaviour, suit the organizational culture and encourage the development of new innovations within the organization through the inspired atmosphere and supportive services. The organization has to take parts in fulfilling and build the capabilities as well as the professionalism in the new-generation workers in order to create sustainability and have performance excellence through the application of technologies in establishing new

innovations. Furthermore, the organization must make a move in providing services that fit to the characteristic of these young generations who prefer mobility in working environment.

The service design and development by transforming the traditional library into the modern co-working space could be divided into two major sections: facilities and supported services. All these elements are linked to each other. The facilities involve (1) rooms used for multi-functional purposes such as working and meeting area, (2) office equipment, (3) required electronic devices like Wi-Fi access, and electrical outlets (4) coffee corner and (5) other functional and decorated furniture. The supported services, in this case, mean the backend operation in order to satisfy users through impressive customer interface and create valuable customer's experiences.

Furthermore, it is expected that the establishment of co-working space would help reducing employee's stress, boosting up working productivity, promoting more creativity, generating more profit, providing flexible work environment and leading the organization to become a happy workplace.

3.4.2 Strategy and concepts definition

At this phase, the policy and customers are defined. So, the organization can get the customer's needs which later be translated into design requirements. The strategy and concepts of this research is defined as "to provide alternative designs of co-working space located in EGAT headquarter aiming at improving service quality, offering better learning atmosphere and facility and boosting the creativity and innovation culture as well as promoting the interactions between groups of employees" which has EGAT employees as the customers.

3.4.3 Application of kano model with quality function deployment (QFD) principle in co-working space design

The research method follows the steps in figure 19. It starts from collection voice of customer (VOC) and translates it into customer requirements.

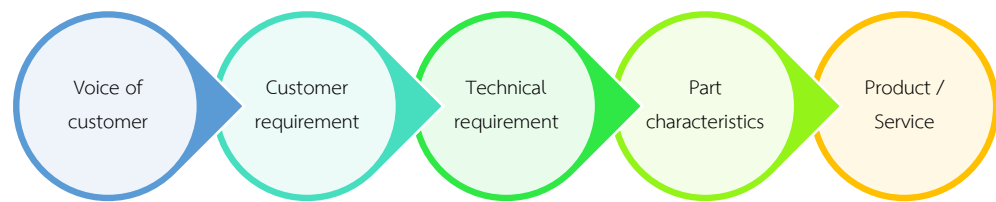


FIGURE 19 THE QFD PRINCIPLE

3.4.3.1 Voice of customer

The research uses questionnaire, shown in appendix A, in gaining customer requirements. EGAT employees are invited to participate in the questionnaire. The questionnaire asks the respondents about their satisfaction on the current office and their satisfaction if the organization would have a co-working space. Furthermore, the questions about the preferred services are also appeared which later be used in the co-working space service design.

3.4.3.2 Customer requirement

The customer requirements are listed according to the feedbacks got from the online survey. The percentage of employee preference is translated into importance weight of each requirement. In addition, the suggestion from the survey respondents is also summarized as one of the inputs.

3.4.3.3 Technical requirement

Because the level of satisfaction of the customers pays an important role on business operation and helps strengthening business competitiveness, the organization take the relationship between satisfaction and requirement into consideration. The kano model is applied in this phase in describing the relationship between subjective and objective aspect. The kano model is useful in understanding the exact requirements of the customers and how to satisfy them.

The questions appeared in the questionnaire are designed to suit the kano model in order to determine the services that should be provide in the co-working space. The questions come in pair and are written positively.

The feedback would be translated and classified into kano categories listed as:

- Must-be requirements: the basic criteria of a product or a service. Customer would dissatisfy if they are not fulfilled. However, its existing does not bring satisfaction to the customer. The requirements are rarely demanded explicitly.
- One-dimensional requirements: Regarding these requirements, the more level of fulfilment of a product or a service directly relates to the higher customer satisfaction. So, the requirements need to be significantly highlighted in the product or service design process. Furthermore, the requirements are usually demanded explicitly by the customer.
- Attractive requirements: If these requirements are fulfilled, they exponentially satisfy the customer. On the other hand, the customer would not dissatisfy if they are not existed. They are neither explicitly asked for nor expected by the customer.

The relationship between subjective and objective purpose is shown in table 4.

Table 4 Evaluation table of customer requirement (Tontini, 2000)

Insufficiency / Sufficiency	Satisfied	Must-be	Indifferent	Dissatisfied	Other
Satisfied	Q	A	A	O	Q
Must-be	Q	Q	N	M	Q
Indifferent	N	N	N	M	Q
Dissatisfied	R	R	R	Q	Q
Other	Q	Q	Q	Q	Q

Customer requirements:

A: Attractive, O: One-dimensional, M: Must-be, N: Indifferent, R: Reversal and Q: Questionable result

Last, the prioritization of the designed services is developed according to the defined kano category of each. The necessity of the designed services is described as must-be category, one-dimensional category and attractive category, respectively. Furthermore, the other category,

which is indifferent, also known as neutral category, might be mentioned. It reveals the so-so satisfaction of the customer on a product or a service. This category is neither be expected by nor satisfy the customers.

3.4.3.4 House of quality

The most difficult part is found in this phase. Inputs for the QFD must be what the customers truly want instead of what the organization thinks the employees would expect. In order to fulfil the house of quality, there are steps to follow as shown in figure 20. Furthermore, the organization have to make sure that there is an opportunity for improvement.

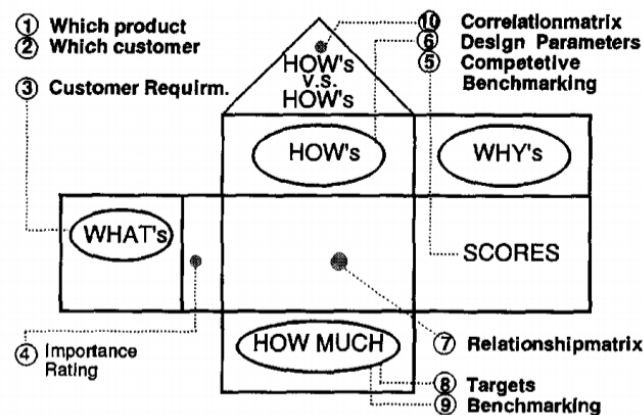


FIGURE 20 THE HOUSE OF QUALITY STRUCTURE (GOVERS, 1996)

However, when asking the customers on what their requirements are, the answers will come in two aspects including expressed requirements and implicit requirements. The expressed ones usually come accordingly to the questions asked, whereas, the implicit ones do not. The implicit requirements always separate into two groups listed as the expected and the excitement features coupled with safety and reliability of the products or services. When all the requirements are collected, the list of those needs should be sufficiently detailed in order to make a judgement on how important each requirement is as well as its prioritization. This can be done by using simple ranking method. Moreover, by applying the QFD, it allows the organization to generate design parameters, analyse relationship and benchmark competitiveness to the competitors. Finally, the correlation matrix is established from all the inputs and analysis using the table 5.

Table 5 House of quality template

		Technical requirements (How's)				
		Importance weight				
Customer requirements (What's)						
	Technical importance weight					
	K-value					
	Adjusted technical importance weight					
	Adjusted technical importance weight (%)					

where relationship is implied as \odot equals to 5, \bigcirc equals to 3 and \bullet equals to 1

The k-value which is calculated from the kano model is introduced as an additional factor in the house of quality. The adjusted technical weight is calculated by multiplying the technical importance weight with the k-value. This is done in order to take customer satisfaction as one of the considered factors in addition to the concern of both customer requirement and technical requirement.

3.4.4 Conceptual design

While Kano model revealed the categories of requirements from customer perspective, the QFD was used in translating the voice of customer into engineering design quality. Until this

phase, the co-working space will be designed accordingly to the outcomes from the house of quality following the QFD principle combining with the result of the kano model. This methodology is adapted from the research on the topic of ergonomic design improvement of school workshop in Malaysia by Hashim and Dawal (2012). At that time, the two researchers aimed to develop a strategy to identify and prioritize the students and technical requirements in order to modify workstation in the school focusing on ergonomic approach. Although there were plenty of methods in fulfilling customer requirement and introducing new product, the researchers applied the kano model with the quality function deployment. The process started from the collecting of student requirement, then, the clarification and prioritization were done using the house of quality.

There are concerns for the interior design in the architectural perspectives. First, aside from the ideal area allocation, the consideration of human body is a must to be taken into account. Second, the circular area for all population in the area is also highlighted. Third, the surrounding environment and its details such as a colour, a structure, a pattern, furniture and materials are factors for the design of any area. Furthermore, the lighting system and other facilities are also essential things to be considered. (Britannica, n.d.)

The conceptual design is summarized and implying the key elements that are needed to be in the co-working space which would be useful to the space designer. Because of the design concept is somehow subjective, it is difficult to truly understand and optimize the needs from different people. However, the design process is beyond the scope of the research and is an architect's matter. Due to the architectural issues, the co-working space interior design, shown in appendix B, is introduced as a preliminary design for the co-working space in EGAT which need to be handed on to the architect team as a design framework.

Chapter 4 Results

This chapter explains the results got from the actions stated in the prior chapter following the research methodology.

4.1 Voice of customer

The overall questions are shown in appendix A. Moreover, the demographic of participants is listed in table 6.

Table 6 Demographic characteristic of respondents

Age	Percentage
Less than 26 years old (Baby boomer)	27.27%
26 – 40 years old (Generation X)	43.18%
41 – 55 years old (Generation Y)	20.46%
More than 55 years old (Generation Z)	9.09%

Current workplace location	Percentage
Headquarter	63.63%
Provincial offices	31.82%
Other: Power plant in Laos	4.55%

Deputy	Percentage
Administration	22.73%
Strategy	13.64%
Finance and accounting	9.09%
Generation	15.90%
Fuel	4.55%
Transmission system	13.64%
Power business	11.36%
Power plant development and renewable energy	6.82%
Governor and internal audit	2.27%

The questionnaire also asks the EGAT employees about their satisfaction on their current office as well as their opinion on having a co-working space in the organization. The result got from the questionnaire shows that more than half of the total staffs feels so-so with their current

office. However, the majority of them are agree with having the common area within EGAT. Whereas, none of them are dissatisfied with the organization organizing the co-working space. The numerical statistic is shown in figure 21 and figure 22.

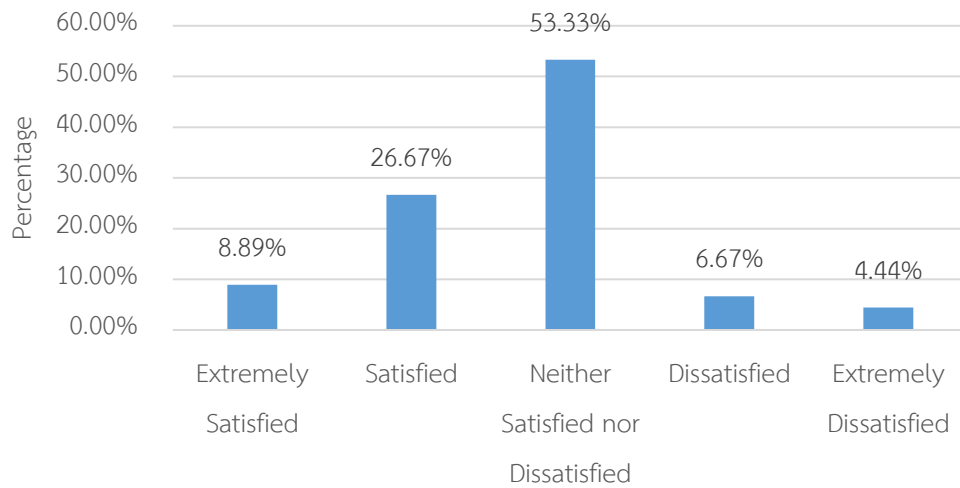


FIGURE 21 EMPLOYEE SATISFACTION ON THEIR CURRENT OFFICE

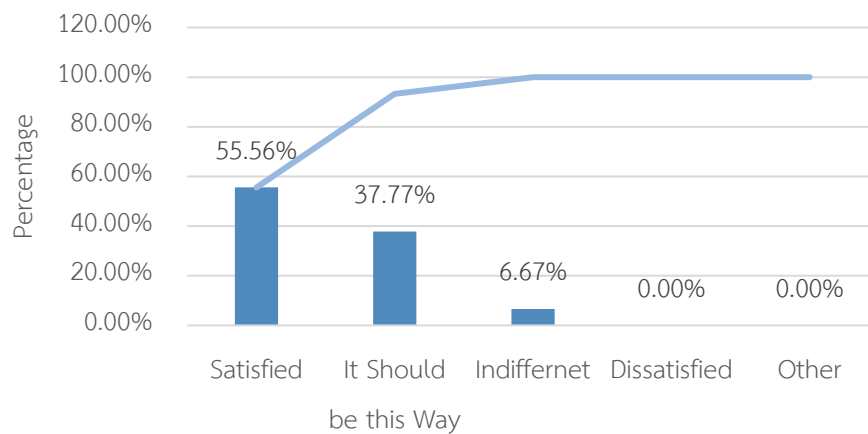


FIGURE 22 EMPLOYEE SATISFACTION ON HAVING A CO-WORKING SPACE IN THE ORGANIZATION

Moreover, some of the suggestions input from the participants include:

- Facilities

The current library is decorated with old-fashion design and creates no impact on EGAT's business. EGAT should have a common work area or at less a room for informal meeting. However, the room must have a modern decoration and suit for employees in all generations. Moreover, the area should provide several corners allowing employee to sit, share, work in

groups, work on personal ideas by having various room types as well as the recreating facilities such as a slider. A table and a power socket should be provided for using the laptop conveniently. In addition, an area for provincial employees to work and stay when coming to the headquarter is recommended. The area could be separated into noise-restricted and noise-allowed zone. This concept could be completed through the renovation of the wide area of the existing library.

- Services

The area should allow its users to bring a drink with a tight lid in order to maintain cleanliness. Moreover, projector borrowing service is recommended. At the same time, EGAT should consider hosting a mini conference or mini event at the existing area. It is suggested that the operating time of the co-working space should not rely on the organization office hours. Although daily working hours end at 4 PM, the place should be opened until 8 PM in case groups of employees have to work overtime or have a productive meeting that should not be interrupted.

4.2 Customer requirements

Customer requirements got from the questionnaire are shown in table 7.

Table 7 Customer requirements (What's)

No.	Customer requirements (What's)	Employee preference	Importance weight (%)
1.	Do creative work	0.6591	18.24%
2.	Do routine work	0.7955	22.01%
3.	Meeting with team	0.7045	19.49%
4.	Self-reading	0.1591	4.40%
5.	Self-learning	0.1364	3.77%
6.	Community building	0.4773	13.21%
7.	Do hobbies	0.0909	2.52%

8.	Rest or relax	0.4773	13.21%
9.	Drinking	0.0682	1.89%
10.	Greeting guests	0.0455	1.26%
		3.6138	100.00%

4.3 Technical requirements

4.3.1 Kano model

To specify the technical requirements to fulfil the customer requirements, hereby, the kano model is applied. This process starts with a questionnaire surveying targeted co-working space users about their perspective on a product or a service. The questionnaire has asked the participants positively. In addition, the questionnaire is reliable since the percentage of participants choosing “other” is less than 1%. The targeted participants have to choose one of the following answers: satisfied, must-be, indifferent, dissatisfied and other as described in table 8.

Table 8 Technical requirements (How's)

In a Co-working space, how would you feel if you ...		Percentage	Technical requirement
Can do activities you prefer in the allocated space	Satisfied	65.91%	Allocated area
Can work / read on your own without making noise in an open floor	Indifferent	52.27%	
Can print or photocopy	Satisfied	75.00%	Printer
Do a work and print later	Dissatisfied	75.00%	
Can get a drink without leaving the area	Must-be	56.82%	Drinking vending machine
Can get a drink from the outside	Dissatisfied	56.82%	
Can leave your belongings at the co-working space	Indifferent	52.27%	Locker
Have to take things with you	Indifferent	68.18%	
Access internet via Wi-Fi / LAN	Satisfied	61.36%	Wi-Fi / LAN
Access internet via personal hotspot	Must-be	56.82%	

Can charge electronic devices at a table	Must-be	68.18%	Power outlet at all table
May charge electronic devices at a charging point	Dissatisfied	64.64%	
Take notes on erasable board or paper	Indifferent	43.18%	Erasable board
Jot notes in your notebook	Indifferent	79.55%	
Present the file using electronic file via a computer	Indifferent	61.36%	Projector and LCD screen
Individuals bring their own laptop or tablet for meeting and presenting	Indifferent	68.18%	
Can use the co-working space whenever you want to	Satisfied	40.91%	Operation hours
Have to visit the co-working space only in the office hours	Indifferent	40.91%	
Select and loan a book via online system	Satisfied	50.00%	Book loan
Apply existing library processes	Indifferent	70.45%	

Then, the answers, then, are translated into kano's method according to Tontini's evaluation table of customer requirements (2000) shown in table 9 and are summarized as described in table 10.

Table 9 Evaluation table of customer requirements (Tontini, 2000)

Insufficiency \ Sufficiency	Satisfied	Must-be	Indifferent	Dissatisfied	Other
Satisfied	Q	A	A	O	Q
Must-be	Q	Q	N	M	Q
Indifferent	N	N	N	M	Q
Dissatisfied	R	R	R	Q	Q
Other	Q	Q	Q	Q	Q

Customer requirements:

A: Attractive, O: One-dimensional, M: Must-be, N: Indifferent, R: Reversal and Q: Questionable result

Table 10 Kano category per technical requirement

Technical requirement	Evaluation table of technical requirements		Importance of the technical requirement
Allocated area	Sufficiency	Satisfied	Attractive (A)
	Insufficiency	Indifferent	
Printer	Sufficiency	Satisfied	One-dimensional (O)
	Insufficiency	Dissatisfied	
Drinking vending machine	Sufficiency	Must-be	Must-be (M)
	Insufficiency	Dissatisfied	
Locker	Sufficiency	Indifferent	Indifferent (I)
	Insufficiency	Indifferent	
Wi-Fi / LAN	Sufficiency	Satisfied	Attractive (A)
	Insufficiency	Must-be	
Power outlet at all table	Sufficiency	Must-be	Must-be (M)
	Insufficiency	Dissatisfied	
Erasable board	Sufficiency	Indifferent	Indifferent (I)
	Insufficiency	Indifferent	
Projector and LCD screen	Sufficiency	Indifferent	Indifferent (I)
	Insufficiency	Indifferent	
Operation hours	Sufficiency	Satisfied	Attractive (A)
	Insufficiency	Indifferent	
Book loan	Sufficiency	Satisfied	Attractive (A)
	Insufficiency	Indifferent	

According to Kano (n.d.), the priority of each requirement is listed as must-be, one-dimensional, attractive and indifferent and are weighted as nine, five, three and one, respectively. Table 11 displays the k-value used in the evaluation of importance of each technical requirement.

Table 11 Kano category per technical requirement and the k-value

Technical requirement	Importance of the technical requirement	Importance weight	K-value (%)
Allocated area	Attractive (A)	3	7.89%
Printer	One-dimensional (O)	5	13.16%
Drinking vending machine	Must-be (M)	9	23.68%
Locker	Indifferent (I)	1	2.64%
Wi-Fi / LAN	Attractive (A)	3	7.89%
Power outlet at all table	Must-be (M)	9	23.68%
Erasable board	Indifferent (I)	1	2.64%
Projector and LCD screen	Indifferent (I)	1	2.64%
Operation hours	Attractive (A)	3	7.89%
Book loan	Attractive (A)	3	7.89%
		38	100%

4.4 House of quality

The relationship between customer requirements and technical requirements are listed as strong, moderate and weak using the measurable value of five, three and one, respectively. Table 12 displays the summary of the concept design through the illustration of the house of quality combining with the k-value applied and calculated from the kano model.

Table 12 House of quality for co-working space design

		Technical requirements (How's)																			
		Facility								Service											
	Importance weight	0.1824	0.2201	0.1949	0.0440	0.0377	0.1321	0.0252	0.1321	0.0189	0.0126										
	Do creative work	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Do routine work	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Meeting with team	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Self-reading	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Self-learning	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Community building	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Do hobbies	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Rest or relax	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Drinking	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Greeting guests	⊙	⊙	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Technical importance weight	5.0000	0.9622	2.4906	1.5472	4.2704	2.7798	2.7043	2.6791	3.6415	2.0881	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789
		K-value	0.789	0.3945	0.2368	0.0263	0.0263	0.2368	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263	0.0263
		Adjusted technical importance weight	14.40 %	4.62 %	21.52 %	1.48 %	12.29 %	24.02 %	2.60 %	2.57 %	10.48 %	6.01 %	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789	0.0789

where relationship is implied as ⊙ equals to 5, ○ equals to 3 and ● equals to 1

From the house of quality in table 12, it shows that the most important factor in co-working space design is the development of the proper infrastructure which hold the percentage as large as 83.50%, as in table 13, while the service components are less concerned.

Table 13 House of quality for co-working space design

	Technical requirements (How's)									
	Facility								Service	
	Allocated area	Printer	Drinking vending M/C	Locker	Wi-Fi / LAN	Power outlet at all Table	Erasable board	Projector and LCD screen	Operation hours	Book loan
Kano category	A	O	M	I	A	M	I	I	A	A
Adjusted technical importance weight (%)	14.40 %	4.62 %	21.52 %	1.48 %	12.29 %	24.02 %	2.60 %	2.57 %	10.48 %	6.01 %

4.5 Conceptual design

According the house of quality in table 13, the solution will be provided covering the details of facilities, service design and purpose of use as displayed in table 14 below.

Table 14 Prioritization of required components in the co-working space

	Technical requirements	Kano category	Importance weight (%)
Facility	Power outlet at all table	Must-be	24.02%
	Drinking vending machine	Must-be	21.52%
	Printer	One-dimensional	4.62%
	Allocated area	Attractive	14.40%
	Wi-Fi / LAN	Attractive	12.29%
	Erasable board	Indifferent	2.60%
	Projector and LCD screen	Indifferent	2.57%
	Locker	Indifferent	1.48%
Service	Operation hours	Attractive	10.48%
	Book loan	Attractive	6.01%

According to the information in table 14, the requirements that are in the must-be category include the power outlet installed at every table and the drinking vending machine. The first two elements, power outlet at the tables and drinking vending machine, turn out to be the most important components in co-working space design. These two things are a-must-to-install in the co-working space in order to fulfil customer requirement. The presence of these things does not promote employee satisfaction. Nevertheless, the employees would not be satisfied if neither power outlet at the tables nor drinking vending machine does not existed.

Even printer has less importance weight than other seven components, it is considered as a one-dimensional category which the customer might be dissatisfied if it is not provided. So, printer has the higher necessity comparing to others. The organization should satisfy its employees by installing, at least, just one printer in the area.

Area allocation and internet network are the things that could attract the employees if it is well organized. The more quality of these two components encourage the more satisfaction of the organizational staffs. However, the staffs would not be dissatisfied if they are not fulfilled, while, the presence of erasable board, projector and LCD screen as well as locker has less impact on employee satisfaction.

4.5.1 Facility

Proper area allocation is one of the attractive factors for service design in a co-working space. The area allocation could be divided according to the feedback gained from the questionnaire into various types of room. The prioritization of the area is concluded in table 15 referring to the employee preference and is developed based on the assumption that each room type has a direct variation to the employee preference.

Table 15 The importance of each room type

Room type	Employee preference	Importance weight (%)
Group meeting area	0.9318	24.26%
Hot desks	0.8636	22.49%
Relaxed zone	0.7727	20.12%
Individual seats	0.7045	18.34%
Recreation area	0.4545	11.83%
Events / workshop / exhibition area	0.1136	2.96%

This leads to the separation of the area following the information stated in table 15. It could be concluded that the area of 1,000 square-meter of the existing library, the new allocation of the area for co-working space design should be designed following this suggested priority. The recommended model consists of six room types listed as group meeting area, hot desks, relaxed zone, individual seats, recreation area and area for events, workshop and exhibition.

4.5.1.1 Group meeting area

The group meeting area is described as the room decorated for group meeting purpose as well as for group discussion and group working that require idea sharing and brainstorming. Due to the fact that, people attending in each meeting are not equal all the time, different room size is a-must to be taken into consideration. The employee preference for the meeting room is almost one-fourth of the total requirement.

Furthermore, an LCD monitor should be installed in every single room although its level of satisfaction is indifferent. Beside from the equipment for presenting purpose, the wall should be decorated with erasable mirror allowing the users to discuss using post-it and to take notes on the wide area of whole sided wall. In addition, the application of folding transparent door enables the adjustability of the meeting rooms either to be wider or smaller in responsive to the purpose of use and meeting participants at a time.

4.5.1.2 Hot desks

Hot desks are defined as a desk and a computer in an office that are available to be used by any employees who needs it. The hot desks are introduced as one of the ways to utilize office building space. The organization staffs do not need to have their own permanent desk but to work at a provided workspace where they can share office equipment and other physical elements. Furthermore, this kind of space allows the cross-functional culture among various departments within the organization. (Cambridge Dictionary, 2019)

Since more than half of the EGAT employees are based in provincial offices, the hot desks are necessary for this group of employees at the time they have to visit the headquarter. The installation of Wi-Fi and LAN network would help providing convenience and work ability to the employees to work anywhere, anytime via any devices. Various types of seats and tables

could be found in this zone aiming at promoting variety of working atmosphere and igniting employee creativity.

4.5.1.3 Relaxed zone

As mentioned in 4.5.1.2, the large number of provincial employees leads to the development of relaxed zone. The zone is introduced especially for the employees who have to travel number of miles from their based location to the EGAT headquarter. However, it is not designed for overnight stay but for a short break either during lunch time or after working hours. The employees are allowed to have a short napping as well as a relaxed gesture which would make them feel like staying at home. The bed is design for one-person use with power sockets in case the users want to charge their electronic devices.

4.5.1.4 Individual seats

Sometimes, staying at the permanent office is a constraint for doing tasks that need creativity. On the other hand, being among group of people might decrease individual's concentration on the task. Because one of the co-working space concepts is too promote creativity and innovative culture, the space would encourage employee creativity through the cross-functional environment with inspired atmosphere. The individual seats are the solution for this condition. The individual seats are introduced to solve the constraint as well as to avoid the losing concentration on the responsible task of the staffs.

4.5.1.5 Recreation zone

To reduce employee stress, the employee should be allowed to take a break in between the tense working hours. The recreation zone is described as a noise-allowed area established in order to provide the feeling of working at home for its users. A comfortable sofa with audio set, sandbag and console game are available in the room.

4.5.1.6 Events / Workshop / Exhibition area

According to the QFD, almost 3% of the total area is allocated for activity purpose. It consists of the wide screen at one side of the room. However, during the event, the shared common area which is currently the hot desks would be rearranged to support the event since the area is designed for multi purposes.

To fulfil employee requirements, a small locker could be installed next to the reception. However, the locker does not require that much space and it is optional for the co-working space service design.

4.5.2 Service

According to the application of QFD and kano model, the service includes the operations hours and book loan service are the attractive category for EGAT employee. The employee would not dissatisfy if these components are not provided. Nonetheless, if these elements are fulfilled, the staffs would exponentially satisfy.

In the service perspective, the co-working space would impress the EGAT staffs more by offering book loan service and the effective managing strategy in term of operation hours.

4.5.2.1 Co-working space operation hours

The expected time the employee would consider working, having a meeting and organizing the activities in the co-working space is in the afternoon until eight o'clock in the evening (8 PM). Figure 23 displays the trend of the period the EGAT employee would visit the co-working space collected from the questionnaire. As a result, the strategy in managing operation hours should be set following this trend.

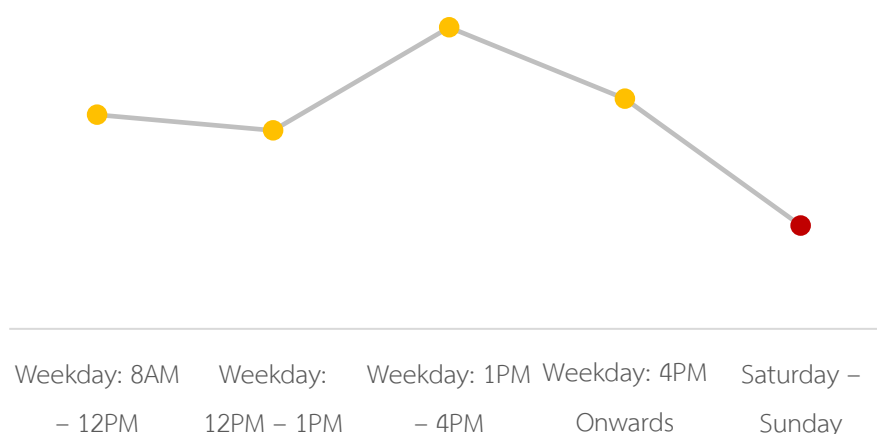


FIGURE 23 SUGGESTED CO-WORKING SPACE OPEN HOURS

As a result, to provide quality service, the suggested operation hours of the co-working space is on the weekdays from eight o'clock in the morning to eight o'clock in the evening. The

total operation hours per day is twelve hours. However, this suggestion is not fixed. Furthermore, the co-working space could be opened occasionally in response to a request from the divisions.

4.5.2.2 Reception and book pick-up counter

Providing book loan service would satisfy the users referring to the study using QFD and kano model. However, according to the questionnaire result about the voice of customer, the online system should be developed since the employee prefers choosing and booking books from the online channel, then, picking the selected books at the counter located in the co-working space. Furthermore, during the design phase, the idea of having a small bookshelf showing the recommended books and journals.



Chapter 5 Analysis

Until this process, figure 24 simplifies and sum up the advantages of co-working space development.

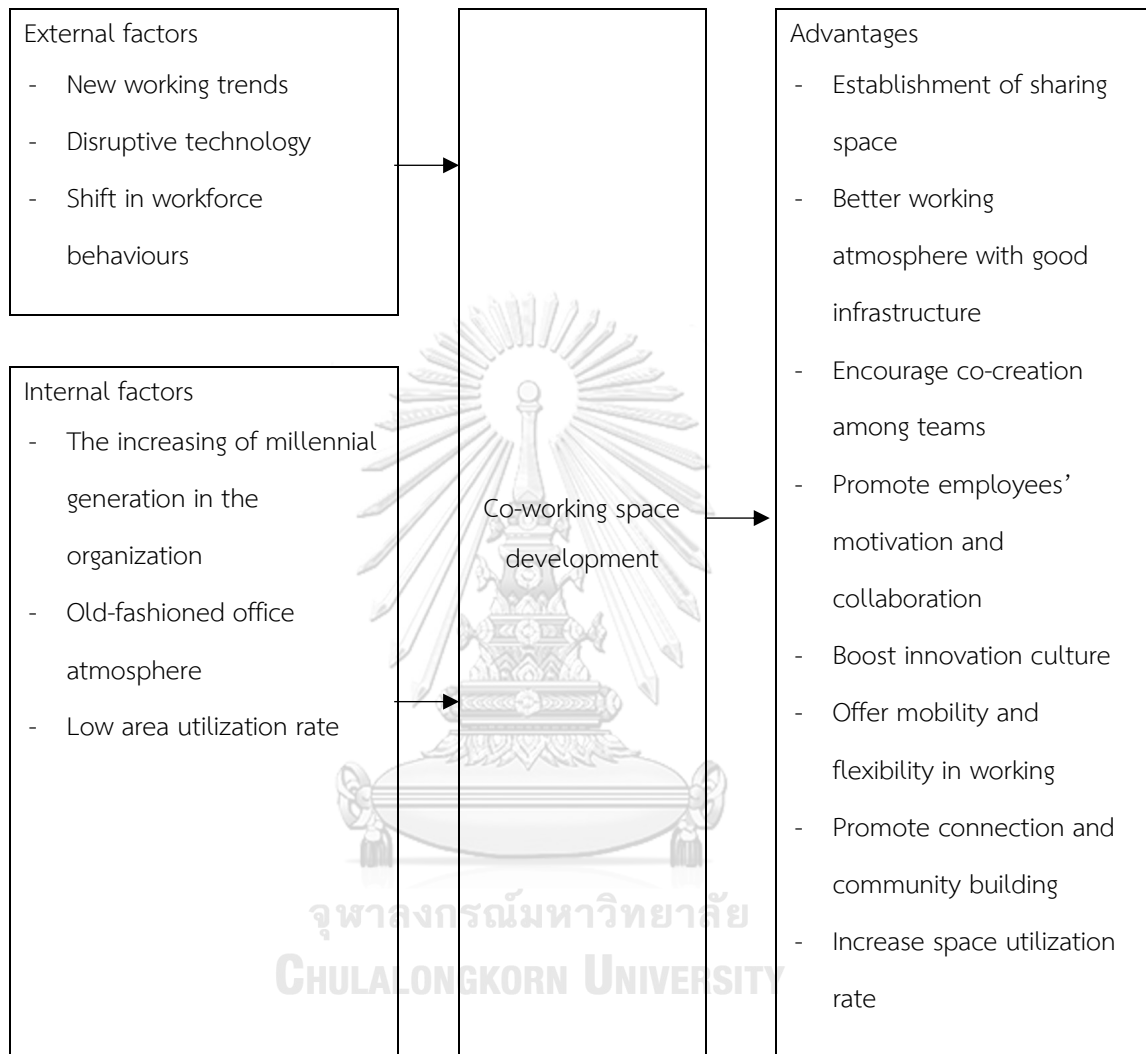


FIGURE 24 ADVANTAGES OF HAVING CO-WORKING SPACE IN THE ORGANIZATION

To improve service quality, the quality function deployment is used as a tool in co-working space design. The summary and conceptual design are introduced based on customer requirements and technical requirements as well as the customer satisfaction using questionnaire through the application of the quality function deployment and the kano model.

The area of 1,000 square meters which is current operated as a library is selected to be one of the options in the office renovation plan. According to the house of quality, the required room types are shown table 16.

Table 16 The importance of each room type

Room type	Employee preference	Importance weight (%)
Group meeting area	0.9318	24.26%
Hot desks	0.8636	22.49%
Relaxed zone	0.7727	20.12%
Individual seats	0.7045	18.34%
Recreation area	0.4545	11.83%
Events / workshop / exhibition area	0.1136	2.96%

Nevertheless, the area is not fixed and could be adjusted in order to fit with the architectural concerns such as the area for people circulation and environmental concerns.

The facilities that must be installed in the co-working space design are power outlet, drinking vending machine and printer. These three things have such a high impact on customer satisfaction. The absence of them surely dissatisfy the space users as detailed in table 17.

Table 17 Prioritization of required components in the co-working space

	Technical requirements	Kano category	Importance weight (%)
Facility	Power outlet at all table	Must-be	24.02%
	Drinking vending machine	Must-be	21.52%
	Printer	One-dimensional	4.62%
	Allocated area	Attractive	14.40%
	Wi-Fi / LAN	Attractive	12.29%
	Erasable board	Indifferent	2.60%
	Projector and LCD screen	Indifferent	2.57%
	Locker	Indifferent	1.48%
Service	Operation hours	Attractive	10.48%
	Book loan	Attractive	6.01%

In order to increase the utilization rate of the area by attracting more users, the presence of internet network is implemented. However, the users could use either their own mobile hotspot or the Wi-Fi signal provided by the telecommunication service providers. Furthermore, the service operation strategy includes the extending of service hours to be longer than the normal daily working hours of the organization. The area is suggested to open on weekdays from 8 AM to 8 PM. In addition, the book loan service is necessary to be maintained as the area is currently be the library. However, the management system is changed from the complete offline to become a blended methodology covering both online system for book selection and offline channel for book picking-up. Nonetheless, their absence does not displease those who visit the co-working space.

While other components have an impact on this common area users, erasable board, projector, LCD screen and locker cause no impact on the satisfaction of the users.

As a result, the establishment of all the mentioned keystones surely fit with the customer requirements to do creative work, do routine work, have a group meeting, apply self-reading and learning, socialize with people, do hobbies, rest, relax and drink as well as welcome guests.

Chapter 6 Discussion

The term service is described as the dealing with people mentally and physically. Furthermore, it appears in everywhere since people involve in all the things on earth. So, it could not be denied that every business is in a service. In the service perspective, customer satisfaction is one of the most important things to be considered among all available factors. Especially in the era of business competition where service-related activities play an important role in generating business advantages among all the competitors within and across the industries. Because of service systems usually relate to the emotion of people as well as human behaviors, it does not have a fix exact solution for one situation. It is the challenge for all business to clearly understand its customers. Nowadays, the business could not just provide its customers what the business could do best. In order to overcome its rivals, the business has to offer their customers what they desire the most and satisfy them properly.

There are plenty formats of service activities. However, the frequently found method is the combination of technology with the back-office operation which allows all stakeholders to take part and involve in the business processes. So, to successfully either design or improve the service, the consideration of all available related perspectives is highlighted.

The quality function deployment or QFD is a tool applied by most organizations in order to define customer requirements and translate them into engineering specifications and develop a product or design a service effectively. It is a tool that is frequently used in the product development since it concerns the two main important factors which are customer requirement and technical requirement. However, the stated requirements are not the only variables that would guarantee the business achievement.

The understand of customer satisfaction would ensure the business success and build confidence to the business. Mostly, the application of kano model is founded in this process. Since the model concerns about the subjective and objective perspectives which impact on customer satisfaction, it implies the necessity of each requirement and promotes the prioritization of all concerned issues.

In the service design and management, the key thing to focus is the voice of customer which has to be reliable and true. It could not be generated by idea from the internal involved parties. The organization has to ask their real users about their opinion on a thing. After the true

requirements are listed, the internal stakeholders such engineers, designers, programmers have to play their roles on their responsible tasks. The mistake from collecting wrong customer requirements surely leads to the incorrect house of quality, and, further impact on all the processes according the QFD principle. This might result in the development of product or service that do not meet the customer requirement and dissatisfy the valuable customers of the organization. Lastly, the organization might be in trouble, have a poor performance and business failure.

In this research, it focuses on the application of QFD for service quality improvement in co-working space design in a state enterprise. The significant of doing this research is to improve the organization performance and encourage the new way of working culture since the organization is now disrupted by the technology and the changes in workforce generation. Both QFD principle and kano model are useful for the study and are successfully combined. Both tools protect the researchers from heading towards a wrong way. For example, according to table 18, the importance weight of printer is very small percentage. Without the application of kano model, the printer might have less consideration and is not stated in a design framework. However, the printer is specified because it contains the kano category of one-dimension.

Table 18 Prioritization of required components in the co-working space

	Technical requirements	Kano category	Importance weight (%)
Facility	Power outlet at all table	Must-be	24.02%
	Drinking vending machine	Must-be	21.52%
	Printer	One-dimensional	4.62%
	Allocated area	Attractive	14.40%
	Wi-Fi / LAN	Attractive	12.29%
	Erasable board	Indifferent	2.60%
	Projector and LCD screen	Indifferent	2.57%
	Locker	Indifferent	1.48%
Service	Operation hours	Attractive	10.48%
	Book loan	Attractive	6.01%

Furthermore, the application of both tools also clarifies and identifies the needs of having various types of room. One of the problems of the research is the area utilization which is now very low. The study shows that the current purpose of use, displayed in figure 25, is mostly a book loan service while use the meeting room service has the least percentage. However, according to the established house of quality following the QFD principle, it shows that meeting room has the highest preference from the employee who complete the questionnaire.

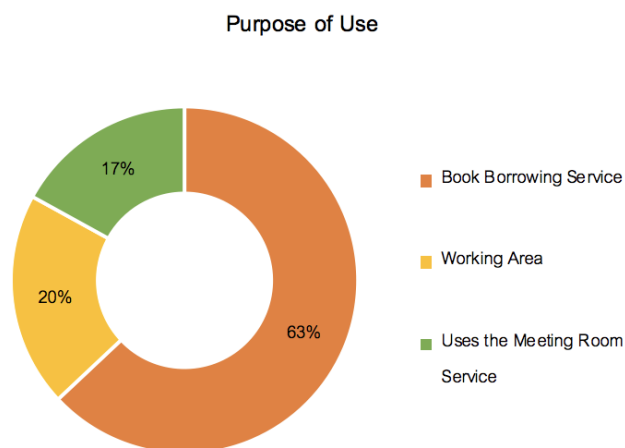


FIGURE 25 PURPOSE OF LIBRARY USE

Table 19 The importance of each room type

Room type	Employee preference	Importance weight (%)
Group meeting area	0.9318	24.26%
Hot desks	0.8636	22.49%
Relaxed zone	0.7727	20.12%
Individual seats	0.7045	18.34%
Recreation area	0.4545	11.83%
Events / workshop / exhibition area	0.1136	2.96%

From table 19, it could be concluded that the introducing of meeting rooms would somehow increase the utilization rate of the area.

In conclusion, the application of quality function deployment and the kano model is useful for the service quality improvement in co-working space design according to this research project. It proves that dealing with people emotion and behavior, as in a service, is not too hard

to handle since there are tools available. The key lesson from the research is to understand the problem in front intently and wisely choose the tools that are appropriated for the creation of solution. In addition, every single opinion from every related parties is valuable and must not be ignored. By considering all the perspectives would ensure the ability to satisfy the customers result in an achievement of the business.



Chapter 7 Conclusions

This chapter provides the conclusion of the research on the topic of quality function deployment for service quality improvement in co-working space design and the recommendation for the future work.

7.1 Conclusion of the research

As mention in chapter 1, five trends that are shaping the future work environment could be separated into two main characteristics which are the technology-related and the human-related. By focusing on human, working environment is changing due to the new behaviors of the workforces, especially the millennial ones who are entering to the workforce market and introducing the new way of working. In addition, the willingness to work anytime, anywhere on any devices is highlighted by most of the organizational employees. In term of technology, the worldwide connection and the rapid growth of social media uses are also disrupting the way of working. As a result, most authorities are facing the challenges in adapting themselves to support these trends that mostly come with the younger generations who are recently hired into the organizations. Moreover, it seems to be difficult for the authorities who are looking towards the growth in their business but still doing their business through the application of traditional practice and ignoring the external situations to generate profits and survive in the high competition world.

The co-working space is recognized as one of the beneficial methods in driving the organization towards the creativity and innovation which would further lead to the business growth and sustainability. Furthermore, it is one of solutions in supporting the organization to cope with the emerging working trends. To answer the research question: “What facilities should be provided in co-working space in a state enterprise, EGAT, and what are the recommended services in order to strategically fit to the employee’s needs and the emerging trends?”, this research has been conducted.

Due to the fact that the elderly is getting retired from many organizations and are replaced by the fresh graduates or people in millennials generations, it could not be denied that the working environment preferred by most young workers has transformed from traditional office layout into common shared area. The research project is held by using the power utility state enterprise known as EGAT to be the case study. Prior to the generation of house of quality, the online questionnaire is conducted to collect the voice of employee which later translated

into employee requirement. The respondents of the questionnaire include employees from all deputies who work in the headquarter and provincial sites whose aged from less than 26 years old up to 60 years old.

The result received from the questionnaire feedback shows that most employees feel indifferent with the existing office. However, they are interested if the organization would establish a co-working space at its head office. The main purposes of use include to individually do creative and routine work, conduct a group meeting, connect with people from either same or different departments and take a rest from stressful work. As a result, facilities must be provided in order to offer effectiveness and productivity as well as comfort in working. In this research, power outlet must be installed at every table and the drinking vending machine is needed to be provided in the co-working space. The presence of these two things would not satisfy the space users, but, the users would be dissatisfied if they are absent. Printer, which is listed as the one-dimensional requirement is one of the facilities that should not be neglected as well. The presence of the printer would bring satisfaction to the employees in the co-working space. In contrast, its absence would bring dissatisfaction instead. Other components that are identified in the design framework include the internet access channel, locker, erasable board and projector with LCD screen. The presence of these things would attract more users to get into the space. Nevertheless, its absence would not bring dissatisfaction to the employees.

In term of back office operation, the preferred operation hours of the space is from eight o'clock in the morning until eight o'clock in the evening. The advantage from operating these long hours is the employee's ability to work overtime in a common room. The staffs could have time to talk to and share their knowledge with people from other departments and become a cross-functional community within the organization. The action surely strengthens the collaboration and relationship within and among teams.

Technology takes part in this phase since the book loan service is still required but in different managing method. The online channel for book searching and reserving has to be developed. The application of digital tools would reduce the required space for bookshelves and encourage the optimization of the floor area.

All the mentioned components are like the jigsaw pieces. When they are completely interlocked, they generate the effective co-working space service design and improvement. They

are the key elements in co-working space design that would strategically fit to the employee's needs and the emerging trends.

7.2 Future work

The conceptual design of co-working space at the area of existing library has been introduced, however, this suggested design could be used as a case study for co-working space establishment in other EGAT's locations across the country. Having been researched so far, the service quality of the co-working space design still has rooms for improvement.

First of all, in this research, the strategic guidance for service quality improvement has been recommended accordingly to the objective information. Nonetheless, service systems usually relate to the subjective factors that could not be measured numerically such as people's perspective, satisfaction, emotion and behavior. In order to improve service quality, offer better working atmosphere, build internal community and encourage innovation culture, the study of the subjective information could strengthen the strategy and promote the success story of the co-working space.

Second, in term of the space utilization rate, the introduction of internal events such as hackathon and innovation contest could be done in order to encourage the employee to visit the co-working space. The example cases include DTAC Accelerate and PEA innovation hub. DTAC Accelerate is the program organized by Total Access Communication Public Company Limited or DTAC. The company has a partnership with many famous companies such as KTBG and PTT in order to encourage and support the start-ups in Thailand. A lot of successful investors are invited to join the program as guest speakers or mentors. While DTAC is focusing on promoting start-ups in Thailand, PEA is concentrating on building innovation within the organization. The introduction of PEA innovation hub is done at PEA headquarter in order to offer a co-working space to its employees to exchange of knowledge across functions. Moreover, the authority also organizes the PEA Think Tank program and innovation bootcamp for its employees aiming at igniting the internal innovators to create the idea of promoting the organization to become a digital utility. So, a good service management could be done by EGAT as well through the introduction of such innovative programs.

Third, the co-working space would support the organization in term of energy consumption. It allows the employees to work in a common area, as a result, less energy is

consumed comparing to the consumption rate when all rooms in the buildings turn on all light bulbs and air conditioners. However, the strategy, policy and rules should be clearly specified in order to protect chaotic in managing the co-working space as well as to avoid crowded population during the prime time.

Fourth, since the space needs to open after the office hours, the agreement and compensation to the staffs who are responsible in taking care of the space should be taken into account. This includes the overtime compensation and shift schedule of the co-working space staffs. The leaders have to provide the proper management and make an agreement with the team.

Fifth, the application of digital tools and available technology could be done. For example, the organization could develop the room reservation system using online website or mobile application. The implementation of online community like forum or live chat would enhance the interaction of people.

Last, aside from the persons in charge who own the space assets, managers in all line functions have to support their employees in using the co-working space instead of forcing them to stay at the office desk working on routine tasks. Organizational policy must be revised in order to promote the interpersonal activities, support working across departments, create innovation as well as encourage co-creation and collaboration among deputies.

There are a lot of successful stories about co-working space management in the worldwide organizations. The researched organization could benchmark itself and take advantages from the existing space providers. Nonetheless, the organization has to customize the service management and design and create its own uniqueness for the co-working space to suit the organizational culture and employee requirement.

REFERENCES



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

REFERENCES

- Britannica. (n.d.) Concepts of design. [Online] Available at: <https://www.britannica.com/art/interior-design/Concepts-of-design> [Accessed 25th December 2019]
- Cambridge Dictionary. (2019) Cambridge Dictionary. [Online] Available at: <https://dictionary.cambridge.org/dictionary/english/hot-desk> [Accessed 15th December 2019]
- Chula Engineering Library. (2018) Chulalongkorn University Engineering Library. [Online] Available at: <https://www.library.eng.chula.ac.th/> [Accessed 3rd December 2018]
- CTDM. (2015) The Future of Education Trend Report 2015 [Online] CTDM. Available at: <https://www.cdtm.de/wp-content/uploads/The%20Future%20of%20Education.pdf> [Accessed 2nd December 2018]
- EGAT. (2013) About EGAT. [Online] EGAT Profile. Available at: https://www.egat.co.th/en/index.php?option=com_content&view=article&id=140&Itemid=178 [Accessed 26th November 2018]
- EGAT. (2017) Annual Report 2017. [Online] EGAT. Available at: <http://www.egat.co.th/en/images/annual-report/2017/egat-annual-eng-2017.pdf> [Accessed 26th November 2018]
- EGAT. (2018) Annual Report 2018. [Online] EGAT. Available at: <https://www.egat.co.th/en/images/annual-report/2018/egat-annual-eng-2018.pdf> [Accessed 26th December 2019]
- EGAT HR. (2019) Monthly Employee Statistic. [Online] EGAT HR. Available at: <https://www.hr.egat.co.th/> [Accessed 9th December 2019]
- Fuzi, A., Clifton, N. and Loudon, G. (2014) New in-house organizational spaces that support creativity and innovation: the co-working space. [Online] R & D Management Conference 2014. Available at: <https://repository.cardiffmet.ac.uk/bitstream/handle/10369/7725/AF-NC-GL%20R%26D%20Mgmt%20final.pdf?sequence=2&isAllowed=y> [Accessed 29th November 2018]
- Govers, C.P.M. (1996) 'What and how about quality function deployment (QFD)'. *International Journal of Production Economics*. 46 – 47, 575 – 585.
- Hashim, A.M. and Dawal, S.Z.M. (2012) 'Kano Model and QFD integration approach for Ergonomic Design Improvement'. *Social and Behavioral Sciences*. 57(2012), 22 – 32.
- Hauser, J.R. and Clausing, D. (1988) The House of Quality. [Online] *Harvard Business Review*. Available at: <https://hbr.org/1988/05/the-house-of-quality> [Accessed 28th November 2018]
- Hefley, B. and Murphy, W. (2008) *Service Science, Management and Engineering Education for the 21st Century*. New York: Springer.
- Huo, J. and Hong, Z. (2013) *Service Science in China*. Springer-Verlag Berlin Heidelberg.
- Kano, N. (n.d.) 'Life Cycle and Creation of Attractive Quality'. University of Tokyo. Tokyo: Science.

- Kidd, R. (2018) Internal vs External Customers: How Are They Different?. [Online] The Business of IT Blog. Available at: bmc.com/blogs/internal-vs-external-customers/ [Accessed 3rd December 2019]
- Laksanasamrith, E. (2018) Coworking space. [Online] Dsign Something. Available at: <https://dsignsomething.com/2016/02/12/coworking-space%E0%B8%9E%E0%B8%A5%E0%B8%B4%E0%B8%81%E0%B9%82%E0%B8%89%E0%B8%A1%E0%B8%9E%E0%B8%B7%E0%B9%89%E0%B8%99%E0%B8%97%E0%B8%B5%E0%B9%88%E0%B8%97%E0%B8%B3%E0%B8%87%E0%B8%B2%E0%B8%99%E0%B8%82/> [Accessed 3rd December 2018]
- Leclercq-Vandelannoitte, A. and Isaac, H. (2016) 'The new office: how coworking changes the work concept'. *Journal of Business Strategy*. 3(6), 3 – 9.
- Leelavansuk, T. (2018) On the Bank. [Online] The Cloud. Available at: <https://readthecloud.co/replace-6/> [Accessed 3rd December 2018]
- Master of Project Academy. (n.d.) LEAN Six Sigma: House of Quality. [Online] Master of Project Academy. Available at: <https://blog.masterofproject.com/house-of-quality/> [Accessed 28th November 2018]
- Moghimi, V., Jusan, M.B.M., Izadpanahi, P. and Mahdinejad, J. (2017) 'Incorporating user values into housing design through indirect user participation using MEC-QFD model'. *Journal of Building Engineering*. 9(2017), 76 – 83.
- Money & Banking Online. (2019) ChomMaiSaKhaKrungthai DesignTanSaMai PromTechnology TobJotYukDigital. [Online] Money & Banking Online. Available at: <https://www.moneyandbanking.co.th/new/27217/2/%E0%B9%82%E0%B8%89%E0%B8%A1%E0%B9%83%E0%B8%AB%E0%B8%A1%E0%B9%88%E0%B8%AA%E0%B8%B2%E0%B8%82%E0%B8%B2%E0%B8%81%E0%B8%A3%E0%B8%B8%E0%B8%87%E0%B9%84%E0%B8%97%E0%B8%A2-%E0%B8%94%E0%B8%B5%E0%B9%84%E0%B8%8B%E0%B8%99%E0%B9%8C%E0%B8%97%E0%B8%B1%E0%B8%99%E0%B8%AA%E0%B8%A1%E0%B8%B1%E0%B8%A2%E0%B8%9E%E0%B8%A3%E0%B9%89%E0%B8%AD%E0%B8%A1%E0%B9%80%E0%B8%97%E0%B8%84%E0%B9%82%E0%B8%99%E0%B9%82%E0%B8%A5%E0%B8%A2%E0%B8%B5%E0%B8%95%E0%B8%AD%E0%B8%9A> [Accessed 9th December 2019]
- Morgan, J. (2018) The Five Trends Shaping the Future of Work. [Online] IE Ideas. Available at: <https://www.ie.edu/corporate-relations/insights/the-five-trends-shaping-the-future-of-work/> [Accessed 2nd December 2018]
- PEA. (2017) Annual Report 2017 [Online] PEA. Available at: <https://www.pea.co.th/Portals/1/AnnualReport/PEA-Annual%20Report%202017-Eng.pdf> [Accessed 9th December 2019]
- PEA Innovationhub. (2019) JOIN US. [Online] PEA Innovationhub. Available at: <https://peainnovationhub.herokuapp.com/> [Accessed 9th December 2019]

- PEA Innovation Hub. (2019) 8 October. [Online] PEA Innovation Hub. Available at: <https://www.facebook.com/peaihub/> [Accessed 9th December 2019]
- PMAT. (2018) Thailand HR Day 2018: Disrupt to Design HR. [Online] PMAT – Personnel Management Association of Thailand. Available at: <https://www.facebook.com/pmatHRsociety/> [Accessed 27th November 2018]
- Richardson, A. (2010) Using Customer Journey Maps to Improve Customer Experience. [Online] Harvard Business Review. Available at: <http://www.iimageservicedesign.com/wpcontent/uploads/2015/07/Experience-Maps-Using-Customer-Journey-Maps-to-Improve-Customer-Experience.pdf> [Accessed 29th November 2018]
- Sharma, A. (2012) House of Quality. [Online] SlideShare. Available at: <https://www.slideshare.net/avinashsweetguy/house-of-quality-14734317> [Accessed 28th November 2018]
- Singh, P. (2018) Serve Your Employees With a Better Infrastructure. [Online] Entrepreneur India. Available at: <https://www.entrepreneur.com/article/316894> [Accessed 27th November 2018]
- Tontini, G. (2000) 'Identification of Customer Attractive and Must-Be Requirements Using a Modified Kano's Method: Guidelines and Case Study'. Annual Quality Congress Proceedings. 728 – 734.
- Qiting, P., Uno, N. and Kubota, Y. (2013) 'Kano Model Analysis of Customer Needs and Satisfaction at the Shanghai Disneyland'. Kyoto University. Kyoto: Graduate School of Management.

Appendix A

Questionnaire collecting voice of customer and the results

QUALITY FUNCTION DEPLOYMENT FOR SERVICE QUALITY IMPROVEMENT IN CO-WORKING SPACE DESIGN

This survey is part of the dissertation submitted in partial fulfilment of the requirements for the dual-degree program; Degree of Master of Science in Service Management and Design (SMD), University of Warwick and Degree of Master of Engineering in Engineering Management, Chulalongkorn University; this research is self-funded by the student.

Project title: Quality function deployment for service quality improvement in co-working space design

Name of researcher: Ms. Patcharin Tanuphol

This survey aims to survey customer requirements on the co-working space in an organization to improve service design.

Participation in this research is voluntary with an assurance that no negative consequences could arise from the refusal of your participation. The data will be corrected anonymously, and once completed it is not possible for participants to withdraw their data.

Please answer based on your experience of working in the organization.

Question 1: Do you satisfy on your current office?

- Extremely satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied
- Extremely dissatisfied

Question 2: If the organization has co-working space, how would you feel?

- Satisfied
- It should be this way
- Indifferent
- Dissatisfied
- Other: _____ (Please specify)

Question 3: What are your purposes of visiting co-working space? (Can select multiple answers)

- Do creative work
- Do routine work
- Meeting with team
- Self-reading
- Self-learning
- Community building
- Do hobbies
- Get a rest / relax
- Drinking
- Other: _____ (Please specify)

Question 4: At What time do you think you would use the co-working space? (Can select multiple answers)

- In the morning (Weekday: 8AM – 12PM)
- During lunch break (Weekday: 12PM – 1PM)
- In the afternoon (Weekday: 1PM – 4PM)
- After office hours (Weekday: 4PM Onwards)
- On weekend (Saturday – Sunday)

Question 5: What are your preferable types of space? (Can select multiple answers)

- Individual seats
- Group meeting area
- Hot desks
- Recreation area
- Events / workshop / exhibition area
- Relaxed zone
- Other: _____ (Please specify)

Question 6: In a co-working space, how would you feel if you _____?

	Satisfied	Must-be	Indifferent	Dissatisfied	Other
Can do activities you prefer in the allocated space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can work / read on your own without making noise in an open floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can print or photocopy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do a work and print later	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can get a drink without leaving the area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can get a drink from the outside	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can leave your belongings at the co-working space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have to take things with you	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
access internet via Wi-Fi / LAN	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access internet via personal hotspot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can charge electronic devices at a table	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
May charge electronic devices at a charging point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Take notes on erasable board or paper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Jot notes in your notebook	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
present the file using electronic file via a computer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Individuals bring their own laptop or tablet for meeting and presenting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can use the co-working space whenever you want to	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have to visit the co-working space only in the office hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Select and loan a book via online system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Apply existing library processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 7: Further suggestions you have for the co-working space design in the organization.

Question 8: What is your deputy?

- Administration
- Strategy
- Finance and accounting
- Generation
- Fuel
- Transmission system
- Power business
- Power plant development and renewable energy
- Governor and internal audit office

Question 9: What is your age?

- Less than 26 years old
- 26 – 40 years old
- 41 – 55 years old
- More than 55 years old

Question 10: Where is your current workplace?

- Headquarter
- Provincial offices
- Other: _____ (Please specify)

Questionnaire Results:

Question 1: Do you satisfy on your current office?

- Extremely satisfied: 8.89%
- Satisfied: 26.67%
- Neither satisfied nor dissatisfied: 53.33%
- Dissatisfied: 6.67%
- Extremely dissatisfied: 4.44%

Question 2: If the organization has co-working space, how would you feel?

- Satisfied: 55.56%
- It should be this way: 37.77%
- Indifferent: 6.67%
- Dissatisfied
- Other: _____ (Please specify)

Question 3: What are your purposes of visiting co-working space? (Can select multiple answers)

- Do creative work: 65.91%
- Do routine work: 79.55%
- Meeting with team: 70.45%
- Self-reading: 15.91%
- Self-learning: 13.64%
- Community building: 47.73%
- Do hobbies: 9.09%
- Get a rest / relax: 47.73%
- Drinking: 6.82%
- Other: _____ (Please specify)
 - Greeting guests: 4.55%

Question 4: At What time do you think you would use the co-working space? (Can select multiple answers)

- In the morning (Weekday: 8AM – 12PM): 61.36%
- During lunch break (Weekday: 12PM – 1PM): 56.82%
- In the afternoon (Weekday: 1PM – 4PM): 86.36%
- After office hours (Weekday: 4PM Onwards): 65.91%
- On weekend (Saturday – Sunday): 29.55%

Question 5: What are your preferable types of space? (Can select multiple answers)

- Individual seats: 70.45%
- Group meeting area: 93.18%
- Hot desks: 86.36%
- Recreation area: 45.45%
- Events / workshop / exhibition area: 11.36%
- Relaxed zone: 77.27%
- Other: _____ (Please specify)

Question 6: In a co-working space, how would you feel if you _____?

	Satisfied	Must-be	Indifferent	Dissatisfied	Other
Can do activities you prefer in the allocated space	65.91%	22.73%	11.36%	0.00%	0.00%
Can work / read on your own without making noise in an open floor	9.09%	31.82%	52.27%	6.82%	0.00%
Can print or photocopy	75.00%	13.64%	11.36%	0.00%	0.00%
Do a work and print later	0.00%	2.27%	22.73%	75.00%	0.00%
Can get a drink without leaving the area	2.27%	56.82%	40.91%	0.00%	0.00%
Can get a drink from the outside	0.00%	38.64%	4.55%	56.82%	0.00%
Can leave your belongings at the co-working space	9.09%	38.64%	52.27%	0.00%	0.00%
Have to take things with you	0.00%	2.27%	68.18%	29.55%	0.00%
access internet via Wi-Fi / LAN	61.36%	36.36%	2.27%	0.00%	0.00%
Access internet via personal hotspot	0.00%	56.82%	20.45%	22.73%	0.00%
Can charge electronic devices at a table	13.64%	68.18%	18.18%	0.00%	0.00%
May charge electronic devices at a charging point	2.27%	4.55%	29.55%	64.64%	0.00%
Take notes on erasable board or paper	31.82%	22.73%	43.18%	2.27%	0.00%
Jot notes in your notebook	2.27%	11.36%	79.55%	6.82%	0.00%
present the file using electronic file via a computer	9.09%	27.27%	61.36%	2.27%	0.00%
Individuals bring their own laptop or tablet for meeting and presenting	6.82%	18.18%	68.18%	6.82%	0.00%
Can use the co-working space whenever you want to	40.91%	38.64%	20.45%	0.00%	0.00%
Have to visit the co-working space only in the office hours	4.55%	18.18%	40.91%	36.36%	0.00%
Select and loan a book via online	50.00%	38.64%	9.09%	0.00%	2.27%

system

Apply existing library processes	9.09%	4.55%	70.45%	15.91%	0.00%
----------------------------------	-------	-------	--------	--------	-------

Question 7: Further suggestions you have for the co-working space design in the organization.

- A Slider
- Allow Food and Drink
- Need Managerial Support and Policy
- Open until 8PM
- EGAT should have a common work area or at less a room for informal meeting. However, the room must be modernly decorated and suit for employees in all generations.
- The current library is out-of-date and creates no impact on EGAT's business.
- The original library has a wide area. But, it should provide several corners allowing employee to sit, share, work in groups, think of personal ideas by having various room types.
- EGAT should consider hosting a mini conference or mini event at the existing area.
- The room should let the users to bring a drink with a tight lid in order to maintain cleanliness.
- A table and a power socket should be provided for using the laptop conveniently.
- Projector borrowing service and individual seat are a must.
- An area for provincial employees to work and stay when coming to the headquarter is recommended.
- Noise should not be restricted in the library.
- Management-level staffs should take part in promoting policy as well as allocate budget in establishing the co-working space project.

Question 8: What is your deputy?

- Administration: 22.73%
- Strategy: 13.64%
- Finance and accounting: 9.09%
- Generation: 15.90%
- Fuel: 4.55%
- Transmission system: 13.64%
- Power business: 11.36%
- Power plant development and renewable energy: 6.82%
- Governor and internal audit office: 2.27%

Question 9: What is your age?

- Less than 26 years old: 27.27%
- 26 – 40 years old: 43.18%
- 41 – 55 years old: 20.46%
- More than 55 years old: 9.09%

Question 10: Where is your current workplace?

- Headquarter: 63.63%
- Provincial offices: 31.82%
- Other: _____ (Please specify)
 - Power plant in Laos: 4.55%

Appendix B

Conceptual design for the co-working space in the organization

Conceptual Design: Facility

Proper area allocation is one of the attractive factors for service design in a co-working space. The area allocation could be divided according to the feedback gained from the questionnaire into various types of room. The prioritization of the area is concluded in table B.1 referring to the employee preference and is developed based on the assumption that each room type has a direct variation to the employee preference.

Table B.1 The importance of each room type

Room type	Employee preference	Percentage of importance
Group meeting area	0.9318	24.26%
Hot desks	0.8636	22.49%
Relaxed zone	0.7727	20.12%
Individual seats	0.7045	18.34%
Recreation area	0.4545	11.83%
Events / workshop / exhibition area	0.1136	2.96%

This leads to the separation of the area following the information stated in table B.1, it could be concluded that in the area of 1,000 square-meter of the existing library, the new allocation of the area for co-working space design should be designed following this suggested priority. The recommended model consists of six room types listed as group meeting area, hot desks, relaxed zone, individual seats, recreation area and area for events, workshop and exhibition. Furthermore, within the area, drinking vending machine and printer are the two most important things to have in the co-working space. So, the summary of the conceptual is illustrated below.

Figure B-1 shows the location of the drinking vending machine which is located near the hot desks. This is done in order to provide convenience to the co-working space users. Furthermore, as displayed in figure B-2, a printer, which is in the one-dimensional category, is installed next to individual seats to provide printing and photocopying service as well.



FIGURE B-1 DRINKING VENDING MACHINE IN THE HOT DESKS ZONE



FIGURE B-2 PRINTER NEARBY THE INDIVIDUAL SEATS

Group Meeting Area

Therefore, three rooms, illustrated in figure B-3, figure B-4 and figure B-5, are designed in order to serve different number of meeting participants.



FIGURE B-3 MEETING ROOM WITH ROUNDED TABLE



FIGURE B-4 LARGE MEETING ROOM



FIGURE B-5 SMALL MEETING ROOM

Furthermore, an LCD monitor should be installed in every single room although its level of satisfaction is indifferent. Beside from the equipment for presenting purpose, the wall should be decorated with erasable mirror allowing the users to discuss using post-it and to take notes on the wide area of whole sided wall. In addition, the two rooms, shown in figure 27 and figure 28, are separated using folding transparent door, therefore, they are adjustable and can combine together to be a wider meeting room.

Hot Desks

The interior design of the hot desks is illustrated in figure B-6, figure B-7 and figure B-8. Various seats and table could be found in the area in order to fulfil different purposes of use of the staffs.



FIGURE B-6 HOT DESKS

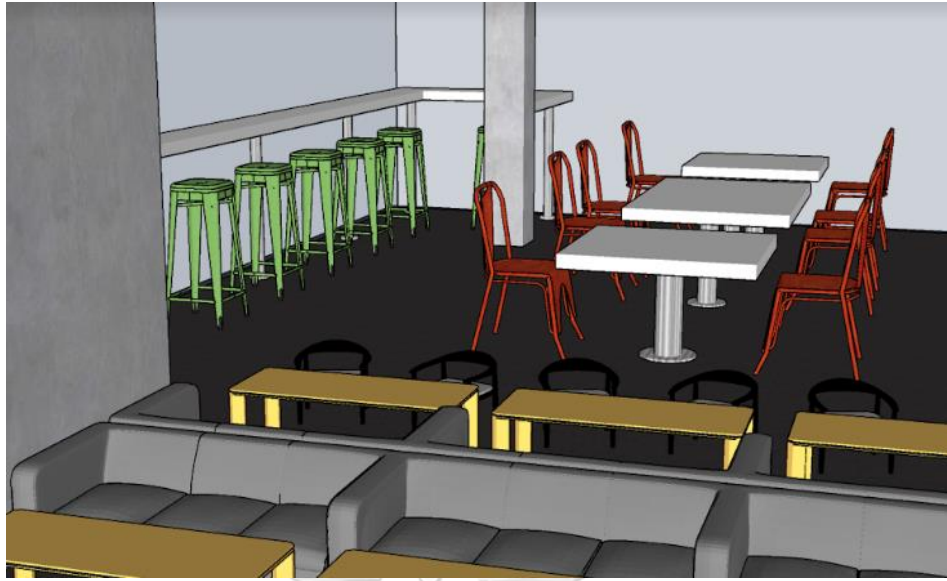


FIGURE B-7 HOT DESKS



FIGURE B-8 HOT DESKS

Relaxed Zone

To reduce stress from work and provide the relaxation to the employees, the establishment of relaxed zone is taken into consideration. The draft-cut design of the zone is shown in figure B-9.



FIGURE B-9 PERSONAL BED IN THE RELAXED ZONE

Individual Seats

Individual seats, shown in figure B-10, is designed for self-working, self-reading and self-learning. So, it allows the area visitors to concentrate on their own tasks without interrupted by other people.



FIGURE B-10 INDIVIDUAL SEATS

Recreation Zone

The draft-cut of recreation zone is illustrated in figure B-11. The area contains the bean bag, Japanese-style table, console games, as well as home studio.



FIGURE B-11 RECREATION ZONE

Event / Workshop / Exhibition Area

Figure B-12 displays the conceptual design for the allocated space for event organizing. It is in the same area with hot desks zone. The furniture in the area should have mobility design and is easy to move. In addition, the area could be decorated occasionally upon types of event or workshop.



FIGURE B-12 COMMON AREA FOR ANY ACTIVITIES

Reception and Book Pick-up Counter

At the front most of the co-working space entrance, the reception counter, displayed in figure B-13, is installed in order to provide information to all space visitors. At the same time, it is the location where the staffs would pick up their reserved books and journals.

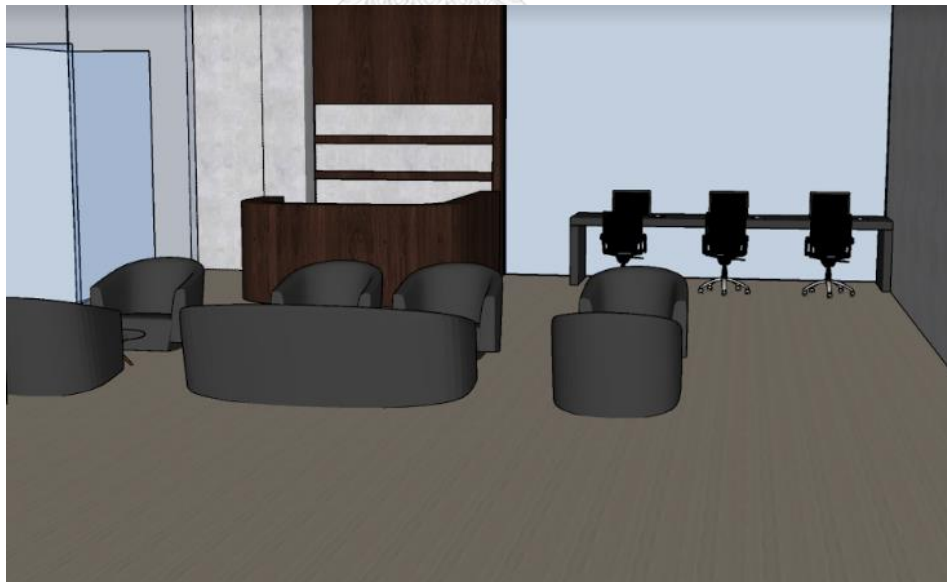
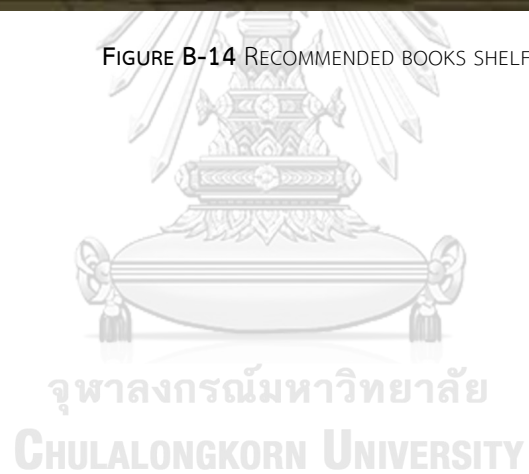


FIGURE B-13 RECEPTION COUNTER

To promote the life-long learning of the employees, the pop-up shelf is introduced on one side of the co-working space aiming at recommending new interesting books at the time as shown in figure B-14.



FIGURE B-14 RECOMMENDED BOOKS SHELF



VITA

NAME	PATCHARIN TANUPHOL
DATE OF BIRTH	01 Dec 1992
PLACE OF BIRTH	Bangkok
INSTITUTIONS ATTENDED	Bachelor of Engineering, Chulalongkorn University
HOME ADDRESS	79/205, Bangplub, Pakkred, Nonthaburi. 11120



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY