A STUDY OF DRIVING FACTORS IN MODEL PLANT FOR ELECTRICITY GENERATING AUTHORITY OF THAILAND (EGAT) IN ATTAINING GLOBAL TOP QUARTILE UTILITY: A CASE STUDY OF NORTH BANGKOK POWER PLANT COMBINED CYCLE UNIT 1.

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ABSTRACT

This research study of driving factors in model plant for Electricity Generating Authority of Thailand (EGAT) in attaining Global Top Quartile Utility: A case study of North Bangkok Power Plant Combined Cycle unit 1. The objectives of the study was to study and find out the working system model concept of driving factors to elevate the performance standard in attaining Global Top Quartile Utility. The research methodology is Qualitative research with Snowball Sampling method, which only interview from five groups of interviewees from twenty-six officers in North Bangkok Power plant and other divisions in EGAT. The result is The Working System Model Concept of ten factors. Human and Enterprise Management Factors: The first priority is Strategy that communicate with the same goal. One driving on the leader, next driving on the culture between employee and coaching team working. Individual Positive thinking & willingness mindset and HRD&HRM are pulled in the process of selection employee and coaching team. Performance Factors: The first one is Reduced Gap of POF, UOF and UDF. Equipment of classification from RCM, planning and management, Corrective maintenance, Preventive Maintenance, Predictive Maintenance, Proactive Maintenance, Replaced with the new components and use innovation tools are mainly tools to reduce the maintenance time. IT & KM database are pulled in the process of sharing information in CSR in process & After Process. Stakeholder and Sustainable Factors: EGATIF is a representative Financial Structure Model. Stakeholder are pulled in the process of monitoring of funding. Community are pulled in the process of CSR in process & After Process. Finally, the success result of all pushing driving force of Human and Enterprise Management Factors, Performance Factors and Stakeholder and Sustainable Factors.

KEY WORDS: The Working System Model Concept/ Model Plant/ Driving Factors/ Global Top Quartile Utility/ Electricity Generating Authority of Thailand

111 pages

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF FIGURES

LIST OF FIGURES (cont.)

CHAPTER I
INTRODUCTION

This chapter explain about the basic background knowledge of the electricity generation system of Thailand, Research Objectives, Research Question and Research Contribution

1.1 Research Background and Problem Statement

Thailand is a middle income country of manufacturing base for over 20 years. The government want to change to be Wealth and High income country. It is time to move to Thailand 4.0 for change and focus on innovation. Three things that the government want to change are: 1. Move from commodity to innovation product 2. Move from heavy industries to Technology, creative thinking and innovation industries 3. Move from make and sell product to more services and more value added.

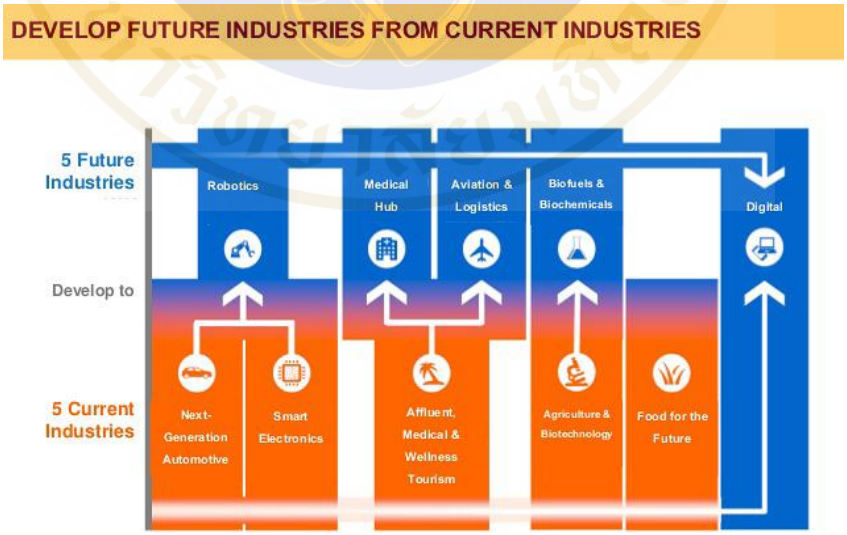

Figure 1.1 Ten industries in Thailand 4.0

Source: Eastern Economic Corridor. [Online].Available http:// http://eec.vec.go.th (March 2, 2018)

Ten industries must be drive in Thailand 4.0 are Next-Generation Automotive, Smart electronics, Affluent Medical and Wellness Tourism, Agriculture and Biotechnology, Food for the Future, Robotics, Aviation and Logistics, Biofuels and Bio chemicals, Digital and Medical Hub. The final transformation is Digitalization. Electricity are the main infrastructure of all ten industries of Thailand 4.0.

The policy of the government also supports for many investments in the country are Infrastructure, sky train, subway, Water Controller management, Business hotel and travelling and Medical Hub services that cause by more demand on electricity in every year. The industrial and commercial consumption also use more demand on electricity. The picture below shows the electricity consumption by Sector in 2014.

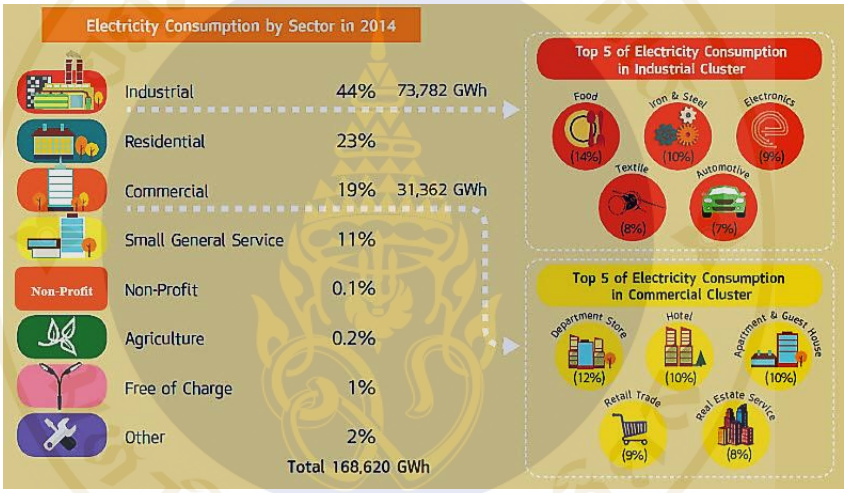

Figure 1.2 Electricity Consumption by Sector in 2014

Source: Energy Policy and Planning Office, Ministry of Energy. [Online].Available http://www.eppo.go.th (October 30, 2016)

Electricity Consumption by Sector in 2014 separate from 8 groups: Industrial 44%, Residential 23%, Commercial 19%, Small General Service 11%, Non-Profit 0.1%, Agriculture 0.2%, Free of charge 1% and other 2%. Top Five groups of Electricity Consumption in industrial Cluster are Food, Iron & Steel, Electronics, Textile and Automotive respectively. Top Five groups of Electricity Consumption in Commercial Cluster are Department Store, Hotel, Apartment & Guest House, Retail Trade and Real Estate Service respectively.

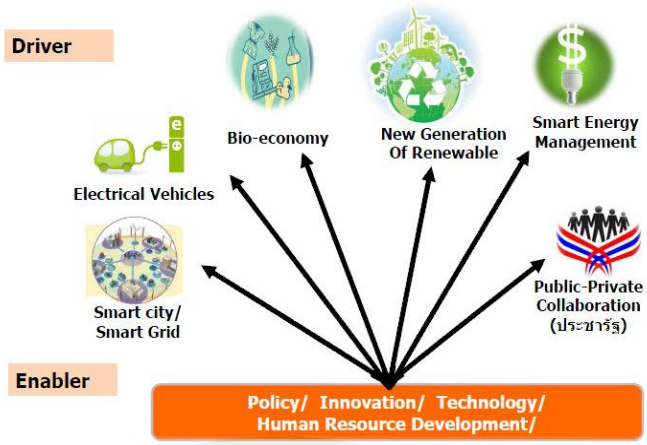

Figure 1.3 The ministry of energy direction of Energy 4.0

Source: Areepong Bhoocha-Oom, Permanent Secretary of the Ministry of Energy of Thailand, 28th October 2016. "The direction of Energy 4.0 in Thailand". [Presentation]. Nonthaburi: Electricity Generating Authority of Thailand Head Office, Bang Kruai, Nonthaburi.

The ministry of energy works on the same direction from the government. The point on energy 4.0 in Thailand are Smart city Smart Grid, Electrical Vehicles, Bio-economy, New Generation Of Renewable, Smart Energy Management and Public-Private Collaboration integrate with Human Resource Development, Internal and Growth with Technology and Innovation.

Electricity Generating Authority of Thailand (EGAT) is Thailand's state-owned power utility under the Ministry of Energy. EGAT responsible for development power generation, acquirement, supply and transmission electricity system. To stabilize the system and manage reasonable electricity prices as well as corporate social responsibility, Community and Environment. EGAT must have to support Thailand 4.0 and Electricity Consumption of Thai people.

Electricity Generating Authority of Thailand (EGAT) is Thailand's leading state-owned power utility under the Ministry of Energy. EGAT responsible for development power generation, acquirement, supply and transmission electricity system. To stabilize the system and manage reasonable electricity prices as well as corporate social responsibility, Community and Environment. EGAT are the largest power producer in Thailand. Thailand has adopted the enhanced single buyer model (ESB) in which EGAT is in charge of

electricity supply and the sole buyer of electricity. EGAT is also responsible for the country's transmission system.

On October 2016 Thailand's gross energy generation is 41,097.25 MW. EGAT power plants has an installed generating capacity of 16,376.13 MW or 40.28 percent of the country's gross energy generation. Percentage of the System Capacity from type of power plant: Thermal 8.87%, Combined Cycle 22.41%, Hydropower 8.39%, Diesel 0.07% and Renewable energy and the others 0.10%.

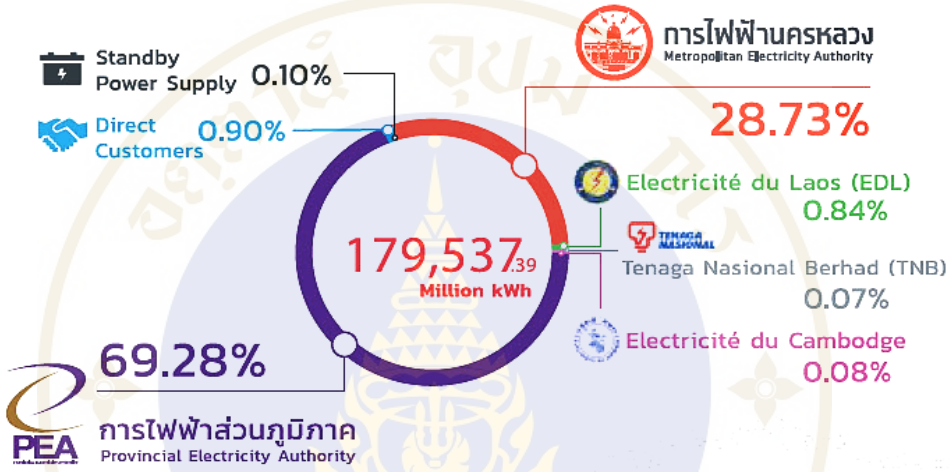

Figure 1.4 Energy Sales in 2016

Source: Electricity Generating Authority of Thailand. [Online]. Available http://www.egat.co.th (October 30, 2016)

EGAT sold total of 179,537.39 million kWh of electric energy out which 51,577.37 million kWh to the Metropolitan Electricity Authority (MEA) and 124,376.08 million kWh to the Provincial Electricity Authority (PEA) which were the main customers, 1,621.66 million kWh to direct customers, 1,768.89 million kWh to neighboring countries (Lao, Malaysia, and Cambodia) and 193.39 million kWh to the customers purchasing electricity for temporary and standby use and other kinds of customers.

The performance of EGAT's power plants

No.	Performance	2012	2013	2014	2015
1.	Heat rate (kJ/kWh)	8,662.00	8,620.00	8,503.00	8,286.00
2.	GWEAF (%)	90.54	92.10	92.80	92.93
3.	POF (%)	5.00	4.10	3.90	3.98
4.	UOF (%)	2.84	2.30	2.30	2.38
5.	UDF (%)	1.62	1.50	1.00	0.71

Figure 1.5 The performance of EGAT's power plant

Source: Electricity Generating Authority of Thailand. [Online]. Available http://www.egat.co.th (October 30, 2016)

In 2015, the overall performance of EGAT generating power plants was improved continuously with lower heat rate than that in the previous year. The generating weighted equivalent availability factor (GWEAF) of EGAT power plants amounted to 0.13 percent, higher than that of the preceding year due to the control measure of the unplanned outage. The planned outage factor (POF) and the unplanned outage factor (UOF) in 2015 were both 0.08 percent higher than those in 2014. The Unit Derating factor (UDF) in 2015 was 0.29 percent lower than that in 2014. EGAT has been able to control the rate of UOF to be less than 3 percent continuously since 2010.

The Three plans for EGAT to implement following the Ministry of Energy are: 1) The Strengthening Security of Thailand power system: To supply enough electricity to all power demand. The diversity of fuel and suitable balancing fuel to produce electricity. Reduce fuel consumption of any kind of excessive fuel in electricity system. 2) The economy of Thailand: To consider the suitable economic cost of the electricity. 3) The Environment: To reduce the impact on the environment and reducing the amount of carbon dioxide emissions per unit of electricity produced into the atmosphere.

While the electricity consumption form residential cluster use electricity form solar Rooftop in the sunrise. Every six o'clock in the evening of the day Households have more demand for electricity in the EGAT system. Non-solar energy sources more flexible it is used to produce electricity to replace solar electricity, which suddenly drops after the sun goes down. So EGAT must solve this problem by rely on Hydropower, which can speed up the production of electricity. Use Combined Cycle, which greatly accelerated the power supply during peak power demand. It may be necessary to use

more thermal power plant supercritical type to response the problem that need to operate Start and Stop the machine or increase the volume of electricity. Development of automatic transmission system. To adjust the order according to the potential of renewable electricity generation in each period. And Research and invest in developing new energy storage systems.

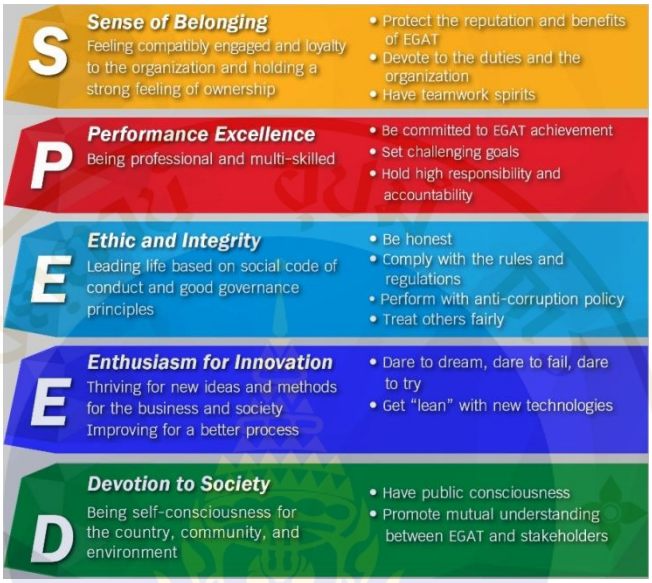

Figure 1.6 EGAT Core Value and Corporate Culture

EGAT's vision is Innovate Power solutions for a better life. EGAT Core Value and Corporate Culture is "SPEED" that consisting of: 1) S-Sense of Belonging 2) P-Performance Excellence 3) E- Ethic and Integrity 4) E-Enthusiasm for Innovation 5) D-Devotion to Society. EGAT Core Value and Corporate Culture show in the picture below.

EGAT's corporate governance is based on 6 pillars of good corporate governance consisting of: Rules of Law, Moral Integrity, Transparency, Participation, Responsibility and Accountability and Effectiveness and Efficiency

The Electricity Generation are the main driving cost of the competitive advantage of the business sector Industry, households and supporting Thailand 4.0, so EGAT must be elevate High Performance Organization target towards the global organization "Global Top Quartile Utility".

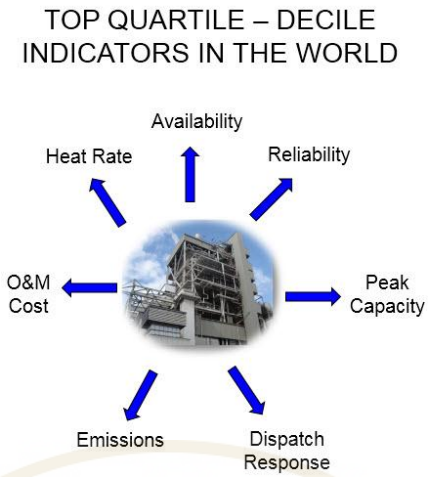

Figure 1.7 The Top Quartile – Decile indicators in the world

Source: "World Energy Council" February 28, 2017. [Online]. Available https://www.worldenergy.org/work-programme/energy-perspectives-studies-groups/performance-of-generating-plant

The Top Quartile – Decile indicators in the world are: Availability, Heat Rate, Reliability, O&M Cost, Peak Capacity, Emissions and Dispatch Response.

But all of The EGAT combined cycle power plants has not been in Global Top Quartile Utility Standard, Some of them cannot serve electricity generation, according to Global Top Quartile Utility. The way that will lead to be the Global Top Quartile. There needs to get the Availability Factor (GWEAF) with efficiency standards.

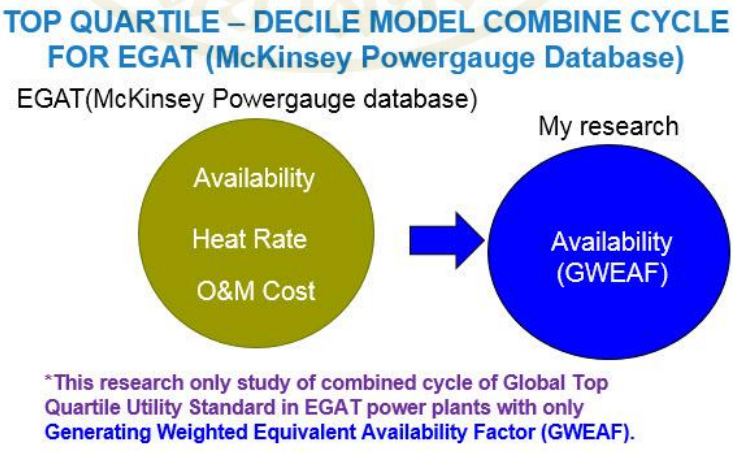

Figure 1.8 Top Quartile-Decile model combined cycle for EGAT and research scope of this project

EGAT will be using Benchmark with McKinsey (McKinsey Powergauge database), which covers more than 600 locations (Coal Thermal Powerplant, Combine Cycle Power Plant) in Europe, America, Asia and Australia. McKinsey Powergauge Database use three indicators for Top Quartile – Decile Utility Standard. There are Availability, Heat Rate and O&M Cost. This research only study of combined cycle of Global Top Quartile Utility Standard in EGAT power plants with only Generating Weighted Equivalent Availability Factor (GWEAF).

The current situation, all of The EGAT combined cycle power plants has not been in Global Top Quartile Utility Standard, some of them cannot serve electricity generation, according to Global Top Quartile Utility. The Top Quartile Utility Standard must be expand to all EGAT power plants and combined cycle power plants. How to work and manage system for driving on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model?

Table 1.1 Top 20 Gas Combined Cycle Factors 2015 in USA

Top 20 Gas Combined Cycle Capacity Factors (2015) 2

Rank	Owner/Operator	Plant	State	Capacity MW	Generation (GWh)	Capacity Factor	Fuel Consumption MMBtu	Heat Rate (MMBtu/MWh)	2014 Rank
1	Nevada Cogeneration Assoc	Garnet Valley	NV	87	723	95.3%	5,286,041	7.312	
2	Southern	Washington County Cogen	AL	104	834	91.9%	7,509,476	9.009	
3	OG&E	McClain	OK	494	3,927	90.8%	26,910,619	6.852	
4	Orlando CoGen Ltd LP	Orlando Cogen LP	FL	125	988	90.2%	7,775,940	7.874	
5	Dynegy	Fayette	PA	665	5,244	90.1%	38,918,443	7.421	
6	Southern	Victor J Daniel Jr	MS	1,027	8,094	90.0%	57,891,318	7.153	
7	OLS Energy	Chino	CA	29	224	89.1%	1,598,251	7.126	2
8	Nevada Cogeneration Assoc	Black Mountain	NV	93	725	88.8%	4,796,016	6.620	9
9	Clark County PUD	River Road	WA	234	1,812	88.4%	13,210,230	7.288	
10	Avista Corp	Coyote Springs II	OR	246	1,892	87.8%	13,259,821	7.009	
11	Dominion	Chesterfield	VA	430	3,290	87.5%	23,981,954	7.288	
12	CMS Michigan LLC	Michigan Power	MI	136	1,037	87.4%	9,930,789	9.573	20
13	Dynegy	Washington	OH	637	4,869	87.3%	35,874,383	7.368	
14	Liberty Electric Power LLC	Liberty	PA	541	4,123	87.0%	30,002,787	7.277	
15	SMUD	Cosumnes	CA	519	3,924	86.3%	26,607,071	6.780	1
16	Graphic Packaging	Santa Clara Mill	CA	27	200	86.0%	1,132,190	5.668	4
17	SCANA	John S Rainey	SC	495	3,710	85.6%	26,857,346	7.240	
18	LS Power	Hog Bayou	AL	238	1,765	84.8%	13,210,443	7.484	
19	AEP	Waterford	OH	830	6,152	84.6%	43,456,105	7.064	
20	JEA	Brandy Branch	FL	537	3,978	84.5%	28,166,008	7.081	
				Total	Total	Average	Total	Average	
		Top 20 Capacity Factor		7,490	57,511	87.7%	416,375,231	7.24	
		EIA Reporting		236,424	1,083,477	52.3%	7,963,835,146	7.35	

Source: "Power Engineering" February 28, 2017. [Online]. Available http://www.power-eng.com/articles/print/volume-120/issue-12/features/power-plant-performance-in-2015.html

Top 20 Gas Combined Cycle Factors 2015 in USA. The availability factor show in the Capacity Factor column. Top three of Gas Combined Cycles in USA are Granet Valley 95.3%, Washington Country Cogen 91.9% and McClain 90.8%.

Table 1.2 The Global Top Quartile and Global Top Decile groups of EGAT Combined Cycle power plants of EGAT report

Top Quartile - Decile Model (Combine Cycle)	
Top Quartile : 92.9%	Top Decile : 95.7%

POWER PLANT	GWEAF	PASS	NOT PASS
NBK-C1	92.96%	✓	-
NBK-C2	93.37%	✓	-
SBK-C3	94.71%	✓	-
BPK-C6 (new construction power plant replaced by retired power plant)	92.89%	✓	-
SBK-C4 (new construction power plant replaced by retired power plant)	93.27%	✓	-
BPK-C5	91.50%	-	✗
CHN-C1	87.41%	-	✗
WNC-C4	92.80%	-	✗
CHN-C2	92.22%	-	✗

The EGAT report of the meeting in the topic of the strategic plan in the Global Top Quartile and Global Top Decile groups of EGAT Combined Cycle power plants on Friday 19, August 2016, at EGAT's Head Office, Nonthaburi show in the picture below. (NBK = North Bangkok Power plant, SBK = South Bangkok Power plant, BPK = Bang Pakong Power Plant, CHN = Chana Power Plant, WNC = Wang Noi Power Plant)

Mathematically: GWEAF = 100% - POF – (UOF+UDF)

POF calculate from the cycle of maintenance power plant. UOF and UDF calculate from the best practice in every seven years of maintenance power plant. ((POF) = Planned outage factor, (UOF)= Unplanned outage factor, (UDF)= Unit derating factor)

Table 1.3 New Grouping of Combined Cycle that cannot serve electricity generation, according to Global Top Quartile Utility

POWER PLANT	GWEAF	NOT PASS
Group 1 Nearly pass Top Quartile		
BPK-C5	91.50%	✗
WNC-C4	92.80%	✗
CHN-C2	92.22%	✗
Group 2 Old power plant construction (Difficulty to pass Top Quartile)		
CHN-C1	87.41%	✗

Grouping two groups of EGAT combined cycle that cannot serve electricity generation, according to Global Top Quartile Utility. Group 1 that nearly pass top quartile are BPK-C5, WNC-C4 and CHN-C2. Group 2 that old power plant construction (Difficulty to pass top quartile) is CHN-C1.

I'm Suphischa Tumthong. I work at Electricity Generating Authority of Thailand in Mechanical Maintenance Division and responsible with North Bangkok power plants and other power plants in EGAT in supporting of maintenance power plants for efficiently duration of Planned Outage Factor (POF), Unplanned Outage (UOF) and Unplanned Derated Factor (UOF). The installed capacity and the availability must be getting in Global Top Quartile Utility standard. This is an interesting study in this research work. The topic is a study of driving factors in model plant for Electricity Generating Authority of Thailand (EGAT) in attaining Global Top Quartile Utility: A case study of North Bangkok power plant combined cycle unit 1.

Figure 1.9 North Bangkok Power Plant Combined Cycle Unit 1

This research study of the Model Plant in North Bangkok power plant unit 1, which is the center to supply electricity to customers in Bangkok and surrounding provinces in the central part of Thailand. They are the large power plant with Net Capacity and Capacity power contracts at 704.0 MW and 670.0 MW respectively.

North Bangkok power plant unit 1 use the high technology, which is accept from the reliability and results of operations from the international. The technology of electricity generation, the specialization in highly maintenance and high efficiency compared to other types of power plants. The best development of management systems of generation operation, North Bangkok power plant unit 1 has been selected as the first "Model Plant" in EGAT to implement for the strategic plan in "Global Top Quartile Utility" by McKinsey & Company as a consultant. A good performance index gets in the high of Generating Weighted Equivalent Availability Factor (GWEAF). The index of Planned Outage Factor (POF), Unplanned Outage Factor (UOF) and The Unit Derating factor (UDF) are relatively low. The heat rate index is also low. (POF = 3.42%, UOF+UDF = 3.62%, GWEAF = 92.96%)

North Bangkok power plant unit 1 have high efficiency compared to power plants using gas from the West power plant in Thailand. The site is located near the community center of end users. It has been ranked as a power plant to serve electricity into the system first and full capacity.

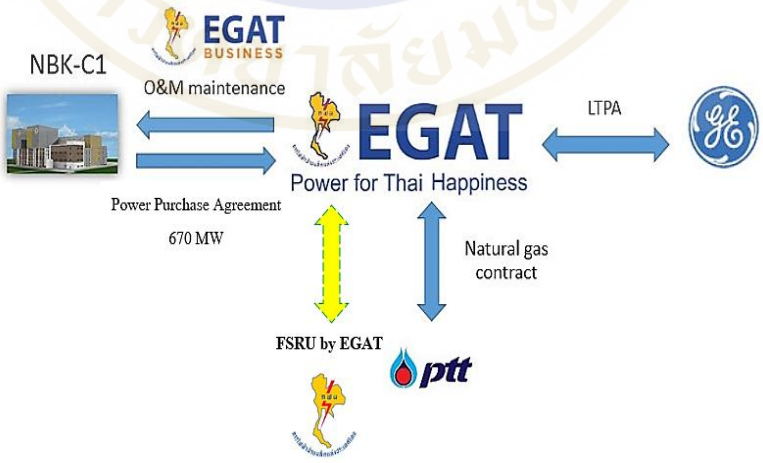

Figure 1.10 Flow of North Bangkok Power Plant Combined Cycle Unit 1 with operation and maintenance, LTPA, Natural Gas Contract, FSRU and Power Purchase Agreement

North Bangkok power plant unit 1 get The Long Term Parts Agreement (LTPA) with GE Energy Parts International LLC and General Electric International Operations Company, Inc., which is a manufacturer of Gas Turbine Generator, to acquire in spare parts for maintenance the North Bangkok power plant unit 1 and unit 2. LTPA contract expires in every seven years. It ensures that there will be stability and continuity in the operation and maintenance. The Power Purchase Agreement (PPA) of North Bangkok power plant unit 1 is 670 MW. At present North Bangkok power plant unit 1 have Natural gas contract with PTT Public Company Limited, but in 2066 North Bangkok power plant unit 1 will use Liquefied Natural Gas (LNG) by EGAT with Floating Storage Regasification Unit (FSRU). The Specialist Operation and Maintenance of North Bangkok power plant unit 1 manage by EGAT Business O&M maintenance.

Figure 1.11 EGATIF Fund of North Bangkok power plant unit 1

EGATIF Fund of North Bangkok power plant unit 1 has based on generation capacity with the Fund Contracted Available Hour. EGAT will retain ownership and management of North Bangkok power plants unit 1. EGAT is the largest unit holder of the Fund. The number of units is 25 percent of the total number of units sold.

Figure 1.12 Location of North Bangkok Combined Cycle Power Plant Unit 1

North Bangkok Combined Cycle Power Plant Unit 1 is located at 53 Moo 2 Bang Kruai sub-district, Bang Kruai district, Nonthaburi alongside EGAT Head office. The area is about 125 acres. Using only natural gas as a fuel to generate electricity. The fuel source is from the Union of Myanmar and the Gulf of Thailand.

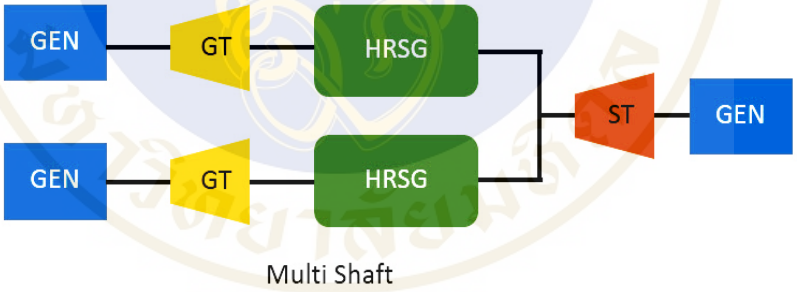

Figure 1.13 Multi Shaft Type of North Bangkok Combined Cycle Power Plant Unit 1

North Bangkok Combined Cycle Power Plant Unit 1 has the net generating capacity of 704 MW. It work as a Multi Shaft Combine Cycle consisting of two gas turbines and one steam turbine. It uses 125 million cubic feet of natural gas per day. Multi Shaft Combine Cycle chart show in the picture below. (GEN = Generator, GT = Gas Turbine, HRSG = Heat Recovery Steam Generator, ST = Steam Turbine)

1.2 Research Objectives

To study and find out the working system model concept of driving factors of this research to be the Roadmap Knowledge Management for generation operation the other power plants in EGAT to elevate the performance standard in attaining Global Top Quartile Utility.

1.3 Research Problem

How to work and manage system model concept for driving on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for EGAT Roadmap Model?

1.4 Research Contribution

1.4.1 The New Academic Contribution

1.4.1.1 Leader (Motivating & Assessment) will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for Leader to be motivating but assessment also must be powerful driving force in model plant of North Bangkok power plant.

1.4.1.2 Strategy communication with the same goal will fulfill all of three theories (The Six box model of Organization Diagnosis theory, The Organization Intelligence Model theory and Learning Organization).

1.4.1.3 Individual positive thinking & willingness mindset will fulfill The Six box model of Organization Diagnosis theory. It is not enough for only Relationship in The Six box model of Organization Diagnosis theory but Individual positive thinking & willingness mindset must be powerful driving force in model plant of North Bangkok power plant.

1.4.1.4 HRD & HRM will fulfill Learning Organization theory. It is not enough for only System thinking in Learning Organization theory but continuously

internal improvement of HRD & HRM must be useful for driving in model plant of North Bangkok power plant.

1.4.1.5 CSR in Process & After Process will fulfill Learning Organization theory. It is not enough for only Team building for internal organization in Learning Organization theory but CSR in Process & After Process must have sharing and exchange knowledge with community and outside stakeholder.

1.4.1.6 Financial Structure Model will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for only performance structure but financial structure model is the main sustainable driving force in model plant of North Bangkok power plant.

1.4.2 Managerial Implication:

For Apply to EGAT

1.4.2.1 Financial Structure Model. EGATIF set to be the model for reducing EGAT's debt. EGAT use EGATIF to pay the debt or invest in new projects. EGATIF use IPO selling to invest in the availability revenue from the operation of the North Bangkok Power Plant combined cycle unit 1. Revenue from availability which the North Bangkok power plant combined cycle unit 1 will already know how much income. Selling to investors is the Future Value. Investors will get the investment units and gradually pay dividends to the income that North Bangkok power plant combined cycle unit 1 have. That is the new Energy management and investment of Energy Sector. EGATIF is the monitoring factor that North Bangkok power plant combined cycle unit 1 must have readily availability for provide electricity from commands of National Control Center (NCC) and consistent with the Global Top Quartile Utility goal and be Sustainable Global Top Quartile Model because of the other monitoring of stakeholder and investor. EGATIF can be the funding model of monitoring model from EGAT power plant that cannot serve the electricity to Global Top Quartile.

1.4.2.2 The working system model concept of model plant of North Bangkok power plant in attaining Global Top Quartile Utility could be the direction Roadmap Knowledge Management to elevate generation operation from the other power plants in EGAT that cannot pass Global Top Quartile Utility standard. The planned outage factor (POF), the unplanned outage factor (UOF) and The Unit Derating factor

(UDF) are in the best standard of World-class and supporting The Strengthening Security of Thailand power system, the lower cost in the fuel adjustment charge of electricity payment for driving the economy of Thailand and the good environment in generation operation.

1.4.2.3 Dynamic and Direction from the working system model concept of model plant. Direction indicates that each factor is linked and affects the other factors, both directly and indirectly. If there is a problem in the process factor. It can be known that it is the result of a mistake of another factor. When there have a problem, the staff can solve the whole process by checking from the next process and the rollback process.

1.4.2.4 Coaching Team and Team working. Coaching Team is the key driver of model plant. Leader push Coaching Team to be representative team of direction controller and supporting team for helping Employee. Coaching Team is the key driver to pull Employee to work in correct role of strategy. And Coaching Team will be push the new culture that work together of organization development. That is the new management that the coaching team and war room model are applied to the core system in the main line function. EGAT can be use Coaching Team and Team working to be change agent to drive of process and policy for going on Global Top Quartile.

1.5 Research Scope

This research only study of combined cycle of Global Top Quartile Utility Standard in EGAT power plants with only Generating Weighted Equivalent Availability Factor (GWEAF). This study is specialize in combined cycle power plant and energy sector.

1.6 Research Methodology

Qualitative research with Snowball Sampling method. Sample Population are Twenty-six officers from five group of Top Level, Middle Level, First Line Level, Operation officers and Coaching Team in North Bangkok Power plant, Mechanical Maintenance Division and other divisions in EGAT.

1.7 Duration of research interview project

1 year 4 months (September 2016 - December 2017)

CHAPTER II
LITERATURE REVIEW

2.1 The Six Box Model of Organization Diagnosis

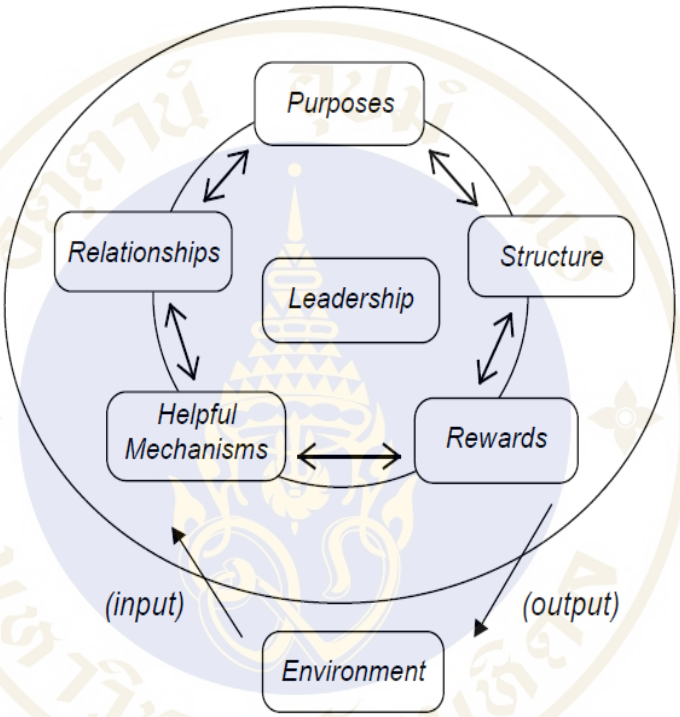

Figure 2.1 The Six-Box Model of Organization Diagnosis

Source: Based on Marvin R. Weisbord, "Organizational Diagnosis: Six Places to Look for Trouble with or without a Theory," Group & Organization Studies 1, 4 (December 1976): 430-447

The Six-Box Model of Organization Diagnosis: A framework developed by Marvin Weisbord. This framework uses for analyzing organization factors to be the great succession organization. It depends on the environment and situation to adapt and change organization. The six-box model is comprised of the following components.

1. Purposes: What 'businesses' are we in? The goal or the purpose that your organization want to be success in the future.

2. Structure: How do we divide up the work? To arrange or plan the responsibility of the employee tasks and manage the system of work to be success in the direction from the goal.

3. Relationships: How do we manage conflict (coordinate) among people? With our technologies?

To manage the relationship and the confliction between the employee and decrease the resistance to the change with new technologies.

4. Rewards: Is there an incentive for doing all that needs doing? To encourage and give the inspiration of the achievement in short term and long term goal with the reward.

5. Leadership: Is someone keeping the boxes in balance? To have the leader to be the center and monitor organization following the goal.

6. Helpful mechanisms: Have we adequate coordinating technologies? To have the best and adequate technologies to go on the mission following the goal.

2.2 Learning Organization

Figure 2.2 Learning Organization

Source: Senge, Peter M. (2006) The Fifth Discipline: The Art & Practice of The Learning Organization New York: Doubleday

Learning Organization: A framework developed by Peter Senge. This framework is a principle in the organization of learning. This process operate organizations and personnel with powerful workflow effectively with the constantly changing environment and the intensely competition. Learning Organization is comprised of the following components.

1. Personal Mastery : The individual personality for learning new things constantly. To improve yourselves to be better following the goal.
2. Mental Model: The individual thinking with positive thinking rationally with the view to creating an open stories and open-minded.
3. Shared Vision: Defining a common vision of the organization to drive the organization towards the same goal.
4. Team Learning: A mutual learning process of the team to create and operate successfully from a shared vision of the organization.
5. Systems Thinking: The individual thinking process with step by step about the relationships everything in the task. To integrate the knowledge and can resolve to work very well.

2.3 Organizational Intelligence Model

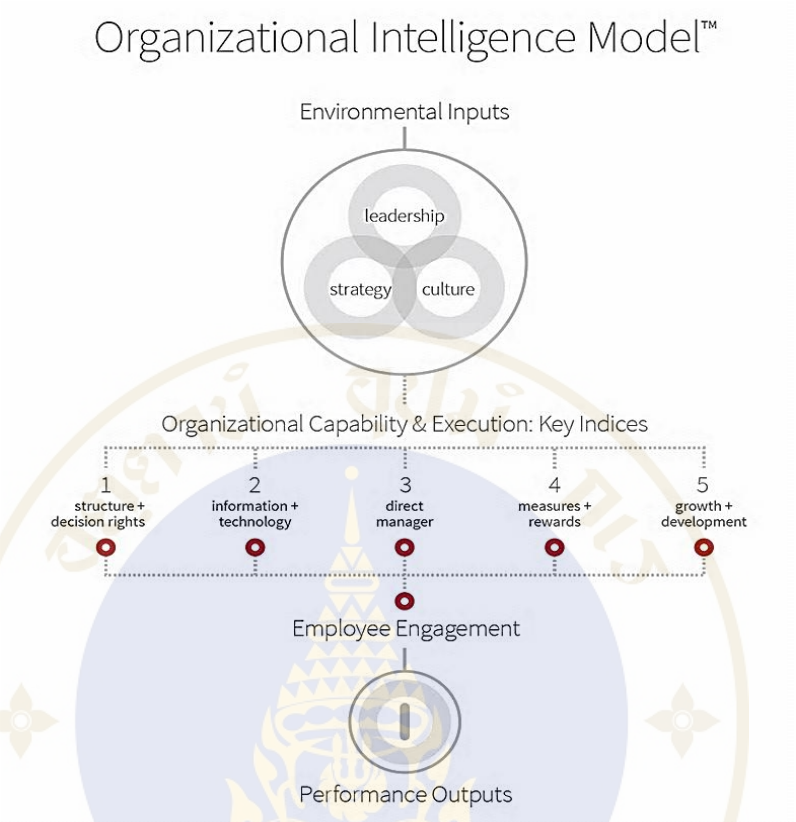

Figure 2.3 Organizational Intelligence Model

Source: Falletta, S. V. (2008). Organizational intelligence surveys. Training & Development, June, 52-58

Organizational Intelligence Model

The organization is intelligent including the framework of work design and the interpretation of the exploration staff. This framework developed by Falletta, S. V., The framework are all 11 factors that affect the participation of staff and the performance of organizations, including Environment Input, Leadership, Strategy, Culture, Structure & Decision rights, Information & Technology, Direct manager, Measures & Rewards, Growth & Development, Employee Engagement and Performance Input.

The relationship of the framework will affect from the top to bottom. The environmental inputs could be the first impulse to leadership, strategy and culture. The organization must adapt to change from the environmental impulse. The developed core competency and the capability must better. The key indices of the Organizational Capability

and Execution are: 1) Structure and decision rights 2) Information & Technology 3) Direct manager 4) Measures & Rewards 5) Growth & Development. The operation requires all employees to engage with work and drive their strategic goals of the organization. Finally, everybody in the organization follow the strategy and work programs. The organization will be able to accomplish the tasks efficiently and effectively as possible goals.

2.4 Venn Diagram Before Interview (7 Hypothesis Factors)

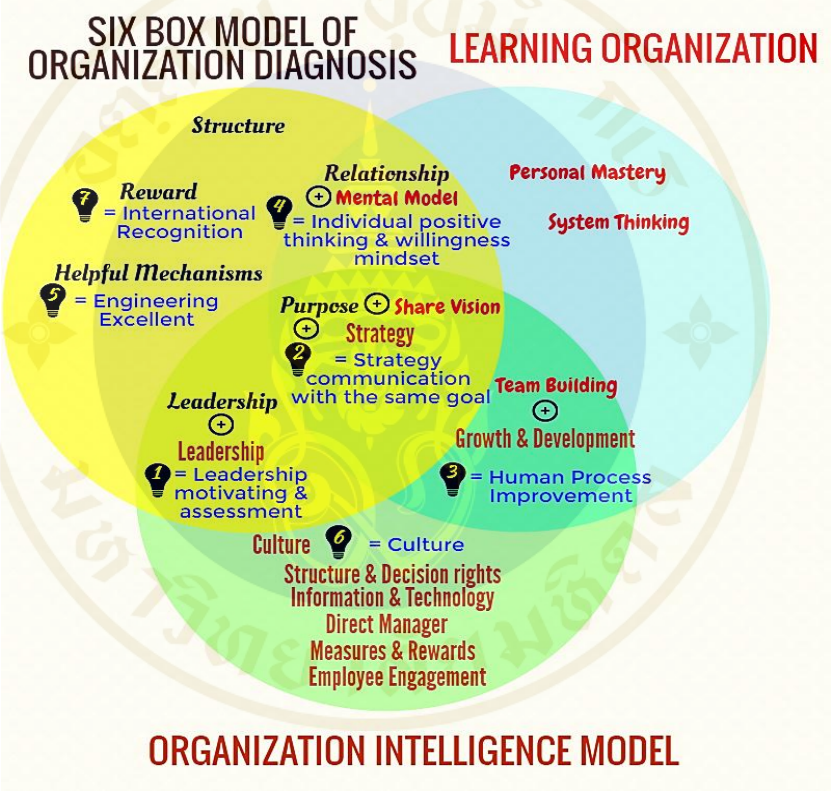

Figure 2.4 Venn Diagram before interview (7 Hypothesis factors)

Venn diagram used to find the driving factors from my research. Three theories that comprised of The Six Box Model of Organization Diagnosis, Learning Organization and Organizational Intelligence Model were intersection and set cofactor names which are driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility.

Leadership from both The Six Box Model of Organization Diagnosis theory and Organization Intelligence model theory set cofactor name with “Leadership motivating and assessment factor”. The purpose factor from The Six Box Model of Organization Diagnosis theory, share vision factor from Learning Organization theory and Strategy from Organization Intelligence model theory set cofactor name with “Strategy communication with the same goal factor”. Team Building factor from Learning Organization theory and Growth and Development from Organization Intelligence model theory set cofactor name with “Human Process Improvement”. The relationship from The Six Box Model of Organization Diagnosis theory and Mental Model from Learning Organization theory set cofactor name with “Individual positive thinking and willingness mindset”. The helpful mechanisms factor from The Six Box Model of Organization Diagnosis theory set new factor name with “Engineering Excellent”. The Reward factor from The Six Box Model of Organization Diagnosis theory set new factor name with “International Recognition”. The seven factors are:

1. Leadership motivating and assessment
2. Strategy communication with the same goal
3. Human Process Improvement
4. Individual positive thinking and willingness mindset
5. Engineering Excellent
6. Culture
7. International Recognition

2.5 Venn Diagram After Interview (10 Hypothesis Factors)

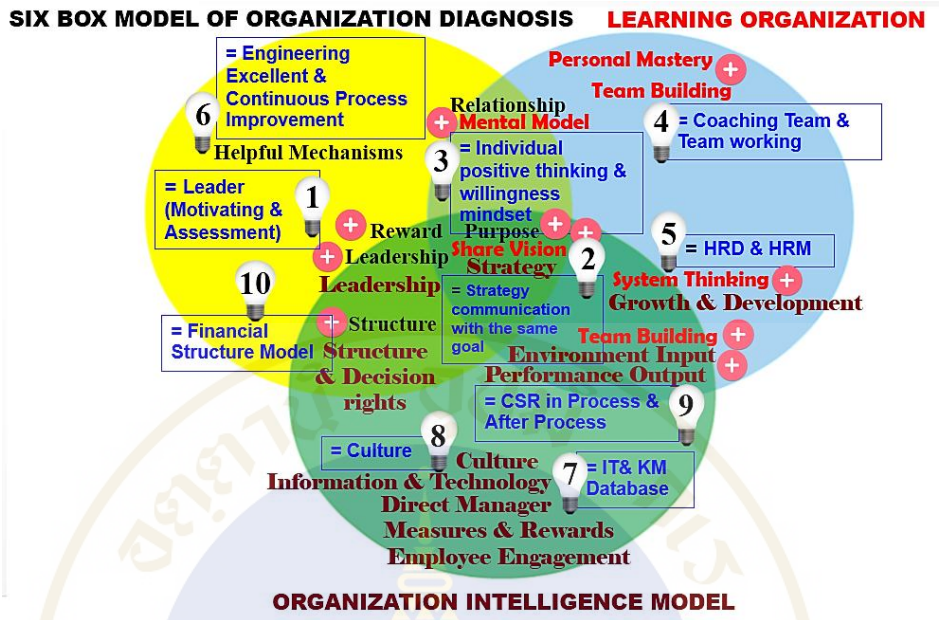

Figure 2.5 Venn Diagram after Interview (10 Hypothesis factors)

Finding 4 hypothesis factors after interview. There are Coaching Team & Team working factor, IT & KM Database factor, CSR in Process & After Process factor and Financial Structure Model factor. Human Process Improvement factor before interview separate to HRD & HRM and Continuous Process Improvement. Next step Continuous Process Improvement merge with Engineering Excellent to be Engineering Excellent & Continuous Process Improvement because they are the same process. The conclusion of factors after interview are ten factors.

The ten factors are:

1. Leader (Motivating and Assessment)
2. Strategy communication with the same goal
3. Individual positive thinking and willingness mindset
4. Coaching Team & Team working
5. HRD & HRM
6. Engineering Excellent & Continuous Process Improvement
7. IT & KM Database
8. Culture

9. CSR in Process & After Process
10. Financial Structure Model

So Venn diagram has been changed to be 10 factors. Venn diagram also use three theories that comprised of The Six Box Model of Organization Diagnosis, Learning Organization and Organizational Intelligence Model were intersection and set cofactor names which are driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility.

Leadership and reward from The Six Box Model of Organization Diagnosis theory and Leadership from Organization Intelligence model theory set cofactor name with "Leader (Motivating and Assessment)". The purpose factor from The Six Box Model of Organization Diagnosis theory, share vision factor from Learning Organization theory and Strategy from Organization Intelligence model theory set cofactor name with "Strategy communication with the same goal". The relationship from The Six Box Model of Organization Diagnosis theory and Mental Model from Learning Organization theory set cofactor name with "Individual positive thinking and willingness mindset". Personal Mastery and Team Building from Learning Organization theory set cofactor name with "Coaching Team & Team working". System thinking from Learning Organization theory and Growth & Development from Organization Intelligence model theory set cofactor name with "HRD & HRM". The helpful mechanisms factor from The Six Box Model of Organization Diagnosis theory set new factor name with "Engineering Excellent & Continuous Process Improvement". Information & Technology from Organization Intelligence model theory set new factor name with "IT & KM Database". Culture from Organization Intelligence model theory is "Culture". Environment Input and Performance Output from Organization Intelligence model theory and Team building from Learning Organization theory set cofactor name with "CSR in Process & After Process". Structure from The Six Box Model of Organization Diagnosis theory and Structure & Decision rights from Organization Intelligence model theory set cofactor name with "Financial Structure Model".

2.6 Hypothesis Factors Before and After Interview

Table 2.1 Hypothesis factors before and after interview

Hypothesis factors after Interview	Hypothesis factors before Interview		Description
	Similarity	Difference	
1. Leader (Motivating and Assessment)	✓		
2. Strategy communication with the same goal	✓		
3. Individual positive thinking and willingness mindset	✓		
4. Coaching Team & Team working		✓	filling after interview
5. HRD & HRM		✓	HRD& HRM separate from Human process improvement
6. Engineering Excellent & Continuous Process Improvement		✓	Integration between Engineering Excellent and process improvement
7. IT & KM Database		✓	filling after interview
8. Culture	✓		
9. CSR in Process & After Process		✓	filling after interview
10. Financial Structure Model		✓	filling after interview

Note: International Recognition of Hypothesis factors before interview has cut off because it didn't drive on Global Top Quartile Utility.

The similarity of hypothesis factors before interview are Leader (Motivating and Assessment), Strategy communication with the same goal, Individual positive thinking and willingness mindset and Culture. The difference of hypothesis factors before interview are Coaching Team & Team working, HRD & HRM, Engineering Excellent & Continuous Process Improvement, IT & KM Database, CSR in Process & After Process and Financial Structure Model. Coaching Team & Team working, IT & KM Database, CSR in Process & After Process and Financial Structure Model are filled after interview. HRD& HRM separate from Human process improvement. Integration between Engineering Excellent and process improvement to be Engineering Excellent & Continuous Process Improvement. International Recognition of Hypothesis factors before interview has cut off because it didn't drive on Global Top Quartile Utility.

2.7 Customer service Factor is Not Included in Hypothesis of Venn Diagram

Customer service factor is not included in hypothesis of Venn diagram that driving on model plant in attaining to Global Top Quartile Utility because the value chain of mission of EGAT are not related directly to the customer. EGAT are responsible for energy generation, the country's transmission system, the country's system operator, managing and controlling, via the National Control Center (NCC) but the distribution, sales and services to end users are responsible of the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA).

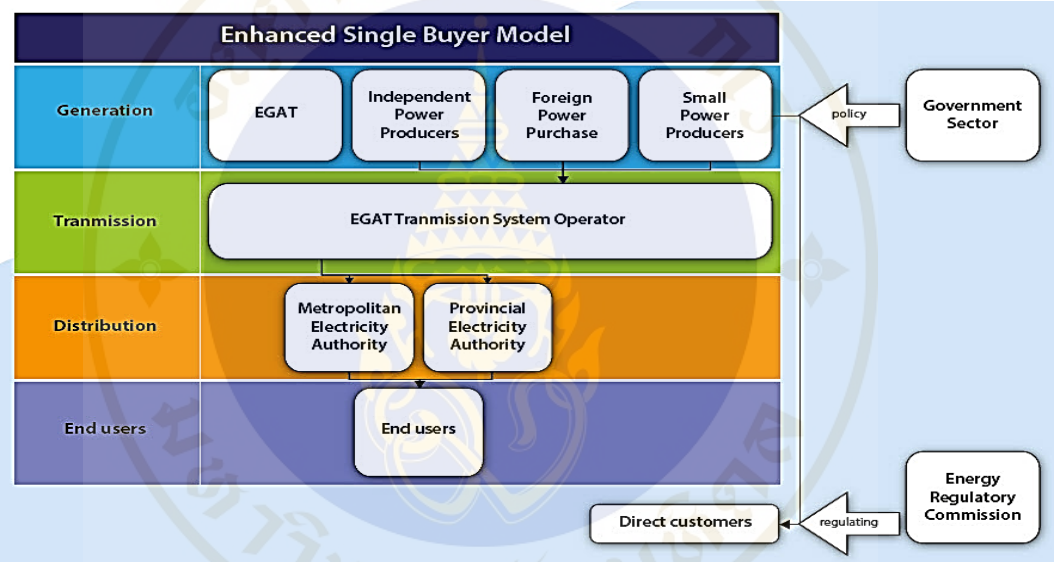

Figure 2.6 The Enhanced Single Buyer Structure of Electric power sector and the value chain of EGAT

Source: Electricity Generating Authority of Thailand. [Online]. Available http://www.egat.co.th (October 30, 2016)

Thailand has adopted the enhanced single buyer model (ESB) in which EGAT is the sole buyer of electricity. On October 2016 Thailand's gross energy generation is 41,097.25 MW. EGAT power plants has an installed generating capacity of 16,376.13 MW or 40.28 percent of the country's gross energy generation. EGAT is in charge of a dominant electricity supply of total power plants capacity in the country and the rests are owned by private power companies from Independent Power Producers (IPPs), Small

Power Producers (SPPs) and Foreign Power purchase. EGAT is also responsible for the country's transmission system. EGAT is the country's system operator, managing and controlling, via the National Control Center (NCC) and five regional control centers, the dispatch of power generation both from both EGAT's own power plants and from private power plants to meet the country's demand in the most efficient, reliable, and environmentally-responsible way. It also owns and operates the national transmission network which includes transmission lines and substations of various high voltage levels which covers all parts of the country. The low voltage transmission lines are responsible for Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA). Thailand electricity system distributing utilities, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). The MEA is responsible for the distribution, sales and provision of electric energy services in Bangkok Metropolis, Nonthaburi and SamutPrakran provinces and the PEA serves the rest of the area in the country.

2.8 Conceptual Framework

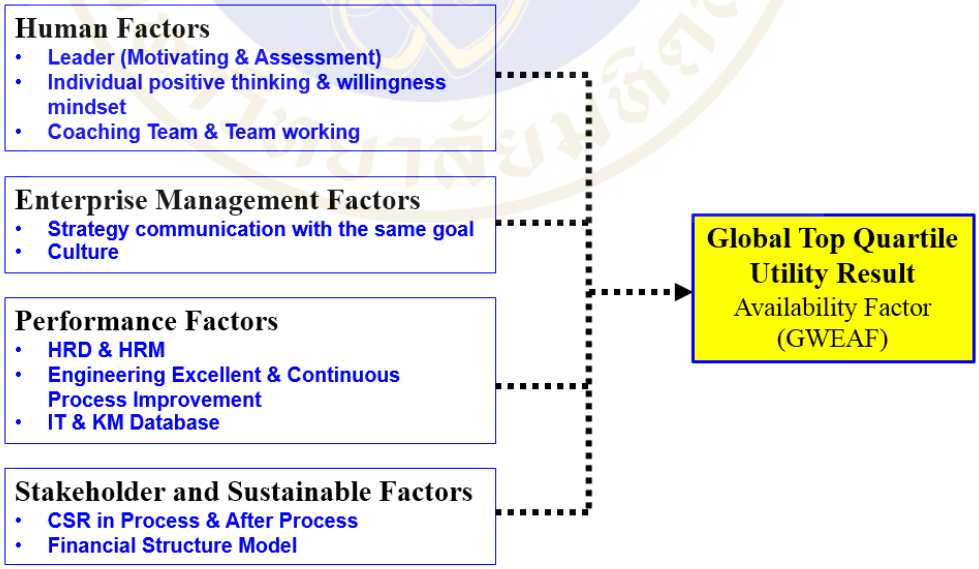

Figure 2.7 Conceptual Framework

To classify four categories factors to be hypothesis factors that driving Availability Factor (GWEAF) in Model Plant of North Bangkok power plant in attaining Global Top Quartile Utility.

1. Human Factors : Leader (Motivating and Assessment), Individual positive thinking & willingness mindset, Coaching Team & Team working
2. Enterprise Management Factors: Strategy communication with the same goal, Culture
3. Performance Factors: HRD & HRM, Engineering Excellent & Continuous Process Improvement, IT& KM Database
4. Stakeholder and Sustainable Factors : CSR in Process & After Process, Financial Structure Model

2.8.1 Leader (Motivating and Assessment) literatures summary grid

Table 2.2 Leader (Motivating and Assessment) literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Bambale, Abdu Ja'afaru; Shamsudin, Faridahwati Mohd; Subramaniam, Chandrakantan A L. Journal of Marketing and Management 3.1 (May 2012): 1-21.	Servant Leadership as Employee-Organization Approach for Performance of Employee Citizenship Behaviors in the Nigeria's Electric Power Sector	The organizational effectiveness is good for the organizational reward system and promote Because of its positive relationship with organizational effectiveness	Servant Leadership behaviours, reward system and promote,
Coffey, Robert P. University of Phoenix, ProQuest Dissertations Publishing, 2013.	A phenomenological study of leadership and millennial employees in the nuclear industry	The resultant major themes included electronic technology practices, communication strategy, employee development, teams and teamwork, and leadership practices.	leadership practices, Leadership motivating, Leadership Monitoring

Table 2.3 Leader (Motivating and Assessment) literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Jones, Ronald C. Walden University, ProQuest Dissertations Publishing, 2013.	Examining Leadership Styles and Financial Performance within Rural Electric Cooperatives.	The results of correlational testing of the identified leadership styles indicated: (a) a significant, positive correlation between transactional leadership and financial performance; (b) a significant, negative correlation between laissez-faire leadership and financial performance; and (c) no significant relationship between transformational leadership and financial performance.	leadership styles, positive correlation with financial performance

2.8.2 Strategy communication with the same goal literatures summary grid

Table 2.4 Strategy communication with the same goal literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Potter, Leslie A; Jackman, John K; Min, K Jo; Search, Matt. IIE Annual Conference. Proceedings (2008): 578-583.	Integrating Communication and Engineering Skills in an Industrial Engineering Curriculum Based on Outcome Assessment Results	The core communication process (Analysis, Formulation, Creation, Delivery, and Assessment): the focus of a new engineering communication course	communication process, engineering communication

Table 2.4 Strategy communication with the same goal literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Jenson, Donna. Nonprofit World 8.5 (Sep/Oct 1990): 22.	Sharing the Vision: Every Leader's Obligation	Two elements are crucial to constructing a successful vision: 1. The leader must be completely proud of it. 2. The vision needs to be communicated in such a way that people will want to embrace it. the leader can follow a 4-step process for testing and sharing: 1. Introduce the vision to members of the organization. 2. Let listeners absorb it. 3. Hear the responses. 4. Use what has been learned.	Sharing the Vision, Communicate the vision
Keenan, Robert. Electronic Design 45.9 (May 1, 1997): 184.	Strong communication skills improve advancement possibilities	The possessing good communication skill is extremely important for engineers. engineers must have the ability to communicate changes and in high-level designs to the non-technical hourly workers	Strong communication skill, engineers communication skill,

2.8.3 Individual positive thinking and willingness mindset literatures summary grid

Table 2.5 Individual positive thinking and willingness mindset literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Vance, Charles; Zell, Deone; Groves,Kevin. International Journal of Organizational Analysis 16.4 (2008): 232-248.	Considering individual linear/nonlinear thinking style and innovative corporate culture	Individual linear/nonlinear thinking style balanced skill development and the formation of a supportive and reinforcing organizational culture have important implications for developing organizational intrapreneurship and innovation in medium-sized and larger organizations leading to increased productivity.	Individual linear/ nonlinear thinking style**,** innovative corporate culture
Zheng, Xingshan; Diaz, Ismael; Jing, Yin; Chiaburu, Dan S. Leadership & Organization Development Journal 36.2 (2015): 232-212.	Positive and negative supervisor developmental feedback and task-performance	To conceptualize, understand, and measure positive and negative aspects of supervisor developmental feedback (SDF) and investigate their relationships with task performance. The importance of supervisors provide both positive and negative feedback to enhance performance.	Positive and negative supervisor developmental feedback
Williams, Scott David. Texas A&M University, ProQuest Dissertations Publishing, 1999.	Personality, attitude, and leader influences on divergent thinking and creativity in organizations	Openness to experience and attitude toward divergent thinking are positively associated with employees' creative performance. Some support is provided for a negative relationship between	Openness to experience and attitude toward divergent thinking

Table 2.5 Individual positive thinking and willingness mindset literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		initiating structure and subordinates' attitudes toward divergent thinking and creative performance.	
Stanley, TL. Super Vision 66.10 (Oct 2005): 14-16.	Think positive and be a winner	Winners think positive and have a can-do attitude. The ways to create a positive mindset: 1. Celebrate your accomplishments. 2. Surround yourself with positive thinkers. 3. Set realistic and positive goals for self-improvement. 4. Always acknowledge the input of others as being important. The ways to create a positive workplace: 1) Encourage individuals lacking confidence. 2) Create a supportive environment for new ideas. 3) Take time to applaud workplace accomplishments. 4) Stay calm and do not overreact to a difficult workplace challenge. 5) Always be honest with employees and promote an integrity that is beyond reproach. Supervisors and managers with a positive can-do approach generate a future teeming with success.	Think positive, can-do attitude.

2.8.4 Coaching Team & Team working literatures summary grid

Table 2.6 Coaching Team & Team working literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Rousseau, Vincent; Aubé, Caroline; Tremblay, Sébastien. Leadership & Organization Development Journal 34.4 (2013): 344-364.	Team coaching and innovation in work teams	Team leaders who engage in coaching behaviors toward their subordinates are likely to foster innovation within their work team. Thus, organizations may benefit by designing and implementing interventions aimed at developing team leaders' coaching skills and encouraging them to consider coaching as a core managerial responsibility. team coaching as a key leverage to stimulate successful innovation in work teams and the motivational and behavioral mechanisms that intervene in this relationship.	Team coaching
Horner, Caroline. Training & Management Development Methods; Bradford Vol.20, Iss. 4, (2006): 535-539.	Coaching for the better	It is important for organizations to agree a shared philosophy for coaching that can be easily communicated and to consider the purpose of coaching and learning interventions at the various levels in their organizations. Coaching is making a positive impact on individual and organizational learning at UK airport company BAA, through a team coaching intervention. Effects reported by individuals and teams indicated that team coaching enhanced individual and team self-awareness.	Coaching

2.8.5 HRD & HRM literatures summary grid

Table 2.7 HRD & HRM literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
T. M. Khan; J. Kwaan; R. McKinnel; K. E. Brown. 1999 International Conference on Human Interfaces in Control Room, Cockpits and Command Centres (1999): 373 – 378.	Explanation, training and decision support for process control	A methodology for designing process control support systems and an implementation is described. The methodology has been successfully used to develop an application that can be used to support operators of combined cycle power plants. The operator's context specific knowledge needs are inferred from an analysis of tasks and a suitable explanation is given. The success of the application has been proven by the positive feedback obtained from the end-users, who completed rigorous end-user questionnaires.	knowledge based systems, explanation, training, decision support system, process control, combined cycle power plants
Hughes, Dirk D. University of Phoenix, ProQuest Dissertations Publishing, 2012.	A quantitative Kirkpatrick Level 1 and 2 study of equipment specialist apprentice operations training	A course of study that is offered in two formats: explicit and tacit instructor led and explicit e-learning operations training. Results of the study concluded that both instructors led and e-based training provided significant learning to the participants. The Kirkpatrick Level 1 results indicated significantly better results	Online instruction, Teaching methods, Electric utilities

Table 2.7 HRD & HRM literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		for instructor led training. There was not a significant difference in the Kirkpatrick Level 2 results between the two training modalities.	
Dionis Francois; Pirus Dominique 2007 IEEE 8th Human Factors and Power Plants and HPRCT 13th Annual Meeting (2007): 42 – 44.	Ways to improve field operation on NPPs facilities by bringing additional operator aids	Activities inside nuclear power plants often require changes of location within the facility. This "standing up" mobility mostly concerns maintenance staff, technicians, field operators and engineers. The new available computerized technologies (wireless, RFID tags, panel PCs, PDAs, etc.) offer new fields of applications that can benefit to a better operation, by answering some requirements that were not satisfied.	Application software, Monitoring, Mechanical sensors, Research and development, RFID tags, Personal communication networks
Dan-Shang, Wang; Chi-Lih Shyu. International Journal of Manpower; Bradford Vol.29, Iss. 2, (2008): 92-110.	Will the strategic fit between business and HRM strategy influence HRM effectiveness and organizational performance?	This study found that the alignment between the business and HRM strategy was the key factor of success for organizations. When the HRM strategy and business strategy were aligned, the effectiveness of HR practices and organizational performance were better than "that of not aligned" by contingency perspective. This study also estimated the practical significance through	Human resource management, Management strategy, Human resource strategies, Organizational performance

Table 2.7 HRD & HRM literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		calculating the impact of HRM effectiveness and strategy fit on labor productivity by each standard deviation increase, respectively. This study confirmed that a firm's competitive advantage can be enhanced by HRM practices and strategy fit. Strategy fit could also moderate the relationship between HRM effectiveness and labor productivity.	

2.8.6 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Siva Reddy, V; Kaushik, S C; Tyagi, S K. Clean Technologies and Environmental Policy 16.3 (Mar 2014): 489-499.	Exergetic analysis and evaluation of coal-fired supercritical thermal power plant and natural gas-fired combined cycle power plant	The major energetic power loss has been found in the condenser for coal-fired supercritical thermal power plant. The exergetic analysis shows that boiler field is the main source of exergetic power loss in coal-fired supercritical thermal power plant and combustion chamber in the	Improvement or maintenance from condenser, boiler and combustion chamber in coal-fired supercritical thermal

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		gas-fired combined cycle thermal power plant. These results will be useful to all involved in the improvement of the design of the existing and future power plants.	
Buck, Douglas; Elliott, Dwayne; Niehaus, Greg; Rives, Bill; Thomas, Laura. Risk Management and Insurance Review 15.1 (Spring 2012): 1-22.	FUEL RISK MANAGEMENT AT AMERICAN ELECTRIC POWER	The senior management team and board of directors at American Electric Power (AEP) have emphasized the importance of an Enterprise Risk Management approach for dealing with the wide array of risk exposures that the firm faces. An unexpected disruption in the firm's coal supply over the coming year due to necessary repairs in railroad facilities near the coal source. The Enterprise Risk Oversight group needs to communicate with the relevant teams within the organization as part of its effort to identify the potential repercussions of the event for the enterprise. the Risk Executive Committee would like the groups to identify other possible adverse events that could occur and steps that should be taken now in preparation.	Risk Management
Anonymous. Utility Week 24.17 (Dec 9, 2005): 16A,16B, 16C, 16D.	Asset Lifecycle Management: Life beyond planned maintenance	To increase operation efficiency still further while maintaining the reliability and availability of distribution networks and other key assets, the ownership and	Asset Lifecycle Management (ALM)

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		operation of this assets must be closely coordinated. This Asset Lifecycle Management (ALM) approach enable a holistic view of investment, maintenance and operation that minimizes whole life costs while increasing availability and adding value to asset base.	
Shafiei, Ehsan; Saboohi, Yadollah; Ghofrani, Mohammad B. Energy Policy 37.6 (Jun 2009): 2221.	Impact of innovation programs on development of energy system: Case of Iranian electricity-supply system	A comprehensive model for assessment of energy technologies and research and development (R&D) planning to evaluate the impact of innovation programs on development of Iranian electricity-supply system. Three emerging electricity generation technologies of solar PV, wind turbine and gas fuel cell are considered in the model and the impact of innovation programs on cost-reducing innovation for them is examined. The main results provided by the modeling approach include optimal allocation of R&D resources, induced capacity expansion policies to guarantee the effectiveness of R&D activities, competitive cost of emerging technologies, impact of innovation programs on optimal structure of electricity-supply system and benefits of innovation programs in the long-run.	Innovation programs

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Söderholm, Peter; Norrbin, Per. Journal of Quality in Maintenance Engineering 19.3 (2013): 316-329.	Risk-based dependability approach to maintenance performance measurement	A risk-based dependability approach can be used to link maintenance performance measurement and management to overall objectives within an organization. Risk-based dependability approach, critical availability goals are communicated with and involve top management. The approach also contributes to enhanced data and information quality by pinpointing critical data and information for dependability management activities. The proposed availability indicator can be used to monitor the effect of dependability management activities aimed at different indenture levels of the infrastructure and related to the responsibility of different hierarchical levels of the organization	Risk-based dependability approach,
Tiffany, Eric D. Power Engineering 113.11 (Nov 2009): 16,252,254.	Maintenance Risk	Every power generation manager is a risk manager balancing maintenance spending, technical performance and un-availability to maximize the financial performance for their assets. The methodology involves a visual framework that focuses on the risk of sub-optimization of the financial and technical performance of the asset rather than merely emphasizing one aspect such as reliability. companies reduce risk by reducing severity (costs) first, primarily	Risk management; Reliability; Decision making; Cost reduction; Electricity generation; Maintenance management

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		because there tends to be an underlying frequency (unavailability) issue that is driving the higher costs. Cutting costs would likely only exacerbate the problem. Unavailability should typically be addressed first, even at a higher, near-term cost to allow the generator the best chance of reducing costs in the long term.	
McAdam, Rodney; McLean, John; Henderson, Joan. The International Journal of Quality & Reliability Management 20.4/5 (2003): 436-457.	The strategic "pull" and operational "push" of total quality management in UK regional electricity service companies	the UK regional electricity companies (RECs) have used total quality management(TQM) as a "push" or as a "pull" change methodology. "Push" is the operational improvement role of TQM; "pull" is the strategic or direction giving, improvement role of TQM. The "push-pull" analysis enables the full range of TQM activities to be evaluated in the RECs studied. Overall, there is a need to have a balanced portfolio of operational or "push"-based TQM activity that is driven by strategic or "pull"-based TQM planning and activity.	The strategic "pull", operational "push", total quality management
Hughes, Susan Lauren. University of Alberta (Canada), ProQuest Dissertations Publishing, 2004.	Quality management and complaints handling in an electrical utility	The ISO 9001:2000 quality management (QM) and ISO 10002:2004 complaints handling (CH) system standards are applied to an electrical utility. The integrating QM and CH.	Quality management (QM), complaints handling (CH) system standards

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		Similarities between ISO 9001:2000 and ISO 1002:2004 are shown and opportunities for integrating QM and CH within the case study utility (CSU) are offered.	
Goosey, Martin; Kellner, Rod. Circuit World 36.1 (2010): 38-42.	Energy conservation and related best practices in printed circuit board (PCB) manufacturing	Best practices in each stage of the printed circuit board (PCB) manufacturing process can lead to material and energy savings that have value in helping board makers to reduce costs.	Energy conservation, Best practice, Process controls
Romm, Joseph J. IIE Solutions 27.6 (Jun 1995): 17.	Keep your facility fit with lean and clean engineering	Using lean and clean management to achieve a variety of unexpected environmental and competitiveness benefits - lower operating costs, increased productivity and quality, shorter product cycle time, and reduced resource consumption and pollution, thus the name lean and clean. The US Department of Energy's Energy Efficiency and Renewable Energy Program has a variety of efforts to help industry develop and implement clean technologies.	Lean and clean management
Hurley, Brion; McArtor, Carolyn; Land, Cal Van't. Industrial Engineer 46.9 (Sep 2014): 36-40.	Continuously improving sustainability	Using the The Environmental Protection Agency (EPA) toolkits and employee expertise, they decided to use the existing Lean Electronics initiative as the framework to reduce Rockwell's	Continuously improving, Lean, The Six Sigma

Table 2.8 Engineering Excellent & Continuous Process Improvement Literatures Summary Grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		carbon footprint. The Six Sigma project started off, with the largest electricity usage and a business case of $200,000 worth of savings in six months.	

2.8.7 IT& KM Database summary grid

Table 2.9 IT& KM Database summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Hong Zhang; Dongmei Zhao; Xu Zhang; Jian Wu 2010 Asia-Pacific Power and Energy Engineering Conference (2010): 1 - 4	Research and Development of Integration of Graph, Model and Database Tool in Power Plant Relay Protection Intelligent Setting Calculation System	In order to make the power plant relay protection setting calculation system more intelligent, Integration of Graph, Model and Database Tool (IGMD) are developed to implement primitive modeling, typical power plant design template modeling, text discription modeling and external pattern recognition modeling. Reducing manual operation and improving efficiency, the IGMD has great value in both theory and practice.	Research and development, Power system modeling, Power generation, Protective relaying, Intelligent systems, Deductive databases, Graphics
Bo Yin; Zhe Zhang; Xi Wang; Zhiqiang Wei 2014 Sixth International Conference on Measuring Technology and Mechatronics	Research and Application of Data Mining Technique in Power Plant	As the development of electric industry, more and more real-time data is sent to databases by data acquisition system and large amounts of data are accumulated. Abundant knowledge exists in those historical data. The application of data mining in	Data mining, Power generation, Mining industry, Real time systems, Databases, Data acquisition, Data analysis, Fault diagnosis, Industrial economics

Table 2.9 IT& KM Database summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Automation Year: 2014 Pages: 476 - 479		electric power industrial is discussed. The fault diagnosis and operation optimization based on data mining is researched in detail. The application of data mining in electric industry can guide the optimal operation based on historical data and improve the economic efficient in power plant.	Data mining, Power generation, Mining industry, Real time systems, Databases, Data acquisition, Data analysis, Fault diagnosis, Industrial economics
Ravu, S.Y.; Parker, K.M.Author Information. The International Business & Economics Research Journal (Online); Littleton 14.2 (2015): 327.	Expatriates and Knowledge Transfer: A Case Study of A Power Plant Constructed In Africa	This paper outlines aspects of a broader exploratory study on the management of skills shortages at a leading energy utility in Africa. Specifically, the paper examines the opinions of local and foreign personnel employed on a power plant construction project on the nature of skills shortages experienced at the energy utility, the organization's short-term strategy of dealing with the shortages by employing expatriates and the latter's role in knowledge transfer. International research on expatriates' impact on knowledge transfer within the public sector environment is very scarce. Preliminary results indicate that the type of knowledge, willingness to learn and share on the part of both expatriates and locals, and national culture are some of the factors impacting the success of knowledge transfer from expatriates to locals.	Knowledge Transfer, Human Capital, Expatriates,

2.8.8 Culture literatures summary grid

Table 2.10 Culture literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Rosario Sola; Inmaculada Silla 2007 IEEE 8th Human Factors and Power Plants and HPRCT 13th Annual Meeting (2007): 149 - 151	Organizational culture and safety expectations: The mediating role of trust in supervisors	Results showed organizational culture and trust to be relevant for safety. Specifically, Constructive cultural styles and trust in supervisors promote safety concerns. Furthermore, the relationship between organizational cultural style and safety is mediated by trust in supervisors. Building trust in supervisors emerges as a crucial issue for safety and as a relevant factor to take into account when developing organizational policies and practices.	Safety Culture, Character recognition, Organizational aspects, Trust
Harsányová, Petra; Mikuláková, Justí; Cambál, Milos. European Conference on Intellectual Capital: 375-381. Kidmore End: Academic Conferences International Limited. (May 2016)	The Business Performance in the Context with Corporate Culture	Corporate culture, the company forms its staff's working environment and aims at the staff's identification with the preferred company values and ideas. Improvement of the company's performance is closely interlinked with the application of knowledge management tools that facilitate the access to the company's know-how, greater awareness and knowledge of the corporate culture and the gaining of a competitive advantage. Its aim is to design for the company's sustainable performance in the context in the corporate culture to	Corporate culture

Table 2.10 Culture literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		be instructions as possible in industrial companies increase employee job satisfaction through targeted shaping corporate culture.	
Al Saifi, Said Abdullah. Journal of Knowledge Management 19.2 (2015): 164-189.	Positioning organisational culture in knowledge management research	A conceptual model for understanding the impact of organisational culture on knowledge management processes and their link with organisational performance. It is suggested that organisational culture should be assessed as a multi-level construct comprising artefacts, espoused beliefs and values and underlying assumptions. A holistic view of organisational culture and knowledge management processes, and their link with organisational performance, is presented. Potential implications of organisational culture levels for the creation, sharing and application of knowledge are elaborated.	organisational culture, knowledge management
Wells, David L. CETYS Universidad - Centro de Ensenanza Tecnica y Superior (Mexico), ProQuest Dissertations Publishing, 2003.	The relationship between employee-organization cultural fit and organization performance	Two of the five tested cultural characteristics—character and change-orientation were uncorrelated to performance. Socialness and personality cultural considerations were moderately correlated with performance. Work ethic was very highly correlated with site performance.	Corporate culture; Organizational behavior, Culture fit

2.8.9 CSR in Process & After Process literatures summary grid

Table 2.11 CSR in Process & After Process literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Metaxas, Theodore; Tsavdaridou, Maria. Management : Journal of Contemporary Management Issues; Split 17.2 (Dec 2012): 119-140.	CORPORATE SOCIAL RESPONSIBILITY IN GREECE: A COMPARATIVE ANALYSIS OF THE THREE MAJOR ENERGY COMPANIES (CASE STUDY)	The concept of CSR is about the commitment of business to an ethical behavior which will contribute to the economic development, the improvement of the quality of life of the local communities and the society. In Greece, it seems that the energy sector companies have realized their role in the society and their CSR reports reveal that their social responsibility is an integral part of their business strategy. Activities that concern the companies' environmental impact are published in their CSR reports but they do not evaluate their methods, except for the Hellenic Petroleum which uses the GRI index for its environmental activities.	Corporate Social responsibility, Energy industry

Table 2.11 CSR in Process & After Process literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
PR Newswire; New York [New York] 28 Mar 2002: 1.	Florida Power Breaks Ground on Additional Generating Capacity To Meet Customers' Needs	The new clean -burning natural gas-fired combined-cycle plant will be located at Florida Power's existing Hines Energy Complex. A combined-cycle block consists of two combustion turbine (CT) generators and a system for recovering exhaust heat from the CTs to produce steam, which generates more electricity by sending the steam through a steam turbine. Thus, for the same amount of gas, the combined-cycle generates about 50 percent more electricity, making it highly efficient. The plant also will be equipped with state-of-the-art emission controls.	combined-cycle plant, clean -burning natural gas-fired

2.8.10 Financial Structure Model literatures summary grid

Table 2.12 Financial Structure Model literatures summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Wang, Yin Shuang. Tsinghua University (People's Republic of China), ProQuest Dissertations Publishing, 2008.	A Study of Financial Management Model on Power Enterprise Group	This paper begins with the form of the electric power enterprises group and the character of the financial management, and it compares the centralized management pattern with the decentralization.	Financial Management Model, Power Enterprise Group

Table 2.12 Financial Structure Model literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
		pattern, then it analyses the financial management system of the modern enterprise group. this paper point out that we should adopt a financial management model which combines the centralization and decentralization. According to this management model, the electric power enterprise group can be activety, and eliminate the goal of adverse selection and moral risk which can ensure the profit maximization of the electric power enterprise group.	
Zhao, Ting; Wang, Lili; Thomas, George M. Voluntas; Baltimore 27.5 (Oct 2016): 2173-2198.	Public Policies, Stakeholder Interest, and Nonprofit Development: The Case of Trade Associations in Shanghai, China	This study examines the reform and development of trade associations in Shanghai, China. The research results show that trade associations are significantly less dependent on the government and they seem to be more oriented to providing services for and representing corporate members. We trace these changes to public policy reforms and growth in private businesses. The transition reflects the dynamic and changing relationship among the government, trade associations, and business in China.	Public Policies, Stakeholder Interest

Table 2.12 Financial Structure Model literatures summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Chi Xie; Zhen Zhu; Cong Yu 2012 IEEE Fifth International Conference on Advanced Computational Intelligence (ICACI) (2012): 900 - 902	A study of feedback trading in stock index futures: An empirical analysis on Asian markets	This paper estimates the feedback trading in nine Asian stock index futures markets using a TGARCH-based asymmetric feedback trading model. The results show that there is strong evidence of positive feedback trading in the majority of Asian stock index futures markets. At the same time, the positive feedback trading activity is much more violent during periods of market declines than periods of market advances, with a clear asymmetry	feedback trading, the stock index futures daily returns data, positive feedback trading activity

2.8.11 International Recognition literature summary grid

Table 2.13 International Recognition literature summary grid

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Lourenço, Isabel Costa; Callen, Jeffrey Lawrence; Branco, Manuel Castelo; Curto, José Dias. Journal of Business Ethics 119.1 (Jan 2014): 17-28.	The Value Relevance of Reputation for Sustainability Leadership	A firm's reputation for being committed to sustainability is an intangible resource that can increase the value of a firm's expected cash flows and/or reduce the variability of its cash flows. The net income of firms with good sustainability reputation has a higher valuation by the market, when compared to their counterparts.	Reputation for Sustainability Leadership, Corporate image

Table 2.13 International Recognition literature summary grid (cont.)

Author (Year)	Paper Title	Conclusion	Indicator/ Keyword
Da Camara, Nuno. Manager Update 18.3 (Spring 2007): 11-18.	Brand and reputation: equals or opposites?	Reputation and brands are closely related. Although they have been extensively researched in the marketing and reputation literatures, it is still unclear exactly how they interact or complement each other. Successful organizations will be those that communicate not only how they look, feel and behave but also express their values. The challenge of communicating this to all stakeholders means that brand and reputation management must go hand in hand and reinforce each other.	Reputation management, Brand image

2.9 Push Factor

The direction of force something to the other thing and also have the motivation attached to the process of push. The motivation things are praising, certified standard, credit and dividend. Push is something that the destination need or does not need. Push is difference from Top down. Top down is commanding of leader to employee and only use for people to people. But Push can use in many cases. Push use for people to people, process to process, process to people and people to process.

2.10 Pull Factor

A force dragging someone or something in approach. Pull is something that the destination need. Pull can use in many cases. Pull use for people to people, process to process, process to people and people to process.

2.11 The different things between Push Factor, Pull Factor, Top down and Bottom up

Table 2.14 The different things between Push Factor, Pull Factor, Top down and Bottom up

Topic	Push	Pull	Top down	Bottom up
Description	force something to the other thing	drag someone or something in approach	command from leader to employee	feedback of employee to leader
Direction people to people	✓	✓	✓	✓
process to process	✓	✓	-	-
process to people	✓	✓	-	-
people to process	✓	✓	-	-
Have motivation	✓	-	Yes/No	-
The destination need	Yes/No	✓	Yes/No	✓

The meaning of Push is “force something to the other thing.” The meaning of Pull is “drag someone or something in approach.” Push and Pull use for people to people, process to process, process to people and people to process. Top down and Bottom up only use for people to people. Push always have the motivation attached to the process but pull and bottom up do not have. Pull is something that the destination need.

CHAPTER III
RESEARCH METHODOLOGY

This research study of driving factor in model plant for Electricity Generating Authority of Thailand (EGAT) in attaining Global Top Quartile Utility: A case study of North Bangkok Power Plant Combined Cycle unit 1. The research methodology is Qualitative research with Snowball Sampling method. To classify five Categories of target group of interviewees. There are twenty-six officers from Top Level, Middle Level, First Line Level, Operation officers and Coaching Team in North Bangkok Power plant, Mechanical Maintenance Division and other divisions in EGAT.

3.1 Use Snowball Sampling method for this research

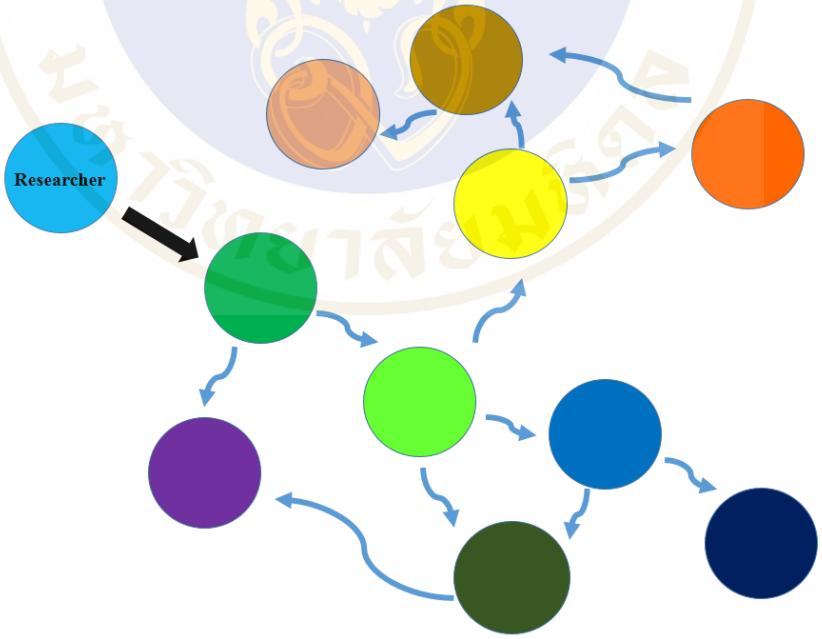

Figure 3.1 Snowball Sampling method

Snowball Sampling is a selection of samples based on the recommendations of the sample population and the sample data that have been collected. For this research, the researchers found that the sample population was matched to this research. The researchers interviewed the data from Mr. A. Then, the researcher asked Mr. A. to introduce a friend or acquaintance that match the researcher's needs. Then wrote their names, the contact address and telephone number. Mr. A. has introduced Mr. B. and Ms. C. Next, Mr. B. and Ms. C was interviewed. Then, the researcher asked Mr. B. and Ms. C. to introduce friends or acquaintances. The researchers wrote their names and telephone number. The researcher interviewed collected information from people who Mr. B and Ms. C. had recommended. The researcher continued to do so until the information was complete. The picture below show Snowball Sampling Method that apply for this research

3.2 Personal Interview Process

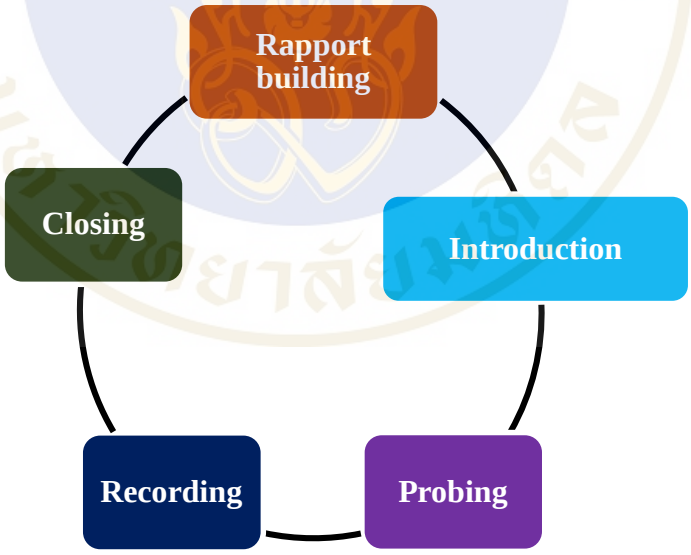

Figure 3.2 Personal interview Process

1. Rapport Building (To make a good relationship before the interview) To create a good atmosphere and relationships before the interview with the right

situation of each person for interview. By making his trust to give good information. It is very useful in research interview go on smoothly.

2. Introduction (Introducing The researcher and research) The researcher should introduce your background and has a preliminary interview by email or call ahead for the schedule of an interview. To tell the interviewee about the research topic, the research objective, the research question and the research contribution. It is good for interviewee to give more information before the interview.

3. Probing (Start Interview with using open answer techniques) Start Interview with using open answer techniques. Beginning with an overview to encourage the interviewee to think and analyze the answer. To ask about important keyword to avoid asking Yes / No Question or question that guide the answer. Make your eye contract with the interviewee and use polite words

4. Recoding audio and notes the detail of an interview for listen or read over analysis and paraphrase from the information in the next step.

5. Closing: It should thank with the interviewee that take their time for give the information and thanks the useful information for use in analyzing the results of the research.

3.3 Group of Interviewees

Table 3.1 Group of interviewees

Categories of target group of interviewees	Interviewees (N)	Ages (Mean)	Percentages (%)	Research Methodology
Top Level	5	56.2	19.23	Snowball Sampling method
Middle Level	6	52.5	23.08	Snowball Sampling method
First Line Level	5	40.4	19.23	Snowball Sampling method
Operation officers	5	35.6	19.23	Snowball Sampling method
Coaching Team	5	34.2	19.23	Snowball Sampling method
Total	26	44.1	100.00	Snowball Sampling method

There are five groups of interviewees in North Bangkok Power plant, Mechanical Maintenance Division and other divisions in EGAT: 1.Top Level, 2. Middle Level, 3. First Line Level, 4. Operation officers and 5. Coaching Team. The number of all interviewee is 26 person. The Middle level are the most interviewees with 23.8% of all. The Average Ages of all are 44.1. The research methodology is Snowball Sampling Method.

3.4 Validation of Qualitative Interview Design Scoring

Verify the validity of the questionnaire from Qualitative Interview Design through expert assessment from three Specialists. The scoring criteria are -1, 0 and 1.

Table 3.2 Validation of Qualitative Interview Design Scoring

Qualitative Interview Question	Specialist 1 (CMMU) TRIN THANANUSAK, PH.D.			Specialist 2 (EGAT) SOMCHAI CHOKMAVIROJ, PHD.			Specialist 3 ALISARA SURIYASOMBOON, PHD.			Recommendation
	-1	0	1	-1	0	1	-1	0	1	
1. How to work and manage system for going on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model?		✓				✓		✓		1.This is the thesis research question. 2. Question is not clear.
2. Which factors are the main driving factors, supporting driving factors and the organization environment factors in attaining Global Top Quartile Utility?			✓			✓			✓	
3. How do you think about leadership, motivation, evaluation, monitoring of good governance affect for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?			✓			✓			✓	
4. How do you think about communication strategies that clearly and enough communication? How many channel of communication? Do you have any ineffectively communication that want to solve them?		✓				✓			✓	1.communication strategy about what issues?/topics? 2.There are three questioins in one.It's better to separate them.

Table 3.2 Validation of Qualitative Interview Design Scoring (cont.)

Qualitative Interview Question	Specialist 1 (CMMU) TRIN THANANUSAK, PH.D.			Specialist 2 (EGAT) SOMCHAI CHOKMAVIROJ, PHD.			Specialist 3 ALISARA SURIYASOMBOON, PHD.			Recommendation
	-1	0	1	-1	0	1	-1	0	1	
5. How do you think about the skills, the knowledge and the person who have talent and work excellently? Do you select the operation officer for working in this model plant? How do you motivate and keep talent worker with the EGAT organization?			✓			✓			✓	
6. How do you think about the attitude of people who work in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?			✓			✓			✓	1. Rewrite Question.
7. How do you think about the process of creating Engineering excellence in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?			✓			✓			✓	
8. How do you think about the corporate value that use to drive the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? Do you have any other value for driving?			✓			✓			✓	
9. Which are the new maintenance and operation methods that supporting North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?			✓			✓			✓	
10. How do you think about Process Improvement that sufficient for Model Plant? What are the procedure or methodology that improve the process to be Global Top Quartile Utility? How about continuously improve processes to be best practice for working in line of Model plant?			✓			✓			✓	
11. How about IT or Knowledge Management Database that use to implement in Model Plant? How about the way that they do? Parallel with the old technology or Stop the old and start the new one?			✓			✓			✓	1. It's better to separate the questions. Add information and rewrite question for more clear understanding for interviewee.

Table 3.2 Validation of Qualitative Interview Design Scoring (cont.)

Qualitative Interview Question	Specialist 1 (CMMU) TRIN THANANUSAK, PH.D.			Specialist 2 (EGAT) SOMCHAI CHOKMAVIROJ, PHD.			Specialist 3 ALISARA SURIYASOMBOON, PHD.			Recommendation
	-1	0	1	-1	0	1	-1	0	1	
12. How about North Bangkok power plant combined cycle unit 1 work with community around the power plant? What they do in the green and clean process for Generation Operation? How about the green process that are comprised of Model Plant in attaining to Global Top Quartile Utility?			✓			✓			✓	1. separate in to 2 questions.
13. How about the relativity between Financial Model and Availability Factor of North Bangkok power plant combined cycle unit 1? How about The way or Platform Structure that use in Model Plant of North Bangkok power plant combined cycle unit 1?			✓			✓			✓	1. 2 Questions in one sentence.
14. In your opinion, do you have more suggestions for continuously improvement for model plant of North Bangkok power plant combined cycle unit 1 in attaining to Global Top Quartile Utility?			✓			✓			✓	

3.5 Improve the questionnaire based on specialists' recommendation

Improve the questionnaire based on specialists' recommendation change from 14 to 21 questions. The twenty-one questionnaires from Qualitative Interview Design is passed and can use to interview the Sample Population Research of in North Bangkok Power plant, Mechanical Maintenance Division and other divisions in EGAT. The twenty-one questionnaires show in the table below.

Table 3.3 Improve the questionnaire based on specialists' recommendation

Qualitative Interview Question
1. How many factors that driving model plant for going on Global Top Quartile Utility? How to work and manage system for going on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model? (Rewrite Question.)
2. Which factors are the main driving factors, supporting driving factors and the organization environment factors in attaining Global Top Quartile Utility?
3. How do you think about leadership, motivation, evaluation, monitoring of good governance affect for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
4. How do you think about model plant communication strategies that clearly and enough communication? (Rewrite Question.)
5. How many channel of communication? (separate from question 4)
6. Do you have any ineffectively communication that want to solve them? (separate from question 4)
7. How do you think about the skills, the knowledge and the person who have talent and work excellently? Do you select the operation officer for working in this model plant? How do you motivate and keep talent worker with the EGAT organization?
8. How about attitude of people who work in the field of model plant for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? (Rewrite Question.)
9. How do you think about the process of creating Engineering excellence in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
10. How do you think about the corporate value that use to drive the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? Do you have any other value for driving?
11. Which are the new maintenance and operation methods that supporting North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
12. How do you think about Process Improvement that sufficient for Model Plant?
13. What are the procedure or methodology that improve the process to be Global Top Quartile Utility? (separate from question 12)
14. How about continuously improve processes to be best practice for working in line of Model plant? (separate from question 12)
15. How about IT or Knowledge Management Database that use to implement in Model Plant?

Table 3.3 Improve the questionnaire based on specialists' recommendation (cont.)

Qualitative Interview Question
16. How about the way of IT or Knowledge Management Database process start? Parallel with the old technology or Stop the old and start the new one? (separate from question 15)
17. How about North Bangkok power plant combined cycle unit 1 work with community around the power plant?
18. What they do in the green and clean process for Generation Operation?How about the green process that are comprised of Model Plant in attaining to Global Top Quartile Utility? (separate from question 17)
19. How about the relativity between Financial Model and Availability Factor of North Bangkok power plant combined cycle unit 1?
20. How about The way of Platform Structure that use in Model Plant of North Bangkok power plant combined cycle unit 1? (Merge question in one sentence.)
21. In your opinion, do you have more suggestions for continuously improvement for model plant of North Bangkok power plant combined cycle unit 1 in attaining to Global Top Quartile Utility?

3.6 Question for Interview

Three are 21 Question Guidelines for asking interviewee.

Grouping 2 Groups of questions for interview: 1. For Top Level, Middle Level, First Line Level and Coaching Team. 2. For Maintenance and Operation officers

1. Question 1-21 for Top Level, Middle Level, First Line Level and Coaching Team

2. Question 4, 5, 6, 11, 12, 13, 14, 17, 18 and 21 for Maintenance and Operation officers

3.7 Table of Qualitative Interview design with group of interviewees

Table 3.4 Qualitative Interview design with group of interviewees

Qualitative Interview Question	Top Level, Middle Level, First Line Level and Coaching Team	Maintenance and Operation officers
1. How many factors that driving model plant for going on Global Top Quartile Utility? How to work and manage system for going on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model?	●	
2. Which factors are the main driving factors, supporting driving factors and the organization environment factors in attaining Global Top Quartile Utility?	●	
3. How do you think about leadership, motivation, evaluation, monitoring of good governance affect for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	●	
4. How do you think about model plant communication strategies that clearly and enough communication?	●	●
5. How many channel of communication?	●	●
6. Do you have any ineffectively communication that want to solve them?	●	●
7. How do you think about the skills, the knowledge and the person who have talent and work excellently? Do you select the operation officer for working in this model plant? How do you motivate and keep talent worker with the EGAT organization?	●	
8. How about attitude of people who work in the field of model plant for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	●	
9. How do you think about the process of creating Engineering excellence in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	●	
10. How do you think about the corporate value that use to drive the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? Do you have any other value for driving?	●	
11. Which are the new maintenance and operation methods that supporting North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	●	●
12. How do you think about Process Improvement that sufficient for Model Plant?	●	●
13. What are the procedure or methodology that improve the process to be Global Top Quartile Utility?	●	●
14. How about continuously improve processes to be best practice for working in line of Model plant?	●	●
15. How about IT or Knowledge Management Database that use to implement in Model Plant?	●	
16. How about the way of IT or Knowledge Management Database start? Parallel with the old technology or Stop the old and start the new one?	●	

Table 3.4 Qualitative Interview design with group of interviewees (cont.)

Qualitative Interview Question	Top Level, Middle Level, First Line Level and Coaching Team	Maintenance and Operation officers
17. How about North Bangkok power plant combined cycle unit 1 work with community around the power plant?	●	●
18. What they do in the green and clean process for Generation Operation? How about the green process that are comprised of Model Plant in attaining to Global Top Quartile Utility?	●	●
19. How about the relativity between Financial Model and Availability Factor of North Bangkok power plant combined cycle unit 1?	●	
20. How about the way of Financial Platform Structure that use in Model Plant of North Bangkok power plant combined cycle unit 1?	●	
21. In your opinion, do you have more suggestions for continuously improvement for model plant of North Bangkok power plant combined cycle unit 1 in attaining to Global Top Quartile Utility?	●	●

3.8 Matching Questions and Conceptual framework

Table 3.5 Matching Questions and Conceptual framework

Qualitative Interview Question	Matching Questions and Conceptual framework
1. How many factors that driving model plant for going on Global Top Quartile Utility? How to work and manage system for going on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model?	Open-coding Axial-coding The goal of result
2. Which factors are the main driving factors, supporting driving factors and the organization environment factors in attaining Global Top Quartile Utility?	Open-coding Axial-coding The goal of result
3. How do you think about leadership, motivation, evaluation, monitoring of good governance affect for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	Leader (Motivating & Assessment)
4. How do you think about model plant communication strategies that clearly and enough communication?	Strategy communication with the same goal
5. How many channel of communication?	Strategy communication with the same goal
6. Do you have any ineffectively communication that want to solve them?	Strategy communication with the same goal
7. How do you think about the skills, the knowledge and the person who have talent and work excellently? Do you select the operation officer for working in this model plant? How do you motivate and keep talent worker with the EGAT organization?	HRD & HRM Coaching Team & Team working

Table 3.5 Matching Questions and Conceptual framework (cont.)

Qualitative Interview Question	Matching Questions and Conceptual framework
8. How about attitude of people who work in the field of model plant for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	Individual positive thinking & willingness mindset
9. How do you think about the process of creating Engineering excellence in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	Engineering Excellent & Continuous Process Improvement
10. How do you think about the corporate value that use to drive the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? Do you have any other value for driving?	Culture
11. Which are the new maintenance and operation methods that supporting North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?	Engineering Excellent & Continuous Process Improvement
12. How do you think about Process Improvement that sufficient for Model Plant?	Engineering Excellent & Continuous Process Improvement
13. What are the procedure or methodology that improve the process to be Global Top Quartile Utility?	Engineering Excellent & Continuous Process Improvement
14. How about continuously improve processes to be best practice for working in line of Model plant?	Engineering Excellent & Continuous Process Improvement
15. How about IT or Knowledge Management Database that use to implement in Model Plant?	IT & KM Database
16. How about the way of IT or Knowledge Management Database start? Parallel with the old technology or Stop the old and start the new one?	IT & KM Database
17. How about North Bangkok power plant combined cycle unit 1 work with community around the power plant?	CSR After Process
18. What they do in the green and clean process for Generation Operation? How about the green process that are comprised of Model Plant in attaining to Global Top Quartile Utility?	CSR in Process
19. How about the relativity between Financial Model and Availability Factor of North Bangkok power plant combined cycle unit 1?	Financial Structure Model
20. How about the way of Financial Platform Structure that use in Model Plant of North Bangkok power plant combined cycle unit 1?	Financial Structure Model
21. In your opinion, do you have more suggestions for continuously improvement for model plant of North Bangkok power plant combined cycle unit 1 in attaining to Global Top Quartile Utility?	Recommendation

3.9 The processes of analysis.

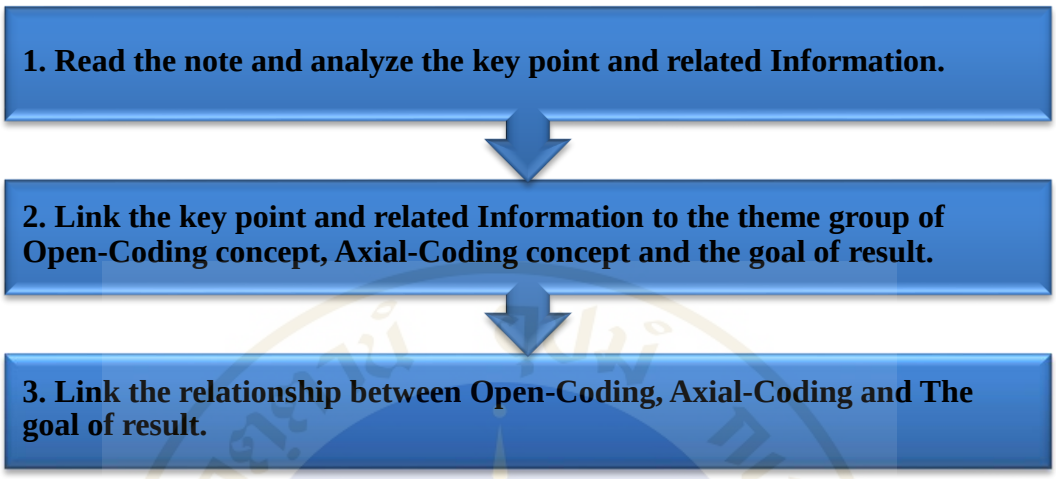

Figure 3.3 The processes of analysis

There are 3 processes of analysis:

1. Read the note and analyze the key point and related Information.
2. Link the key point and related Information to the theme group of Open-Coding concept, Axial-Coding concept and the goal of result.
3. Link the relationship between Open-Coding, Axial-Coding and The goal of result.

3.10 The Relationship of Open-Coding, Axial-Coding and The Goal of Result from Conceptual Framework

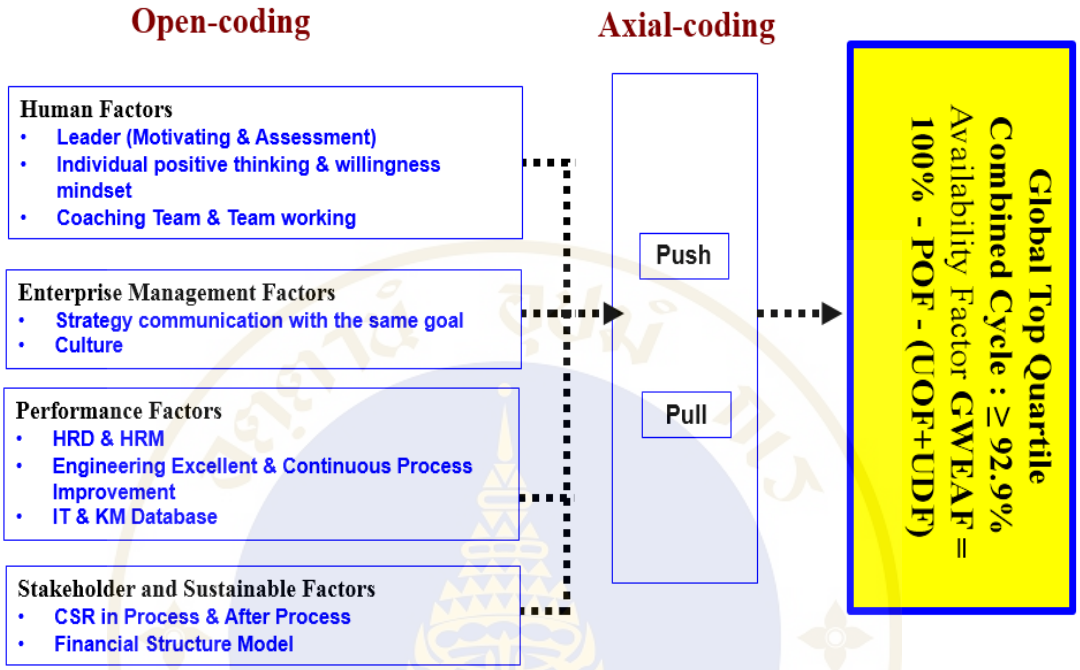

Figure 3.4 The relationship of Open-coding, Axial-coding and The goal of result from Conceptual framework

Open-coding: Change key points from the recording and notes information to be coding

Axial-coding: intermediaries driving coding between Open-coding and the goal of result the conclusion

The goal of result: Global Top Quartile Combined Cycle (The availability factor or GWEAF)

For this research Open- Coding are Human Factors, Enterprise Management Factors, Performance Factor and Stakeholder and Sustainable Factors. Human Factor Open-Coding: Leader (Motivating & Assessment), Individual positive thinking & willingness mindset, Coaching Team & Team working. Enterprise Management Factor Open-Coding: Strategy communication with the same goal, Culture. Performance Factor Open-Coding: HRD & HRM, Engineering Excellent & Continuous Process Improvement, IT & KM Database. Stakeholder and Sustainable Factor Open-Coding: CSR in Process & After

Process, Financial Structure Model. Axial-coding are Push and Pull. The goal of result is The Global Top Quartile of Availability Factors of Combined Cycle result that the availability factor can have the better number index that more than 92.9%.

3.11 Table of matching the key point of notes to open coding

Table 3.6 Matching the key point of notes to open coding

Catetagories of Factors	Key point	Coding
Human Factor Leader (Motivating & Assessment)	Leadership, leader, person ordered, supervisors, team leaders, managers, motivate, evaluate, monitoring, tracking consistency, encouragement, attention, the management system of tracking information, good governance, provide support during the operation, Reward and punishment, warnings, reward, promote and benefits	HL
Human Factor Individual positive thinking & willingness mindset	People who have willingness, people with passion, young and energetic, good mindset, people think of the interests of the organization and the country as a major benefit, a curiosity person, thinking with technology, attitude, mood to feel that you can actually possible do it, work well with others, not block every ideas, Open mind to learn new things, exchange and learn from each other.	HIP
Human Factor Coaching Team & Team working	Coaching team, Team working, The process of work of Coaching team and Operation team, Morning talk, Tool Box Meeting, Daily Meeting with two departments, Weekly Meeting, War Room, working as a team and help each other.	HCT

Table 3.6 Matching the key point of notes to open coding (cont.)

Catetagories of Factors	Key point	Coding
Enterprise Management Factors Strategy communication with the same goal	Set the goal to be challenge, Set the goal of Global Top Quartile, should be communicate all of levels with the same direction and goal, communicate the receiver is completely all of information, Input indicators are policy and budget, Output indicator is understand of Coaches, team and Executives, The process of communicate strategy from coaching team are understand, communicate, responsible for work and good assessment, simple to understand, two way communication, ability to explain to other people and ability of receiver,ask and Repeat understand of receiver,Executives must attend in the war room meeting to motivate, decision and assess following to the goal of Global Top Quartile, top to down communication, bottom-up communication,Wareroom share a common problem, solve the problem, transfer the information, Mix Top down and bottom up, think or do repeatedly.	ES
Enterprise Management Factors Culture	Do your best responsibility, Work like family, Have discipline in work and do your task completely, Work as a team, Know the functions and do them successfully, Networking Communication Team building, Teamwork, Connection, Loyalty, Excellence, Integrity, Sense of Belonging, Performance Excellence, Ethic and Integrity, Enthusiasm for Innovation, Devotion to Society, SPEED.	EC
Performance Factors HRD & HRM	Coach Selection, Coaches must have a lot of experience, a broad perspective and good human relations, Selection of coaching team from the new generation that have idea to develop the organization, Select the talented people to lead the success, The characteristics of a good coaches, Good Mindset, Work like a person in your family, Take care and Support, Recruit Coaches who are both leaders and followers at the same time, The development of people to go on field trips and training, forum to exchange their knowledge in many field with other power plant, Supporting in research, development and invention in many contest, Use successful process to apply and expand, Continuous knowledge development, learning for fulfill skill and knowledge from each profile data, qualifying or selecting, developing, maintaining, screening people with talent, increase skill, add Knowledge.	PHR

Table 3.6 Matching the key point of notes to open coding (cont.)

Catetagories of Factors	Key point	Coding
Performance Factors Engineering Excellent & Continuous Process Improvement	Evaluate the difference of GAP, Choose the methodology of maintenance, Preventive Maintenance, Predictive Maintenance, Proactive Maintenance, replaced the new components, Condition base Maintenance (CBM), Classification from duration of maintenance, operation generation, safety and environment and legal controller,Corrective Maintenance (CM), Classification from Reliability Centered Maintenance (RCM), Priority, Scheduling, Executation, Prevent for recurrence situation, Root Cause Analysis (RCA), Failure Mode Effect Analysis (FMEA), Risk Base Maintenance (RBM), Use innovation tool, Online Condition monitoring, software system one-Analyze Vibration, Engineering Management, reduce duplication of work, o Choose the right way to maintenance and reduce time, Networking and Team working, o Use Expert System and special tool, Quality and efficiency of material from owner producer, , Engineering skill, improve or develop knowledge and process continuously.	PEN
Performance Factors IT & KM Database	Knowledge must use to apply in process and develop, share ideas in the forum and make the same standard, Sharing the knowhow and Community of Practice (CoP), EIS system, Keep the information easy to find, can search on mobile phone in real time, Use online monitoring and expert system, Do BAR (Before Action Review) and AAR (After Action Review), Show and sharing knowledge and process, record knowledge in the knowledge portal of the organization, create a network of practitioners for development knowledge and exchange mutual experience, access knowledge and applied to innovate and improve their responsibilities.	PIT

Table 3.6 Matching the key point of notes to open coding (cont.)

Catetagories of Factors	Key point	Coding
Stakeholder and Sustainable Factors CSR in Process & After Process	CSR in Process, Water quality control system, online monitoring in real time, Install the air quality meter, report directly to the Pollution Control Department and the Department of Industrial Works, Report air quality from power plants, communicate the information on the LED screen at the entrance to the North Bangkok power plant, Install Online Water Meter,Waste Water Analysis and Analysis Report Submitted to Department of Industrial Works, Install sound absorbing material, Install Steam Silencer System, Environmental Management System (ISO 14001:2004), OHSAS 18001 : 2007, CSR-DIW, EIA Monitoring, Green System and Carbon Footprint Organization, CSR after Process, help the community for getting sustainable income, Study visit , Academic Exhibitions at schools and universities, Youth Environment Program for school, School painting Project, WanKaew Project which donate money to buy glasses to help solve eye problems for the disadvantaged people, Send candles to 15 temples, Youth Sports Development Project.	SCSR
Stakeholder and Sustainable Factors Financial Structure Model	EGATIF, the model for reducing EGAT's debt, pay the debt or invest in new projects, monitoring factor, must have readily availability for provide electricity from commands of National Control Center (NCC) and consistent with the Global Top Quartile Utility goal, the monitor factor that North Bangkok power plant combined cycle unit 1 must done and be Sustainable Global Top Quartile Model, the other monitoring of stakeholder and investor.	SFI
Recommendation	The next step of model plant, To give the reward, Clearly incentive, Special structure and clearly career path of coaching team.	RE

3.12 Table of matching the key point of notes to axial coding

Table 3.7 Matching the key point of notes to axial coding

Catetagories of Factors	Key point	Coding
Push	Push	P1
Pull	Pull	P2

3.13 Table of Matching The Key Point of Notes to The Goal of Global Top Quartile

Table 3.8 Matching the key point of notes to the goal of Global top quartile

Catetagories of Factors	Key point	Coding
Goal	Global Top Quartile, GWEAF : ≥ 92.9%, model plant	G

3.14 Theory Triangulation Validation

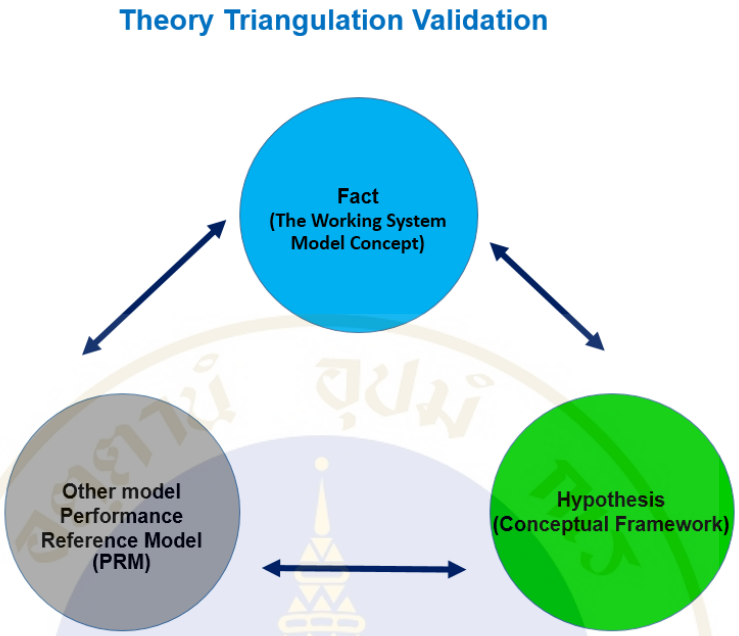

Figure 3.5 Theory Triangulation Validation

Theory Triangulation Validation by benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model (Performance Reference Model: PRM)

CHAPTER IV
RESULTS

The result of interview from twenty-six people of North Bangkok Power plant.

4.1 Descriptive Writing of Open-Coding, Axial-Coding and The Goal of Result

The Electricity Generating Authority of Thailand (EGAT) Responsible for the production, development and maintenance of power generation and transmission systems in Thailand. EGAT has been focusing on three key areas: 1. The Strengthening Security of Thailand power system 2. The economy of Thailand 3. The Environment. EGAT has good results of operation generation and transmission systems all the time and have been implemented following by KPIs from regulators such as the Ministry of Energy and the State Enterprise Policy Office (SEPO), so EGAT is recognized as a leading energy organization in Thailand. EGAT Governor and EGAT leader believe that EGAT should be an internationally leading organization in electricity business role. To increase the international role and development opportunities or become "Global Top Quartile Utility"- To become the best 25 percent of all generation operator in the world. Three strategies attaining to Global Top Quartile Utility of Electricity Generating Authority of Thailand Strategies Plan are: 1. Global Top Quartile Player 2. Regional Power Specialist 3. Learning For Society and integrate with CSR Master Plan.

The Top Quartile – Decile indicators in the world are: Availability, Heat Rate, Reliability, O&M Cost, Peak Capacity, Emissions and Dispatch Response. EGAT use McKinsey Powergauge database of Top Quartile – Decile model with three rank of indicators- Availability, Heat rate and O&M cost. (This research only study the Availability factor or GWEAF and with of combined cycle power plant.) EGAT choose McKinsey as a consultant.

The first step of process, the EGAT Governor set the strategy following to the vision. The vision is an internationally leading organization in electricity business. (On October 2017, EGAT change the new vision which is Innovate power solution for a better life but the process to be Global Top Quartile Utility still perform at the same process.)

The Generation Operation is the main responsibilities of EGAT and has been classified in Global Top Quartile Player strategies. Every Conventional power plants - Combined Cycle power plant, Thermal power plant and Hydro power plant must be international performance according to Global Top Quartile Utility.

EGAT set Model plant- The pilot model power plant has guaranteed to be the best performance in attaining Global Top Quartile Utility. EGAT choose North Bangkok Power Plant Combined Cycle to be the model plant because of North Bangkok Power Plant have high efficiency. The site is located near the community center of end users. The first rank of serving electricity into the system and full capacity. The location near the EGAT head office that's easy to manage and monitor from EGAT leader.

The main responsible of Model plant is North Bangkok power plant. The supporting of strategy planning are Corporate Planning Division and McKinsey advisor team. The supporting of operation and maintenance are every maintenance divisions in Assistant Governor-Operation and Maintenance Business –Mechanical Maintenance Division, Civil Maintenance Division, Chemical Division, Electrical Maintenance Division and Workshop and Spare Parts Division. The Global Top Quartile North Bangkok power plant combined cycle unit 1 of availability factor must be equal or more than 92.9%.

The two things must be change in attaining to Global Top Quartile are management and performance.

Two groups of management categories are Human Management and Enterprise Management.

EGAT used to work in a hierarchical or special project which separate from the core system structure. Head of North Bangkok power plant tell the policy which will be attaining in Global Top Quartile Utility and the criteria indicator must be passed. The coaching team and war room model are applied to the core system in the main line function. Head of North Bangkok power plant show that everybody in North Bangkok power plant have the same goal to work together. That are smooth operation

generation and good maintenance. Reduce time of maintenance and have full capacity of generation operation with high efficiency, low heat rate and low of O&M cost. Leader have system and coaching team are representative and helper the operation technical and frequently evaluate on the process of operation. Leader and Coaching must use soft skill and hard skill. To make them see the benefits. If the new generation sees the benefits, they will do and do continuously. Leader set the coaching team who must be the change agent to brainstorm and solve problem with operation team, do not have responsible work in line function. Coaching team and operation team play the role with brainstorm ideas and solve problems in engineering technic, management, quality, environment and safety. Coaching Team secretly insert a culture of collaboration and change the mindset of people in the main line function. Leaders and coaches play a role in inspiring operation to reach their goals and report the findings to a leader called the war room meeting. Leader have the war room meeting once a month with the coaching team and operation team to resolve the problem and follow up. Leaders need to be directed to support and motivate the way through of process.

In model plant, Coach Selection must come from a variety of major or function. Coaches must have a lot of experience, a broad perspective and good human relations. Coaches must be people who communicate and describe others to understand. The model plant want the new generation who are ready to change for the better. Can be tolerance with resistance and pressure. Do not give up trying. High earnestness. The individual mindset that coaches must have: 1. Positive thinking. 2. Look beyond yourself. Look for Overview. Look at the benefits of the country. 3. Humility. Coaches are the person who work well with others and will not block every ideas, open minded and have willingness to learn the new things, exchange and learn from each other. They must interest in knowledge and technology and keep pace with them. They like to ask questions and find the answer and think that everything can be done. They will try to find out the solution. The characteristics of a good coaches: 1. Good Mindset 2. Work like a person in your family 3. Take care and Support. In model plant do not have a lot of people in coaching team. Because of more people more different ideas, it will be wasting time to conclusion. The coach recruitment must choose the person who are both leaders and followers at the same time. It must be a variety of people in the team. The development of training course are important things of fulfill skill and knowledge

for operation with EGAT in house training and learning courses in country and foreign country. Operation level must have fulfill skill and knowledge from each profile data both engineering skill and management skill. Support thinking innovation and research of the operation officer in many contest in EGAT and outside.

Coaches and teams will need to set the problem and the question correctly. It will be possible to find the answer. When coaches and team have a preliminary evaluation. What to do? How to do? How many activities must be done in each process? It is written as an initiative project. Determine the person responsible for each task according to the function. Deploy to be an action plan. Finally, the initiative project is successfully, the team must integrate ideas and apply processes to sustainability. The process of work of Coaching team and Operation team are: 1. Section Process: Morning talk in every day in North Bangkok Power plant. Tool Box Meeting in every morning in Mechanical Maintenance Division. 2. Department Process: Daily Meeting with two departments between Maintenance Department and Generation and Operation Department. 3. Weekly Meeting 4. War Room for once a month with Executives and first line manager. 5. Finally, the war room meeting will summarize the results every month. What activities have been completed? What are not editable? What to do next month? Who are responsible to continue to complete? How long will it take to succeed? Strengths of the process is working as a team and help each other. The coaches will audit each other.

When the model plant start, in the kickoff meeting it should be communicate all of levels with the same direction and goal. Communication is very effective, when the information that communicate the receiver is completely all of information. No excerpts of information. Input indicators are policy and budget. Output indicator is understand of Coaches, team and Executives. The goal of Global Top Quartile Combined Cycle is equal to or more than 92.9%. Mathematically: GWEAF = 100% – POF – (UOF + UDF). So The Planned outage factor (POF), the Unplanned outage factor (UOF) and the Unit derating factor (UDF) must be less than or equal to 7%. If North Bangkok power plant want more GWEAF, North Bangkok power plant must reduce maintenance time of the POF, UOF and UDF maintenance. The main waste time of maintenance are combustion inspection and suddenly emergency case of auxiliary part of power plant. Main equipment of Combined Cycle power plant do not have a problem ,but Balance of plant equipment or auxiliary part like pump and valve often have the problem,

so the UOF and UDF may be need to maintenance more than the POF. In the other hand of supporting way of Mechanical Maintenance Division and Electrical Maintenance Division will reduce time of major overhaul, minor overhaul and combustion inspection that maintenance with optimization in necessary work and set the maintenance team to support in suddenly emergency case of auxiliary part of power plant. All of above North Bangkok power plant must operate generation smoothly and full capacity, loss the little time to maintenance that cause the result of the GWEAF following the goal of Global Top Quartile Utility that is equal to or more than 92.9%.

The methodology to solve this problems are: Find the GAP of problem equipment first. Choose the methodology of maintenance with Reliability Center Maintenance (RCM).

The Equipment Classification from Reliability Centered Maintenance (RCM). Classification from duration of maintenance, operation generation, safety and environment and legal controller: Class A are Very high critical equipment about 4% of all. Class B are high critical equipment about 2% of all. Class C are moderate critical equipment about 13% of all. Class D are low critical equipment about 81% of all.

Use Corrective Maintenance Optimization (CM) tool. They have four steps: 1) Classification from Reliability Centered Maintenance (RCM). 2) Priority 3) Scheduling 4) Execution. Change the duration from 30 days to 10 days.

Use Preventive Maintenance. 1. Prevent to damage situation. Change from time base maintenance to condition base maintenance (CBM). 2. Prevent for recurrence situation. The three engineering tools are Root Cause Analysis (RCA), Failure Mode Effect Analysis (FMEA) and Risk Base Maintenance (RBM).

Use Predictive Maintenance –Evaluate from Condition base Maintenance (CBM)

Use Proactive Maintenance- Analyze Predictive Information to be PF curve of maintenance. X axis is Equipment condition. Y axis is time. Check the Equipment condition and link of failure situation with low failure to severe failure. Nine step of failures from low to severe failure are failure initiated, Ultrasonic detection, Vibration detection, oil Analysis Detected, Audible Noise, Hot to touch, Mechanically Loose, Ancillary damage and Catastrophic Failure.

If it's not worth to maintenance. Must be replaced the new components that have more quality and efficiency. North Bangkok power plant use innovation tool to help in the line function. Online Condition monitoring software system one apply to analyze vibration.

Furthermore North Bangkok power plant use Online in Real time to analyze performance and link with performance Center of EGAT. North Bangkok power plant use online monitoring tool to support operation and maintenance. Can control the unplanned outage both of Operation term and maintenance term.

In supporting way of Mechanical Maintenance division, Engineering Management use to reduce duplication of work and create value of maintenance. Choose the right way to maintenance and reduce time to find the cause. Use Networking and Team working- fast and focus on informative goals. Use CBM that work with optimization maintenance -cut unnecessary tasks, extend the job without additional maintenance, but it can be operation without problems. Use RCA, RBM and FMEA – Use knowhow of engineering to analyze the solution. Use Expert System and special tool such as electrical bolt heater.

The last impact of availability factor is quality and efficiency of material from owner producer with TOR North Bangkok power plant combined cycle unit 1. Different materials tolerate different damage. If you buy a good grade material from the first time, it can reduce maintenance. Therefore, it can increase availability factor rather than low grade materials.

After the maintenance and operation process, the operation and coaches must check and have the conclusion of BAR (Before Action Review) and AAR (After Action Review), Show and sharing knowledge and process, record knowledge in the knowledge portal of the organization, create a network of practitioners for development knowledge and exchange mutual experience. The information system is a tool to support knowledge management. Workers can learn and access knowledge and applied to innovate and improve the job. All of line functions must be improve or develop knowledge and process continuously. In the War Room every month, there will be integration of ideas. The conclusion of knowledge must use to apply in the process, the next step the impact necessary of information knowledge will sharing in CSR in process to community and stakeholder. Furthermore, North Bangkok power plant have to sharing the knowhow

and Community of Practice (CoP) in the same area function in every power plant in EGAT. There are many forum to exchange the knowledge. In the forum, let people come together to share ideas in the forum and make the same standard.

In the process to note the load report. It is not use manual. It will use EIS system that can search on mobile phone in real time. Keep the information easy to find. Fast of find out the keyword from data searching. North Bangkok power plant also use online monitoring and expert system.

In line function, everybody in North Bangkok power plant understand their responsibility and do them successfully. They also work following the SPEED, 1, S-Sense of Belonging 2. P-Performance Excellence 3. E- Ethic and Integrity 4. E-Enthusiasm for Innovation 5. D-Devotion to Society. The operation officer understand and work their activity that will be smoothly, do not have the problem in everyday planning. The first line manager and middle level manager have to planning and integrate the activity of the line function and the result goal of global top quartile to force to the operation officer. The coaching team will help them and set in new culture that "Work as a Team" - work together as a family and help each other. If they have problems, discuss, solve and help each other. Coaches bring more brainstorming on innovation in the organization. Hear and exchange ideas in open talk format. And this culture is pulled on every process in model plant of North Power Plant of Combined Cycle Unit 1: Setting the goal of Global Top Quartile, Human and Enterprise Management Process, Performance Process, IT&KM Database process and other Power Plant sharing process following model plant of North Power Plant of Combined Cycle Unit 1.

In the CSR in process, North Bangkok power plant have standard work system in Environmental Management System (ISO 14001:2004), OHSAS 18001 : 2007, CSR-DIW, EIA Monitoring, Green System and Carbon Footprint Organization. The community join in the Commission. Big committee has the governor of Nonthaburi as president. Small Committee has the Director of Environment Agency Region 6 (Nonthaburi) as president. Install Online Water Meter. Waste Water Analysis and Analysis Report Submitted to Department of Industrial Works. Water quality control system is available online monitoring in real time and show the public at the entrance to the North Bangkok power plant. Install the air quality meter and report directly to the Pollution Control Department and the Department of Industrial Works. Report air quality from power plants and

continuously communicate the information on the LED screen at the entrance to the North Bangkok power plant and the surrounding community areas. Install sound absorbing material. Noise in the factory standard is less than 80 decibels. Install Steam Silencer System. It is a device that reduces the volume of steam by decreasing the speed and pressure of the steam released.

In CSR after process, In addition to study visit in the North Bangkok power plant by the community, academic and government agencies and organize the academic exhibitions at schools and universities around the North Bangkok Power Plant. There are many projects to help the community for getting sustainable income such as Bag Making for Career Project. WanKaew Project which donate money to buy glasses and equipment for special units to help solve eye problems for the disadvantaged surrounding North Bangkok power plant. Send candles to 15 temples around the area of North Bangkok in the Buddhist Lent Day. Youth Sports Development Project. School painting Project. North Bangkok Power Plant Division in cooperation with Project Environment division and Project Community Relations Division jointly organized the Youth Environment Program for school.

North Bangkok power plant must have CSR in process and After process in the line function of Human management, Enterprise management and Performance. CSR in Process & After Process of North Bangkok Power Plant pull community to the sharing and monitoring information process.

EGATIF set to be the model for reducing EGAT's debt. EGAT use EGATIF to pay the debt or invest in new projects. EGATIF use IPO selling to invest in the availability revenue from the operation of the North Bangkok Power Plant combined cycle unit 1, the payment is due within 20 years. So North Bangkok power plant combined cycle unit 1 must be maintenance of the energy and power system and readily available for provide electricity from commands of National Control Center (NCC).Revenue from availability which the North Bangkok power plant combined cycle unit 1 will already know how much income. Selling to investors is the Future Value. Investors will get the investment units and gradually pay dividends to the income that North Bangkok power plant combined cycle unit 1 have.

EGATIF is one of the key drivers of this model. The North Bangkok power plant combined cycle unit 1 must have availability factor for this fund. Stakeholders of

EGATIF impulse North Bangkok power plant to be High Performance Organization to the Availability Payment from commands of National Control Center (NCC). EGATIF is the monitoring factor that North Bangkok power plant combined cycle unit 1 must have readily availability for provide electricity from commands of National Control Center (NCC) and consistent with the Global Top Quartile Utility goal. EGATIF is the monitor factor that North Bangkok power plant combined cycle unit 1 must done and be Sustainable Global Top Quartile Model because of the other monitoring of stakeholder and investor.

Finally, the successfully goal of Global Top Quartile Combined Cycle that availability factor (GWEAF) is equal or more than 92.9% are the result of pushing driving force of Human and Enterprise Management Factors, Performance Factors, Stakeholder and Sustainable Factors and culture.

4.2 The Result: The Working System Model Concept of Model Plant From The Conclusion of Interview

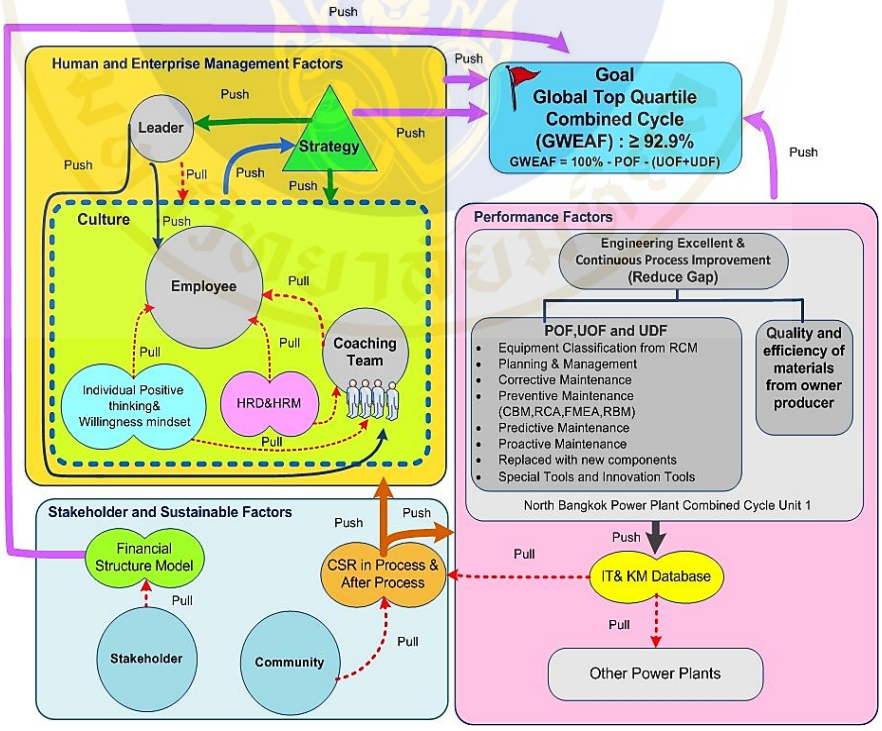

Figure 4.1 The Working System Model Concept of Model plant from the conclusion of interview

The goal of Global Top Quartile Combined Cycle that availability factor (GWEAF) is more than or equal 92.9%. Mathematically: GWEAF = 100% – POF – (UOF+UDF). If North Bangkok power plant want more GWEAF, North Bangkok power plant must reduce maintenance time of the POF, UOF and UDF maintenance. The Planned outage factor (POF), the Unplanned outage factor (UOF) and the Unit derating factor (UDF) must be less than or equal to 7%.

Human and Enterprise Management Factors: The first priority of Model plant Concept of North Bangkok Combined Cycle Unit 1 is the direction of Strategy that communicate with the same goal. Human and Enterprise Management factors begin with strategy that everybody understand in the same goal. The strategy is driving in two lines of working. One driving on the leader, next driving on the culture between employee and coaching team working. The culture are work like the family and the ware room system. If the leader change, the process of working in model plant can continue. The main of Human and Enterprise Management Factors is the culture between employee and coaching team working. If employee and coaching team work and improve continuously process system that can going on global top quartile, there is not necessary for leader to follow or command. First line is Leader working. Leader push strategy by motivating and assessment. Leader push Employee and Coaching Team to understand and work in the same goal of strategy. Leader push Coaching Team to be representative team of direction controller and supporting team for helping Employee. Second line is the culture between employee and coaching team working. Coaching Team is the key person and are pulled in the process of supporting of Employee function. Coaching Team help Employee to work in correct role of strategy. Individual Positive thinking & willingness mindset and HRD&HRM are pulled in the process of selection employee and coaching team to work in model plant. The last Employee and coaching team can work the correct system and happy workplace together that more pushing cause to driving strategy to success at the goal setting.

Performance Factors: The main cause of improve GWEAF to be better index in Global Top Quartile Standard is Engineering Excellent & Continuous Process Improvement. From mathematically: GWEAF = 100% – POF – (UOF+UDF). The first one that must do in Performance Factors in Model Plant is Reduced Gap of POF, UOF and UDF. Equipment of classification from RCM, planning and management,

corrective maintenance, Preventive Maintenance, Predictive Maintenance, Proactive Maintenance, Replaced with the new components and use special tools and innovation tools are mainly working tools to reduce the maintenance time that cause of POF, UOF and UDF factors. All of engineering tools as mentioned earlier can reduce time of maintenance and increase performance of operation generation according to Quality and efficiency of materials from owner producer of the first buyer of power plant unit. The success Model plant concept of knowledge management process of North Bangkok Combined Cycle Unit 1 that can reduce gap of POF, UOF and UDF are stored in IT& KM database. The IT& KM database are pulled in process of applying for other EGAT power plant that cannot serve electricity in attaining to Global Top Quartile Utility. IT & KM database of the performance process that clean and safe for community and environment are pulled in the process of sharing information in CSR in process & After Process.

Stakeholder and Sustainable Factors: EGATIF is a representative Financial Structure Model. Stakeholder are pulled in the process of monitoring of funding. EGATIF Invest in the revenue of availability factor (GWEAF) of North Bangkok Power Plants Combined Cycle Unit 1 that EGAT hold 25% of the total number of investment units sold. Next, EGATIF push in the goal of Global Top Quartile Combined Cycle. Community are pulled in the process of CSR in process & After Process, Next CSR in process & After Process will push Human and Enterprise Management Factors and Performance Factors. CSR in Process & After Process of North Bangkok Power Plant pull community to the sharing and monitoring information process.

Finally, the successfully goal of Global Top Quartile Combined Cycle that availability factor (GWEAF) is more than or equal 92.9% are the result of pushing driving force of Human and Enterprise Management Factors, Performance Factors and Stakeholder and Sustainable Factors.

4.3 Descriptive writing of Recommendation

The next step of model plant that must be change the mindset of all everybody in North Bangkok power plant and other power plant. Things to improve are as follows: 1. To give the reward 2. Clearly incentive 3. Special structure and clearly career path

of coaching team and team working. Need to solve the incentive and career path of coaching team

4.4 Content analysis from Open Coding frequency

Table 4.1 Content analysis from Open Coding frequency

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Human Factor Leader (Motivating & Assessment)	Leadership, leader, person ordered, supervisors, team leaders, managers, motivate, evaluate, monitoring, tracking consistency, encouragement, attention, the management system of tracking information, good governance, provide support during the operation, Reward and punishment, warnings, reward, promote and benefits	HL	21	21	100
Human Factor Individual positive thinking & willingness mindset	People who have willingness, people with passion, young and energetic, good mindset, people think of the interests of the organization and the country as a major benefit, a curiosity person, thinking with technology, attitude, mood to feel that you can actually possible do it, work well with others, not block every ideas, Open mind to learn new things, exchange and learn from each other.	HIP	20	21	95.24
Human Factor Coaching Team & Team working	Coaching team, Team working, The process of work of Coaching team and Operation team, Morning talk, Tool Box Meeting, Daily Meeting with two departments, Weekly Meeting, War Room, working as a team and help each other.	HCT	21	21	100
Enterprise Management Factors Strategy communication with the same goal	Set the goal to be challenge, Set the goal of Global Top Quartile, should be communicate all of levels with the same direction and goal, communicate the receiver is completely all of information, Input indicators are policy and budget, Output indicator is understand of Coaches, team and Executives, The process of communicate strategy from coaching team are understand, communicate, responsible for work and good assessment, simple to understand, two way communication, ability to explain to other people and ability of receiver,ask and Repeat understand of receiver,Executives must attend in the war room meeting to motivate, decision and assess following to the goal of Global Top Quartile, top to down communication, bottom-up communication,Wareroom share a common problem, solve the problem, transfer the information, Mix Top down and bottom up, think or do repeatedly.	ES	26	26	100
Enterprise Management Factors Culture	Do your best responsibility, Work like family, Have discipline in work and do your task completely, Work as a team, Know the functions and do them successfully, Networking Communication Team building, Teamwork, Connection, Loyalty, Excellence, Integrity, Sense of Belonging, Performance Excellence, Ethic and Integrity, Enthusiasm for Innovation, Devotion to Society, SPEED.	EC	19	21	90.48

Table 4.1 Content analysis from Open Coding frequency (cont.)

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Performance Factors HRD & HRM	Coach Selection, Coaches must have a lot of experience, a broad perspective and good human relations, Selection of coaching team from the new generation that have idea to develop the organization, Select the talented people to lead the success, The characteristics of a good coaches, Good Mindset, Work like a person in your family, Take care and Support, Recruit Coaches who are both leaders and followers at the same time, The development of people to go on field trips and training, forum to exchange their knowledge in many field with other power plant, Supporting in research, development and invention in many contest, Use successful process to apply and expand, Continuous knowledge development, learning for fulfill skill and knowledge from each profile data, qualifying or selecting, developing, maintaining, screening people with talent, increase skill, add Knowledge.	PHR	19	21	90.48
Performance Factors Engineering Excellent & Continuous Process Improvement	Evaluate the difference of GAP, Choose the methodology of maintenance, Preventive Maintenance, Predictive Maintenance, Proactive Maintenance, replaced the new components, Condition base Maintenance (CBM), Classification from duration of maintenance, operation generation, safety and environment and legal controller,Corrective Maintenance (CM), Classification from Reliability Centered Maintenance (RCM), Priority, Scheduling, Executation, Prevent for recurrence situation, Root Cause Analysis (RCA), Failure Mode Effect Analysis (FMEA), Risk Base Maintenance (RBM), Use innovation tool, Online Condition monitoring, software system one-Analyze Vibration, Engineering Management, reduce duplication of work, o Choose the right way to maintenance and reduce time, Networking and Team working, o Use Expert System and special tool, Quality and efficiency of material from owner producer, , Engineering skill, improve or develop knowledge and process continuously.	PEN	26	26	100
Performance Factors IT & KM Database	Knowledge must use to apply in process and develop, share ideas in the forum and make the same standard, Sharing the knowhow and Community of Practice (CoP), EIS system, Keep the information easy to find, can search on mobile phone in real time, Use online monitoring and expert system, Do BAR (Before Action Review) and AAR (After Action Review), Show and sharing knowledge and process, record knowledge in the knowledge portal of the organization, create a network of practitioners for development knowledge and exchange mutual experience, access knowledge and applied to innovate and improve their responsibilities.	PIT	20	21	95.24

Table 4.1 Content analysis from Open Coding frequency (cont.)

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Stakeholder and Sustainable Factors CSR in Process & After Process	CSR in Process, Water quality control system, online monitoring in real time, Install the air quality meter, report directly to the Pollution Control Department and the Department of Industrial Works, Report air quality from power plants, communicate the information on the LED screen at the entrance to the North Bangkok power plant, Install Online Water Meter,Waste Water Analysis and Analysis Report Submitted to Department of Industrial Works, Install sound absorbing material, Install Steam Silencer System, Environmental Management System (ISO 14001:2004), OHSAS 18001 : 2007, CSR-DIW, EIA Monitoring, Green System and Carbon Footprint Organization, CSR after Process, help the community for getting sustainable income, Study visit , Academic Exhibitions at schools and universities, Youth Environment Program for school, School painting Project, WanKaew Project which donate money to buy glasses to help solve eye problems for the disadvantaged people, Send candles to 15 temples, Youth Sports Development Project.	SCSR	26	26	100
Stakeholder and Sustainable Factors Financial Structure Model	EGATIF, the model for reducing EGAT's debt, pay the debt or invest in new projects, monitoring factor, must have readily availability for provide electricity from commands of National Control Center (NCC) and consistent with the Global Top Quartile Utility goal, the monitor factor that North Bangkok power plant combined cycle unit 1 must done and be Sustainable Global Top Quartile Model, the other monitoring of stakeholder and investor.	SFI	19	21	90.48

4.5 Content Analysis of Axial Coding Frequency

Table 4.2 Content analysis of Axial Coding frequency

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Push	Push	P1	26	26	100
Pull	Pull	P2	26	26	100

4.6 Content Analysis of The Goal of Global Top Quartile Frequency

Table 4.3 Content analysis of The goal of Global top quartile frequency

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Goal	Global Top Quartile, GWEAF : ≥ 92.9%, model plant	G	26	26	100

4.7 Content analysis of Recommendation

Table 4.4 Content analysis of Recommendation

Catetagories of Factors	Key point	Coding	Frequency of Respondents	The total number of Respondents	Percentage
Recommendation	The next step of model plant, To give the reward, Clearly incentive, Special structure and clearly career path of coaching team.	RE	15	26	57.69

4.8 The Benchmarking Model by Performance Reference Model: PRM)

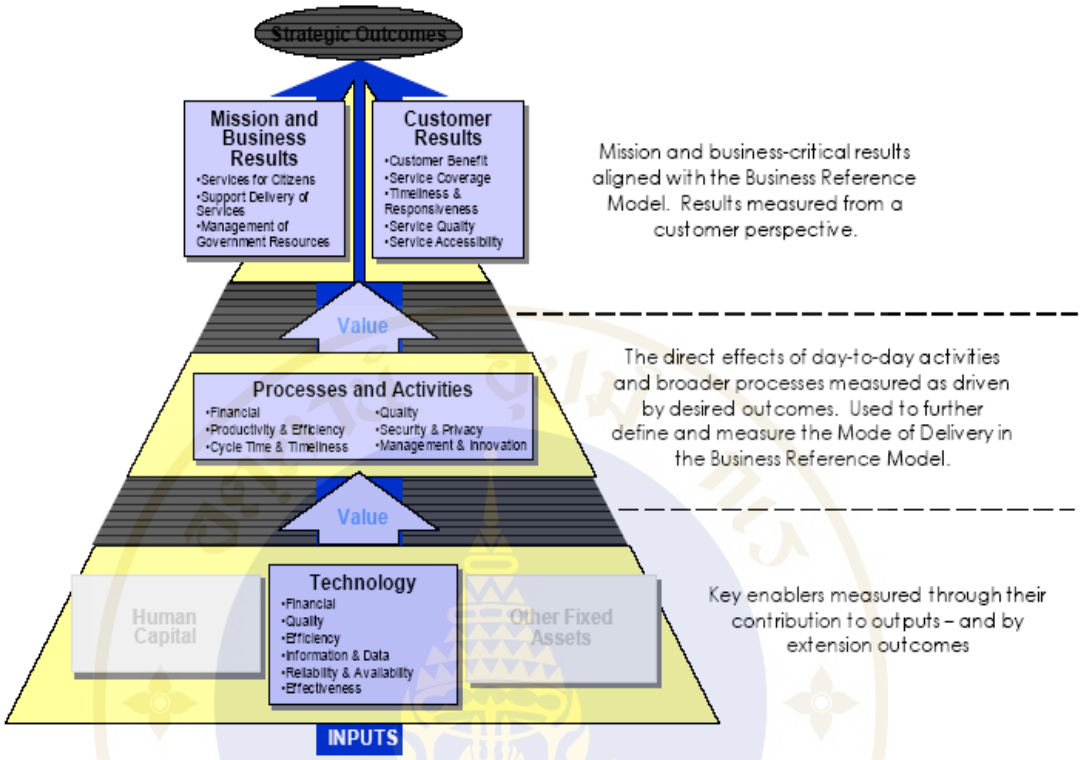

Figure 4.2 The Benchmarking model by Performance Reference Model: PRM)

Source: IBM knowledge center, Understanding the Performance Reference Model. [Online]. Available https://www.ibm.com/support/knowledgecenter/en/SS6RBX_11.4.2/com.ibm.sa.irma.doc/topics/c_Under_Perf_Ref_Mdl_PRM.html (March 4, 2018)

In case of this research, the goal of result is The Global Top Quartile of Availability Factors of Combined Cycle result that the availability factor can have the better number index that more than 92.9%. The model in comparative efficiency in similar scale is Performance Reference Model: PRM.

PRM are used to be benchmarking model because this model apply of mission and business results include in the process of performance model. It is not only focus on Engineering and IT process. It is also focus on business and management result.

4.9 The Benchmarking analysis with Hypothesis (Conceptual Framework)

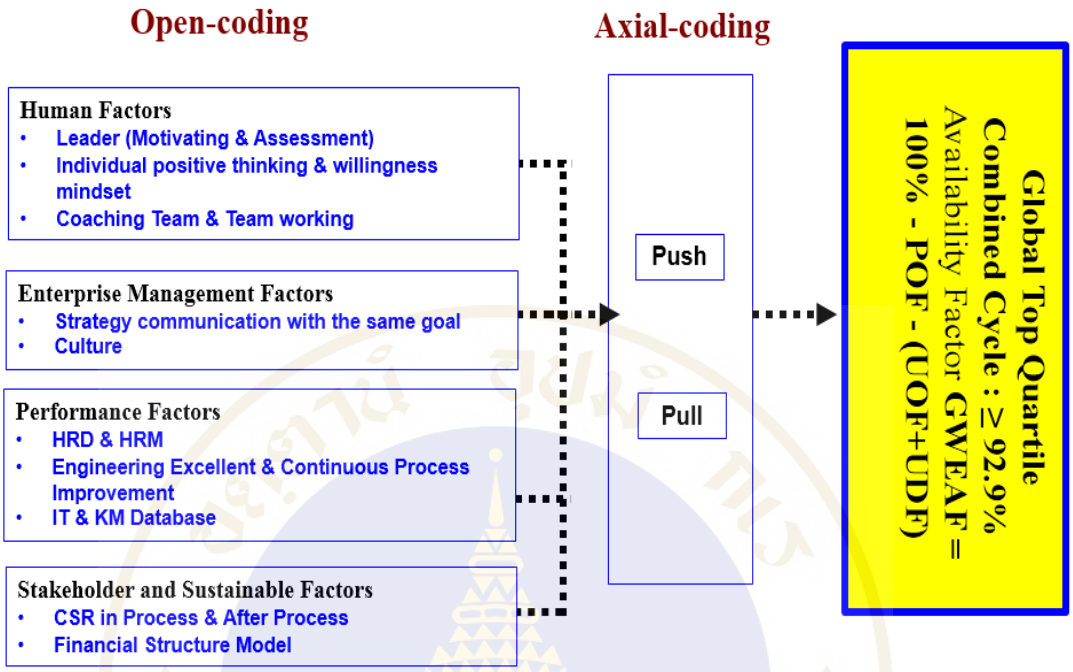

Figure 4.3 The Benchmarking analysis with Hypothesis (Conceptual Framework)

4.10 Table of Benchmarking Analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and Other Model Performance Reference Model: PRM)

Table 4.5 Benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model Performance Reference Model: PRM)

Fact (The Working System Model Concept)	Other Model (PRM)		Hypothesis (Conceptual Framework)		Other Model (PRM)	Hypothesis (Conceptual Framework)
	Similarity	Difference	Similarity	Difference	Description	Description
Human Factors						
Leader (Motivating & Assessment)		•	•		It is not show that leader is the key person of PRM.	Confirmation of the hypothesis from content analysis actual data show that Leader (Motivating & Assessment) factor affects the model plant.
Individual positive thinking & willingness mindset		•	•		It is not show that Individual positive thinking & willingness mindset is the key process of PRM.	Confirmation of the hypothesis from content analysis actual data show that Individual positive thinking & willingness mindset factor affects the model plant.
Coaching Team & Team working		•	•		It is not show that Coaching Team & Team working is the key person of PRM	Confirmation of the hypothesis from content analysis actual data show that Coaching Team & Team working factor affects the model plant.

Table 4.5 Benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model Performance Reference Model: PRM) (cont.)

Fact (The Working System Model Concept)	Other Model (PRM)		Hypothesis (Conceptual Framework)		Other Model (PRM)	Hypothesis (Conceptual Framework)
	Similarity	Difference	Similarity	Difference	Description	Description
Enterprise Management Factors						
Strategy communication with the same goal	•	•	•		The similar thing is Mission, but the different thing is about communicate strategy with the same goal. It is not clear that the process of communicate with the same goal is the key process of PRM.	Confirmation of the hypothesis from content analysis actual data show that Strategy communication with the same goal factor affects the model plant.
Culture		•	•		It is not show that culture is the key process of PRM.	Confirmation of the hypothesis from content analysis actual data show that Culture factor affects the model plant.

Table 4.5 Benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model Performance Reference Model: PRM) (cont.)

Fact (The Working System Model Concept)	Other Model (PRM)		Hypothesis (Conceptual Framework)		Other Model (PRM)	Hypothesis (Conceptual Framework)
	Similarity	Difference	Similarity	Difference	Description	Description
Performance Factors						
HRD & HRM	•		•		The similar things are Employee satisfaction, Recruitment & Retention, Employee Development and Employee Ratios.	Confirmation of the hypothesis from content analysis actual data show that HRD & HRM factor affects the model plant.
Engineering Excellent & Continuous Process Improvement	•		•		The similar things are Quality, Productivity and Efficiency, Management & Innovation,Cycle and Resource time and Maintenance & efficiency.	Confirmation of the hypothesis from content analysis actual data show that Engineering Excellent & Continuous Process Improvement factor affects the model plant.
IT & KM Database	•	•	•		The similar things is information and data, but the different thing is about KM database. It is not clear that the process of KM database is the key process of PRM.	Confirmation of the hypothesis from content analysis actual data show that IT & KM Database factor affects the model plant.

Table 4.5 Benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model Performance Reference Model: PRM) (cont.)

Fact (The Working System Model Concept)	Other Model (PRM)		Hypothesis (Conceptual Framework)		Other Model (PRM)	Hypothesis (Conceptual Framework)
	Similarity	Difference	Similarity	Difference	Description	Description
Stakeholder and Sustainable Factors						
CSR in Process & After Process	•	•	•		The similar things is customer result, but the different thing is about CSR process. It is not clear that the process of CSR is the key process of PRM.	Confirmation of the hypothesis from content analysis actual data show that CSR in Process & After Process factor affects the model plant.
Financial Structure Model	•		•		The similar things is strategic Outcomes	Confirmation of the hypothesis from content analysis actual data show that Financial Structure Model factor affects the model plant.

Table 4.5 Benchmarking analysis of Fact (The Working System Model Concept), Hypothesis (Conceptual Framework) and other model Performance Reference Model: PRM) (cont.)

Fact (The Working System Model Concept)	Other Model (PRM)		Hypothesis (Conceptual Framework)		Other Model (PRM)	Hypothesis (Conceptual Framework)
	Similarity	Difference	Similarity	Difference	Description	Description
Dynamic and Direction						
Push	•	•	•		The similar thing is the forward or push directions of value, but the different thing is about the directions of each step of factors. It is not show the directions of each factors of PRM.	Confirmation of the hypothesis from content analysis actual data show that the dynamic and direction of Push in each step of factors link with other factors and can achieve the goal.
Pull		•	•		It is not show the pull directions of each factors of PRM.	Confirmation of the hypothesis from content analysis actual data show that the dynamic and direction of Pull in each step of factors link with other factors and can achieve the goal.
The goal of result						
The goal of output	•		•		The similar things is Business Result and strategic Outcomes	Confirmation of the hypothesis from content analysis actual data show that setting the goal of output can achieve the goal of Global Top Quartile Combined Cycle power plant.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 The New Academic Contribution of The Working System Model Concept of Model Plant by benchmarking analysis of PRM

1. Leader (Motivating & Assessment) is the key driving factor of model plant. If the leader does not motivate and assess. Every process are difficult to achieve. The content analysis actual data show that Leader (Motivating & Assessment) factor affects the model plant. The frequency of respondents, 21 of 21 people agree that Leader (Motivating & Assessment) factor impact of the model plant in attaining Global Top Quartile Utility. It is not show that leader is the key person of PRM.

2. Individual positive thinking & willingness mindset is the key driving of Human factors in model plant in attaining Global Top Quartile Utility. Individual Positive thinking & willingness are pulled in the process of selection people to work in model plant team and coaching team. The content analysis actual data show that Individual positive thinking & willingness mindset factor affects the model plant. The frequency of respondents, 20 of 21 people agree that Individual positive thinking & willingness mindset factor impact of the model plant in attaining Global Top Quartile Utility. It is not show that Individual positive thinking & willingness mindset is the key process of PRM.

3. Coaching Team & Team working is the representative team of direction controller and supporting team for helping Employee. Coaching Team is the key person and are pulled in the process of supporting of Employee function Coaching Team help Employee to work in correct role of strategy. The content analysis actual data show that Coaching Team & Team working factor affects the model plant. The frequency of respondents, 21 of 21 people agree that Coaching Team & Team working factor impact of the model plant in attaining Global Top Quartile Utility. It is not show that Coaching Team & Team working is the key person of PRM.

4. Strategy communication with the same goal. The model plant focus on communicate all of levels with the same direction and goal. Communication is very effective, when the information that communicate the receiver is completely all of information. The content analysis actual data show that Strategy communication with the same goal factor affects the model plant. The frequency of respondents, 26 of 26 people agree that Strategy communication with the same goal factor impact of the model plant in attaining Global Top Quartile Utility. It is not clear that the process of communicate with the same goal is the key process of PRM.

5. Culture are work like the family and the ware room system. The main of Human and Enterprise Management Factors is the culture between employee and coaching team working. Everybody in North Bangkok power plant understand their responsibility and do them successfully. They also work following the SPEED Core Value and Corporate Culture. The content analysis actual data show that culture factor affects the model plant. The frequency of respondents, 19 of 21 people agree that culture factor impact of the model plant in attaining Global Top Quartile Utility. It is not show that culture is the key process of PRM.

6. IT & KM Database. The success Model plant concept of knowledge management process of North Bangkok Combined Cycle Unit 1 that can reduce gap of POF, UOF and UDF are stored in IT& KM database. The IT& KM database are pulled in process of applying for other EGAT power plant that cannot serve electricity in attaining to Global Top Quartile Utility. The content analysis actual data show that IT & KM Database factor affects the model plant. The frequency of respondents, 20 of 21 people agree that IT & KM Database factor impact of the model plant in attaining Global Top Quartile Utility. It is not clear that the process of KM database is the key process of PRM.

7. CSR in Process & After Process. Community are pulled in the process of CSR in process & After Process, Next CSR in process & After Process will push Human and Enterprise Management Factors and Performance Factors. CSR in Process & After Process of North Bangkok Power Plant pull community to the sharing and monitoring information process. The content analysis actual data show that CSR in Process & After Process factor affects the model plant. The frequency of respondents, 26 of 26 people agree that CSR in Process & After Process factor impact of the model plant in attaining

Global Top Quartile Utility. It is not clear that the process of CSR is the key process of PRM.

8. The dynamic and direction of Push. The content analysis actual data show that the dynamic and direction of Push in each step of factors link with other factors and can achieve the goal. The frequency of respondents, 26 of 26 people agree that the dynamic and direction of Push is the intermediate direction between driving factor and the goal of Global Top Quartile Utility. It is not show the Push directions of each factors of PRM. PRM is only have direction of value.

9. The dynamic and direction of Pull. The content analysis actual data show that the dynamic and direction of Pull in each step of factors link with other factors and can achieve the goal. The frequency of respondents, 26 of 26 people agree that the dynamic and direction of Pull is the intermediate direction between driving factor and the goal of Global Top Quartile Utility. It is not show the pull directions of each factors of PRM.

5.2 To fulfill the literature review by driving factors from The Working System Model Concept of Model Plant.

1. Leader (Motivating & Assessment) will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for Leader to be motivating but assessment also must be powerful driving force in model plant of North Bangkok power plant.

2. Strategy communication with the same goal will fulfill all of three theories (The Six box model of Organization Diagnosis theory, The Organization Intelligence Model theory and Learning Organization).

3. Individual positive thinking & willingness mindset will fulfill The Six box model of Organization Diagnosis theory. It is not enough for only Relationship in The Six box model of Organization Diagnosis theory but Individual positive thinking & willingness mindset must be powerful driving force in model plant of North Bangkok power plant.

4. HRD & HRM will fulfill Learning Organization theory. It is not enough for only System thinking in Learning Organization theory but continuously internal improvement of HRD & HRM must be useful for driving in model plant of North Bangkok power plant.

5. CSR in Process & After Process will fulfill Learning Organization theory. It is not enough for only Team building for internal organization in Learning Organization theory but CSR in Process & After Process must have sharing and exchange knowledge with community and outside stakeholder.

6. Financial Structure Model will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for only performance structure but financial structure model is the main sustainable driving force in model plant of North Bangkok power plant.

5.3 The New Academic Contribution to Fulfill of Literature Review of the Six Box Model of Organization Diagnosis Theory, The Organization Intelligence Model theory and Learning Organization

Figure 5.1 Literature Review of The Six box model of Organization Diagnosis theory, The Organization Intelligence Model theory and Learning Organization

Table 5.1 The New Academic Contribution to fulfill of Literature Review of The Six box model of Organization Diagnosis theory, The Organization Intelligence Model theory and Learning Organization

The Working System Model Concept of Model Plant	Venn Diagram			The New Academic Contribution
	The Six box model of Organization Diagnosis theory	The Organization Intelligence Model theory	Learning Organization	
Leader (Motivating & Assessment)	•	•		Leader (Motivating & Assessment) The assessment from Leader
Strategy communication with the same goal	•	•	•	Strategy communication with the same goal
Individual positive thinking & willingness mindset	•			Individual positive thinking & willingness mindset
HRD & HRM			•	HRD & HRM
CSR in Process & After Process			•	CSR in Process & After Process
Financial Structure Model	•	•		Financial Structure Model

Leader (Motivating & Assessment) will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for Leader to be motivating but assessment also must be powerful driving force in model plant of North Bangkok power plant.

Strategy communication with the same goal will fulfill all of three theories (The Six box model of Organization Diagnosis theory, The Organization Intelligence Model theory and Learning Organization).

Individual positive thinking & willingness mindset will fulfill The Six box model of Organization Diagnosis theory. It is not enough for only Relationship in The Six box model of Organization Diagnosis theory but Individual positive thinking & willingness mindset must be powerful driving force in model plant of North Bangkok power plant.

HRD & HRM will fulfill Learning Organization theory. It is not enough for only System thinking in Learning Organization theory but continuously internal

improvement of HRD & HRM must be useful for driving in model plant of North Bangkok power plant.

CSR in Process & After Process will fulfill Learning Organization theory. It is not enough for only Team building for internal organization in Learning Organization theory but CSR in Process & After Process must have sharing and exchange knowledge with community and outside stakeholder.

Financial Structure Model will fulfill The Six box model of Organization Diagnosis theory and The Organization Intelligence Model theory. It is not enough for only performance structure but financial structure model is the main sustainable driving force in model plant of North Bangkok power plant.

5.4 The New Managerial Implication of Energy Sector and Power plant

1. Financial Structure Model. EGATIF set to be the model for reducing EGAT's debt. EGAT use EGATIF to pay the debt or invest in new projects. EGATIF use IPO selling to invest in the availability revenue from the operation of the North Bangkok Power Plant combined cycle unit 1. Revenue from availability which the North Bangkok power plant combined cycle unit 1 will already know how much income. Selling to investors is the Future Value. Investors will get the investment units and gradually pay dividends to the income that North Bangkok power plant combined cycle unit 1 have. That is the new Energy management and investment of Energy Sector. EGATIF is the monitoring factor that North Bangkok power plant combined cycle unit 1 must have readily availability for provide electricity from commands of National Control Center (NCC) and consistent with the Global Top Quartile Utility goal and be Sustainable Global Top Quartile Model because of the other monitoring of stakeholder and investor. EGATIF can be the funding model of monitoring model from EGAT power plant that cannot serve the electricity to Global Top Quartile.

2. The working system model concept of model plant of North Bangkok power plant in attaining Global Top Quartile Utility could be the direction Roadmap Knowledge Management to elevate generation operation from the other power plants in EGAT that cannot pass Global Top Quartile Utility standard. The planned outage factor (POF), the unplanned outage factor (UOF) and The Unit Derating factor (UDF)

are in the best standard of World-class and supporting The Strengthening Security of Thailand power system, the lower cost in the fuel adjustment charge of electricity payment for driving the economy of Thailand and the good environment in generation operation.

3. Dynamic and Direction from the working system model concept of model plant. Direction indicates that each factor is linked and affects the other factors, both directly and indirectly. If there is a problem in the process factor. It can be known that it is the result of a mistake of another factor. When there have a problem, the staff can solve the whole process by checking from the next process and the rollback process.

4. Coaching Team and Team working. Coaching Team is the key driver of model plant. Leader push Coaching Team to be representative team of direction controller and supporting team for helping Employee. Coaching Team is the key driver to pull Employee to work in correct role of strategy. And Coaching Team will be push the new culture that work together of organization development. That is the new management that the coaching team and war room model are applied to the core system in the main line function. EGAT can be use Coaching Team and Team working to be change agent to drive of process and policy for going on Global Top Quartile.

5.5 Recommendation

5.5.1 Recommendation of Improvement process of model plant

- Coaching Team must have career path and incentive clearly in the role of organization development.
- Must be change the mindset of all everybody in North Bangkok power plant and other power plant.
- To give the reward and promote to hard working person.
- North Bangkok power plant can elevate to the next step of Global Top Decile by driving on digital and innovation to be digital power plant in the future.

5.5.2 Recommendation of the working system model concept of model plant

- Weight Adjustment from the next step of the working system model concept of model plant.
- The working system model concept of model plant is good for Global Top Quartile Combined Cycle with only the availability indicator. If it can apply to other type of power plant such as Thermal power plant, Hydro power plant or Distributional power plant, it will set the new goal Global Top Quartile Utility from each type of power plant.

5.5.3 Recommendation of Strategies

- The strategy of leader are applying the coaching team to be the representative or change agent to support and drive the employee and system that can going on Global Top Quartile Utility.
- The culture are work like the family and the ware room system. The main of Human and Enterprise Management Factors is the culture between employee and coaching team working. If the leader change, the process of working in model plant can continue.
- Financial Model use for two strategies. One for reducing EGAT's debt and investment the new project. Two is monitoring of model plant in attaining to Global Top Quartile Utility.
- Find and reduce the Gap of POF, UOF and UDF. Use the correct tools of Engineering Excellent & Continuous Process Improvement.

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APPENDICES

Appendix A: Questions for Interview

Three are 21 Question Guidelines for asking interviewee.

Grouping 2 Groups of questions for interview: 1. For Top Level, Middle Level, First Line Level and Coaching Team. 2. For Maintenance and Operation officers

- Question 1-21 for Top Level, Middle Level, First Line Level and Coaching Team
- Question 4, 5, 6, 11, 12, 13, 14, 17, 18 and 21 for Maintenance and Operation officers

1. How many factors that driving model plant for going on Global Top Quartile Utility? How to work and manage system for going on Global Top Quartile Utility of EGAT combined cycle power plants that cannot serve electricity generation by using model plant of North Bangkok power plant combined cycle unit 1 for duplicate EGAT Roadmap Model?
2. Which factors are the main driving factors, supporting driving factors and the organization environment factors in attaining Global Top Quartile Utility?
3. How do you think about leadership, motivation, evaluation, monitoring of good governance affect for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
4. How do you think about model plant communication strategies that clearly and enough communication?
5. How many channel of communication?
6. Do you have any ineffectively communication that want to solve them?
7. How do you think about the skills, the knowledge and the person who have talent and work excellently? Do you select the operation officer for working in this model plant? How do you motivate and keep talent worker with the EGAT organization?
8. How about attitude of people who work in the field of model plant for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?

9. How do you think about the process of creating Engineering excellence in this field for driving in the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
10. How do you think about the corporate value that use to drive the North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility? Do you have any other value for driving?
11. Which are the new maintenance and operation methods that supporting North Bangkok power plant combined cycle unit 1 in attaining Global Top Quartile Utility?
12. How do you think about Process Improvement that sufficient for Model Plant?
13. What are the procedure or methodology that improve the process to be Global Top Quartile Utility?
14. How about continuously improve processes to be best practice for working in line of Model plant?
15. How about IT or Knowledge Management Database that use to implement in Model Plant?
16. How about the way of IT or Knowledge Management Database process start? Parallel with the old technology or Stop the old and start the new one?
17. How about North Bangkok power plant combined cycle unit 1 work with community around the power plant?
18. What they do in the green and clean process for Generation Operation? How about the green process that are comprised of Model Plant in attaining to Global Top Quartile Utility?
19. How about the relativity between Financial Model and Availability Factor of North Bangkok power plant combined cycle unit 1?
20. How about the way of Financial Platform Structure that use in Model Plant of North Bangkok power plant combined cycle unit 1?
21. In your opinion, do you have more suggestions for continuously improvement for model plant of North Bangkok power plant combined cycle unit 1 in attaining to Global Top Quartile Utility?

Appendix B: Definition of Terms Used in This Thesis

Term	Definition
Global Top Quartile Utility	To become the best 25 percent of all generation operator in the world. Three strategies attaining to Global Top Quartile Utility of Electricity Generating Authority of Thailand Strategies Plan are: 1. Global Top Quartile Player 2. Regional Power Specialist 3. Learning For Society and integrate with CSR Master Plan.
Model Plant	The power plant has guaranteed to be the best performance in attaining Global Top Quartile Utility.
GWEAF	Generating Weighted Equivalent Availability Factor (GWEAF): The availability for serving electricity in electricity system that show the real available time and capacity. The GWEAF is a measure of the number of hours the full capacity of a generating unit is available per the total period hours. $\text{GWEAF} = \sum_{i=1}^{N} \frac{((PH - POH_i - UOH_i - EUNDH_i) \times GMC_i)}{\sum_{i=1}^{N}(PH \times GMC_i)} \times 100\ \%$ i = Unit of Electricity Generation N = Total number of Electricity Generation PH = Period Hours POH_i = Planned Outage Hours: The hours of clearly duration plan that cannot serve the electricity in the system UOH_i = Unplanned Outage Hours: The hours of unclearly duration plan that cannot serve the electricity cause by Maintenance Outage Hours and Forced Outage Hours. $EUNDH_i$ = Equivalent Unit Derated Hours: The hours of reduce power of electricity (Megawatt:MW) cause by Equivalent Planned Derated Hours (EPDH) and Equivalent Unplanned Derated Hours (EUDH)

Term	Definition
	GMC_i = Gross Maximum Capacity Unit of GWEAF = Percent (%) "Electricity Generating Authority of Thailand" January 12, 2017. [Online]. Available http://www.egat.co.th (January 12, 2017)
Heat Rate	Heat rate is the common measure of system efficiency in a steam power plant. It is defined as "the energy input to a system, typically in BTU/kWh, divided by the electricity generated, in kW. The heat rate is the inverse of the efficiency. The lower heat rate is better that can save Input Energy and more Output Power" Mathematically: $$Heat\ Rate(BTU/kWh) = \frac{Input\ Energy\ (BTU/hr)}{Output\ Power\ (kW)}$$ Online Dynamic Enterprise Solution for Industry Excellence. "HEAT RATE BASICS." [Online].www.myodesie.com/wiki/index/returnEntry/id/2995 (January 12, 2017).
Efficiency	Efficiency is "a ratio of the useful energy output by the system to the energy input to the system." Mathematically: $$Efficiency = \frac{Useful\ Output\ Energy}{Input\ Energy}$$ Online Dynamic Enterprise Solution for Industry Excellence. "HEAT RATE BASICS." [Online].www.myodesie.com/wiki/index/returnEntry/id/2995 (January 12, 2017).
POF	**Planned outage factor (POF)** $$POF = (\frac{POH}{PH}) \times 100$$ "IEEE Power Engineering Society" January 26, 2017. [Online]. Available http:// www.nerc.com/docs/pc/gadstf/ieee762tf/762-2006.pdf (January 26, 2017)

Term	Definition
UOF	**Unplanned outage factor (UOF)** $$UOF = (\frac{UOH}{PH}) \times 100$$ "IEEE Power Engineering Society" January 26, 2017. [Online]. Available http:// www.nerc.com/docs/pc/gadstf/ieee762tf/762-2006.pdf (January 26, 2017)
UDF	**Unit derating factor (UDF)** The unit derating factor is the fraction of maximum generation (MG) that could not be produced due to unit deratings. $$UDF = (\frac{EUNDH}{PH}) \times 100$$ "IEEE Power Engineering Society" January 26, 2017. [Online]. Available http:// www.nerc.com/docs/pc/gadstf/ieee762tf/762-2006.pdf (January 26, 2017)
PH	**Period Hours (PH)** Number of hours a unit was in the active state. A unit generally enters the active state on its commercial date. "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)
UDH	**Unplanned Derated Hours (UDH)** Sum of all hours experienced during Forced **Deratings and Maintenance Deratings plus any** Scheduled Derating Extensions of any **Maintenance Deratings.** "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)

Term	Definition
UOH	**Unplanned Outage Hours (UOH)** Sum of all hours experienced during Forced **Outages and Maintenance Outages plus any** Scheduled Outage Extensions of any Maintenance Outages. "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)
POH	Planned outage hours, or the numbers of hours a unit was in the planned outage state. "IEEE Power Engineering Society" January 26, 2017. [Online]. Available http://www.dcregs.dc.gov/Notice/Download.aspx?VersionID=376377
EUDH	**Equivalent Unplanned Derated Hours (EUDH)** Product of the Unplanned Derated Hours and the Size of Reduction, divided by the NMC "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)
EPDH	**Equivalent Planned Derated Hours (EPDH)** Product of the Planned Derated Hours and the Size of Reduction, divided by the NMC "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)
NMC	**Net Maximum Capacity (NMC)** Capacity a unit can sustain over a specified period when not restricted by ambient conditions or equipment deratings, minus the losses associated with station service or auxiliary loads. "North American Electric Reliability Council" January 26, 2017. [Online]. Available http:// www.nerc.com (January 26, 2017)