# RISK ASSESSMENT AND DEVELOPMENT OF OCCUPATIONAL STANDARD AND PROFESSIONAL QUALIFICATION PROCESS FOR ENVIRONMENTAL WORKS

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# ABSTRACT


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| **Title of Dissertation** | RISK ASSESSMENT AND DEVELOPMENT OF OCCUPATIONAL STANDARD AND PROFESSIONAL QUALIFICATION PROCESS FOR ENVIRONMENTAL WORKS |
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This qualitative research aimed to conduct the risk assessment in occupational standard and professional qualification process for environmental work by collecting data from key informants based on purposive sampling such as consultants, working group, and endorsement board in total 49 samples from 7 professional groups through the semi-structured interviews. Then, the data analysis conducts with the content analysis to conclude and interpret according to the theories from the occupational standard processes namely 1) Publicizing the project to the target group 2) Studying occupational standards from role model countries 3) Conducting functional analysis to endorsement board for approval 4) Developing assessment tools and evaluating their quality 5) Testing assessment tools and proposing to the endorsement board for approval. The study results found the significant risks from risk identification, risk analysis, and risk assessment at low and moderate levels with risk treatment and management. Based on the findings, several process improvements and developments were recommended including: 1) Determine the selection criteria including the ratio of representation from government agencies, private sector entitles, and independent organizations 2) Determine the public relations plan, period, and result dissemination 3) Organize trainings on functional analysis 4) Recruit the working group 5) Determine common and specific competency 6) Determine the ratio of academic and practical test 7) Facilitate a meeting for understanding and self-assessment among the testing groups and examiners 8) Compile the list of professional experts 9) Collect feedback for improvement and 10) Create a positive perception benefit through the media outreach to the target group.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Background and Rationale

Current environmental problems have been partially derived from consistent development activities that are normally contradictory to environmental quality. (Office of Natural Resources and Environment Policy and Planning, 2017). This is partly because of operations of personnel related to environmental affairs in respect of management, oversight, control, and execution. These functions need to be directed properly and theoretically, while operators have to possess knowledge, understanding, skills, competence, as well as attributes of professional expertise, especially in the area of natural and man-made environmental resources.

The country's industrial structuring according to Thailand's 20-Year Strategy of the development of Industry 4.0 (2017-2036) (Ministry of Industry, 2016) released a report that for the national development to overcome the middle-income trap and move towards high income country, it is necessary to undergo industrial restructuring. The industrial restructuring constitutes a major mechanism to drive the country's economy by focus on industrial development that uses advanced technology in production and the industry that is developed based on creativity and innovation approach. Technology and innovations have the Innovation Lifecycle or the S-curve graph which shows the growth of technology and explains the efficiency and the cost effectiveness of the changing technology with time. Presently, the industrial groups in Thailand are divided into 3 groups according to the economic value and the trend of future growth as follows:

Group 1 The industries are enhanced on the old potential industries (First S-Curve) . They are the industries that Thailand has potential and expertise in production. They are also the industries with potential to create economic value and trade value but lack the development that is enhanced on advanced technology. This group of industries will be saturated with ability of low growth so it is necessary to use new technologies and innovations to develop these industries to grow further.

Group 2 New S-Curve industrial group is the new technology and innovation intensive industrial group. This group is able to experience high growth in the future. But as it is new industry, there are a few entrepreneurs. The industrial group is not strong and the economic value is not as high as the first group. Therefore, it is necessary to develop and strengthen the entrepreneurs in this industrial group.

Group 3 The industry that should undergo reform is the industrial group that uses traditional technology in production. It has the ability of limited growth. Some industries create small economic value compared to the first group. Therefore, this industrial group needs to undergo industrial restructuring such as cluster, large scale industry, increase advanced technology, increase creativity and innovation to ensure that this industrial group can develop further.

Among the 3 industrial groups, the industrial group 1 and the industrial group 2 namely the enhancement on the old, potential industrial group (First S-Curve) and the industries of the future (New S-Curve) are the target industries that drive the country's economy. They constitute the enhancement and the creation of new S-curve as the New Engine of Growth and the tool for the country to move towards Thailand 4.0.

The development of the mentioned industries requires technology and innovation for the development. The main technology framework must be determined as the development tool by shifting the country's two dimensions of competitive advantage namely biodiversity and cultural diversity to competitiveness by adding creativity, innovation, and technology R&D to restructure the old industrial group to the industrial group with higher value and complications to drive the 5 technology and innovation groups as follows:

1. Food, Agriculture & Bio-Tech
2. Health, Wellness & Bio-Med
3. Smart Devices, Robotics & Mechatronics
4. Digital, IoT, Artificial Intelligence & Embedded Technology
5. Creative, Culture & High Value Services

The report of Institute (2017) Chulalongkorn University Intellectual Property Institute on the analysis of the technological and industrial trend, agro-industry and biotechnology, there was the overall information on the analysis of the potentials of agro and biotechnology industries by using the Diamond Model. It was concluded

that the potential of competition was at moderate to high levels. The production factors constituted positive motivation from the skills of human resources with the clear R&D center. However, there might be negative constraints from the ban of the cultivation of bio plants in the country, increasing costs due to the reliance on import of raw materials and advanced technology. In terms of market demands, the market and customers at the global level increased. Yet, there were direct protests against the consumption of bio products. Acknowledgement or acceptance of the practical mechanism of domestic customers is still not widespread. In terms of relevant and supporting industries, the basic supply chain on the whole is strong. The midstream and downstream industries possessed knowledge. There was also good cooperation and coordination along the guideline of the cluster system, in particular Facilitators and Influencers. There may be exceptions of the upstream industry as it is not possible to use land for cultivation in the country and it must be replaced by import of raw materials.

In terms of competition in the industry, the bio-based agro-industry is related to advanced technology and there is yet no free trade market access so it results in the lack of competitive advantage in marketing and costs. In terms of the government's role, the government stresses the importance of formulation of target framework and promotional policy to develop the country's Bio-based Economy and determination of various continuous supporting measures. But the government still assumes a main role of not opening up free trade especially in the context of the ingredients from bio-based raw materials and strict and formal compliance with the regulations on the cultivation of bio-based plants in the country. In terms of the role of opportunity, it is feasible to have both positive and negative impacts covering major issues such as the evolution and continuous progress of bio technology demands of the global society from greenhouse gas situations or global warming, and those who protest or preserve require knowledge and guideline to clearly raise awareness of bio products at the national and regional levels.

Therefore, in order to produce and develop personnel in every professional field, including environmental profession to have Knowledge, Skill, Attribute of the environmental operators based on the standard on a par with international standard, the driving tool is used which is the system of professional qualification to be developed. The national professional qualification system is the center to certify the

competency of the manpower with the competency according to occupational standard in response to the demand of the business and the industry. It is the mechanism to ensure that an individual's ability is recognized and receives professional qualification in line with the competency, experience, and knowledge and to use the professional qualification for the development of career advancement.

The National Qualifications Framework ( NQF) is the linkage of national qualifications system, linking between individual performance level as a result of learning, education, training, and experience, with availability of educational qualification framework of educational agencies, and occupational standards framework of agencies related to occupational skill standards, as well as several organizations, so as to ensure the integrity of national manpower development system.

On January 9, 2017, the NQF Committee resolved to endorse "(Draft) revised version of NQF" in the Meeting No. 1/2017 based on the following principles:

1) To build linkage between learning outcome of graduates from educational institutes and competencies as required by manufacturing and service sectors, to determine core competencies and occupational competencies, and to use mutually agreeable competencies to develop and establish curriculum, design learning system, develop executives, faculties, teachers, facilitators in enterprises (industrial, agricultural, business, and service sectors), and educational personnel.

2) To develop the system regarding testing, measuring, and evaluating knowledge, skills, and transfer of experience which is widely available, flexible, and diverse, so that it is accessible to everyone easily, conveniently, and at all times.

3) To raise performance and capability of educational institutes in educational administration and management in order to fulfill requirements of manufacturing and service sectors. The administration and management involve 3 stakeholders, namely, educational institutes acting as the creator of manpower, manufacturers and service providers acting as the utilizer, and manpower being regarded as the output of educational agencies.

4) To develop performance of executives, faculties, teachers, educational personnel, and facilitators in enterprises to gain knowledge and understanding, and be able to provide various types of learning, focusing on occupational competencies, and analytical & problem-solving skills.

5)To strengthen enterprises in each professional group, including professional organizations so as to be able to certify core competencies and occupational competencies, and to determine remuneration that properly reflects performance, capability, and competency in each level of qualification.

In addition, Thailand professional qualifications are also linked to AEC qualifications framework so as to encourage mutual economic benefits among ASEAN countries through the single market and production base. This would enable workforce to be relocated among member countries. Currently, there has not been any relevant regulation or professional qualification system. Therefore, the establishment of occupational standards and professional qualification in several professional groups would help accommodate ASEAN economic community, be applied by personnel in related professional groups to developing own performance and competencies, enable operators to employ workforce as required, enable educational institutes to develop curriculum to fulfill requirements of enterprises, contributing to rising competitive advantages of the country in the end.

Thailand Professional Qualification Institute (Public Organization) is a government agency under the supervision of the Prime Minister. The main objective is to promote, support and develop professional qualifications system, support various professional groups to set up the occupational standards, and certify competency according to occupational standards. This creates opportunities for promotion and career advancement both domestically and internationally. Furthermore, TPQI's professional database and information system support the development of the country's workforce with professional qualifications system which promote free movement of labor in the ASEAN Economic Community. (TPQI, 2023).

Consequently, it is necessary for environmental personnel to engage in occupational standards and professional qualification processes. At present, Thailand Professional Qualification Institute ( Public Organization) in association with stakeholders in professional groups, associations, federations, public agencies, government sector, and private sector jointly establish occupational standards and professional qualification related to environmental affairs, and build networks for publicizing occupational standards and professional qualification to gain international

recognition, strengthen workforce to develop their competencies and capability so as to catch up with progressive development and competitiveness of the country.

In this regard, environmental professionals need to possess knowledge, skills, competence, and attribute that directly support their operations, while the output would not have any environmental impact or have minimum impact.

Currently, both complete and pending professional groups consist of 10 industries according to the order of Thailand Professional Qualification Institute Committee, titled the Appointment of the Occupational Standards and Professional Qualification Sub-Committee, in order to cover professional groups pursuant to the announcement of Thailand Professional Qualification Institute Committee regarding the determination of professional groups to be awarded with a professional qualification certificate, and to be eligible to implement the professional qualification system efficiently. The professional groups include logistics and supply chain professional group; agricultural, food & beverage professional group; real estate & public service professional group; service & financial professional group; health, sports & tourism professional group; communication & mass communication professional group; digital industry professional group; creative & entertainment industry professional group; manufacturing industry professional group; and energy & environment professional group ( the order of Thailand Professional Qualification Institute Committee no. 262-271/2018, titled the Appointment of the Occupational Standards and Professional Qualification Sub-Committee).

Therefore, in order to ensure that the process of establishing occupational standards and professional qualification is implemented efficiently and complies with the principle of establishing occupational standards and professional qualification, as well as not having any environmental impact or having minimum impact, it is advisable to study how to support the development of such process. One of significant concepts involves risk management which can be applied to the process of establishing occupational standards and professional qualification for environmental personnel. The study includes risk assessment for each process of establishing occupational standards and professional qualification related to environmental work, aiming to analyze, evaluate, prioritize risks of existing process of establishing occupational standards and professional qualification, explore findings of appropriate

process or procedure, and propose the process of devising measures of risk management for the processes of establishing occupational standards and professional qualification for environmental personnel appropriately without any risk throughout the processes, and/or propose new processes which are of higher efficiency. So, this research aims to focused on the processes of establishing occupational standards and professional qualification in order to solve some problem from uncertainty situation that have any risks in each process and affect next processes and propose the new processes acquired after the improvement of existing process be able to help increase efficiency of the processes of establishing occupational standards and professional qualification.

## 1.2 Research Questions

1.2.1 Do the processes of establishing occupational standards comply with Terms of Reference (TOR) of the occupational standards and professional qualification establishing project? Are there any within each process that could affect subsequent stages, potentially leading to non-completion?

1.2.2 Would the risk assessment for the processes of establishing occupational standards and professional qualification related to environmental affairs be able to reduce, prevent, or monitor problems regarding the establishment of occupational standards and professional qualification related to environmental affairs to reach an acceptable level, and help reduce environmental impact or minimize such impact.

1.2.3 Would the prototype of the processes of establishing occupational standards and professional qualification from the risk assessment of new processes acquired after the improvement of existing process be able to help increase efficiency of the processes of establishing occupational standards and professional qualification.

## 1.3 Objective

1.3.1 To conduct risk assessment and develop the processes of establishing occupational standards and professional qualification related to environmental affairs.

1.3.2 To propose risk management guideline for the processes of establishing occupational standards and professional qualification related to environmental affairs.

1.3.3 To propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency.

## 1.4 Materials and methods

### 1.4.1 Conceptual framework

The concept of this research adapted from ISO 31000 and risk analysis text books (ISO, 2009a) that define risk analysis (1) Establish context, which means for example to define the purpose of the risk management activities, and specify goals and criteria (2) Identify situations and events (hazards/threats/opportunities) that can affect the activity considered and objectives defined. The methods have been developed for this task (3) Conduct cause and consequences analysis of these events, and impact to activities, objective and goal (4) Make judgements of the likelihood and impact of the events and their consequences, and establish risk characterization (5) Analyze and evaluate risk, to judge the risk significance and (6) Risk treatment.

This research is the qualitative research (Ongart Naiphat, 2008; Wannee Kaemkate, 2008) to conduct risk assessment, and to propose measures of risk management for the processes of establishing occupational standards and professional qualification (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000) ranging from the process of formulating operating plans to submitting the complete version of occupational standards and professional qualification. The processes consist of 1) Publicizing the project to the target group, 2) Studying occupational standards of role model countries, 3) Conducting Functional Analysis to be proposed to the endorsement board for approval, 4) Making assessment tools based on occupational standards, and assess quality of tools, and 5) Testing assessment tools with the target group and proposing to the endorsement board for approval (Thailand Professional Qualification Institute (Public Organization), 2022). The prototype of the processes of establishing occupational standards and professional qualification related to environmental works acquired after the improvement of existing process for more efficiency would be proposed.

### 1.4.2 Population Scope

1) The samples in the study are selected by a stratified random sampling with the following steps (Chantavanich, 2009; Krejcie, 1970):

(1) The total of 72 professional groups according to the announcement of occupational standards and professional qualification in the Royal Thai Government Gazette were investigated during the 2015-2017 fiscal years.

(2) These 54 groups were then classified into ten industrial groups including two groups directly related to environmental works for establishing occupational standards and professional qualification.

(3) The two groups directly related to environmental works comprises 7 professional sub-groups. The 49 key informants from 7 professional sub-groups are selected by a purposive sampling based on the structure of establishing occupational standards. These key informants were from advisory committee, working group, and endorsement board as described below.

(3.1) advisory committees from 7 professional sub-groups were selected to serve as advisors to the occupational standards establishing project with 3 representatives from each sub-group (a project leader, researcher and a coordinator) totaling 21 samples.

(3.2) working groups representing government or private sector selected by 7 professional sub-groups with 3 representatives for each sub-group totaling 21 samples.

(3.3) one representative of the endorsement board for each professional sub-group comprises representatives of associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in professional groups, including experts and representatives of related government organizations, totaling 7 samples.

### 1.4.3 Area Scope

The study is conducted in the area for establishing occupational standards and professional qualification related to environmental affairs in Thailand.

### 1.4.4 Timing Scope

This study explores the establishment of occupational standards and professional qualification related to environmental works during the 2015-2017 fiscal years (October 2014 – September 2017).

### 1.4.5 Data Collection and Preparation Process

The collecting data process and preparation process for this study are as follows:

1) Secondary Data Collection –Data were collected from documents of public agencies, reports regarding environmental quality in Thailand, e.g. the 12th National Economic and Social Development Plan (2017 – 2021), potential industrial groups, (Order of Thailand Professional Qualification Institute No 263/2018, 2018; Order of Thailand Professional Qualification Institute No 264/2018, 2018; Order of Thailand Professional Qualification Institute No 265/2018, 2018; Order of Thailand Professional Qualification Institute No 266/2018, 2018; Order of Thailand Professional Qualification Institute No 267/2018, 2018; Order of Thailand Professional Qualification Institute No 268/2018, 2018; Order of Thailand Professional Qualification Institute No 269/2018, 2018; Order of Thailand Professional Qualification Institute No 270/2018, 2018; Order of Thailand Professional Qualification Institute No 271/2018, 2018; Order of Thailand Professional Qualification Institute No. 262/2018, 2018) titled the Appointment of the Occupational Standards and Professional Qualification Sub-Committee)professional qualification system (National Qualifications Framework Committee, 2017), and processes of establishing occupational standards and professional qualification, Competency Development Technique (Thailand Professional Qualification Institute (Public Organization), 2022) principle, definition, significance of risk assessment, principle of risk management, risk management guidance (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000; Sanguan ChangChat, 2004), other related studies ( best practice countries and processes, summary of concept, theory).

2) Primary Data Collection –data were collected from semi-structured interviews by 49 key informants based on the structure of establishing occupational standards.

3) Data for the risk assessment of the establishing occupational standards and professional qualification process related to environmental work - from 2), an in-depth interview based on the case study theory, records the data of viewpoints and opinions throughout the interview, focusing on “risks in the processes of establishing occupational standards and professional qualification related to environmental works” were employed.

4) Next processes are to ensure completeness of data, and to collect additional data in case of insufficient data, or to determine a new source of data in order to acquire an instrument for deciding to summarize prospective ideas.

### 1.4.6 Data analysis

The content analysis is applied to the data acquired from the semi-structured interview for 3 groups of samples, namely, project consultants ( project leaders’ researcher and coordinators), working group, and endorsement board inputs from key informants were classified for further comparison, analysis, and interpretation, coupled with using the documentary data. There are three process to analyze the data as follow.

1) Establish the context

The data analysis involves data interpretation to find out the meaning from collected data, to gain understanding about the data contents, and to use the cause explanation and linkage of the samples’ set of data by linking rationality both directly and indirectly. viewpoints toward risks in each process of establishing occupational standards and professional qualification. (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000; Sanguan ChangChat, 2004). During the interview data acquired from the transcription and note-taking were analyze to gain understanding about the overall content (Supang Chantavanich, 2010). In reference to the above-mentioned processes in conceptual framework, our processes are modified situationally as follow.

1.1) Identify the processes of establishing occupational standards and professional qualification (Thailand Professional Qualification Institute (Public Organization), 2022).

1.2) Review relation of process objective and objective of establishing occupational standards and professional qualification for each process. ( Dawn Henry, 2002; Thailand Professional Qualification Institute (Public Organization), 2022).

1.3) Identify the aim of each objective of establishing occupational standards and professional qualification.

1.4) Define risk issues and risk situation (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000; Sanguan ChangChat, 2004).

1.5) Define cause and factor of risk issues and risk situation.

2) Risk analysis and evaluate

Use risk Assessment Criteria for prioritizing the significance risks. ; (John P. Kindinger and John L. Darby, 2000; The Grasgow school of art, 2023). This step consists of two processes as follow.

2.1) Assessing possibilities of risks from the scale of impact and likelihood in order to calculate total risk scores and determine levels of risk ( 1-5 scale) ; (SRA, 2015b; Vanem, 2012).

(1) Very low risk: No potential, being adequately controlled; no further control measures are required.

(2) Low risk: No potential for serious consequences. Risk assessment is not essential.

(3) Moderate risk: Potential for moderate consequences. Risk assessment is recommended.

(4) High risk: The potential for extreme consequences but risk low probability. Risk assessment is recommended.

(5) Very high risk: Potential for extreme consequences, with high probability. Risk assessment is necessary.

2.2) Comparing the potential impact on the objective of establishing occupational standards and professional qualification include time and aim (PMI Europe, 2001; Project Management Process Improvement Office, 2003; Sanguan ChangChat, 2004).

2.3) Main idea about the viewpoints toward risks of the processes of establishing occupational standards and professional qualification related to environmental

works were captured. If the data was not enough for analyzed as well as determining issues, selecting additional informants. (Supang Chantavanich, 2009, 2010) .

2.4) Each significant issue classified and acquire from informant were review in order to further draw conclusions based on the research objectives. (Veland & Aven, 2015).

3) Risk treatment and management

Risk treatment and management can be mixing main actions; transfer, tolerate, treat, terminate or take the opportunity. Transfer; for some risks, the best response may be to transfer them need to be set and should inform your decisions. Treat; by far the greater number of risks will belong to this category. The conclusions from the analysis and evaluate risk, were drawn based on the research objectives aiming to explore risks of the processes of establishing occupational standards and professional qualification related to environmental works. So, this research adapted the concept of risk management or risk response for set up the risk management related processes of establishing occupational standards and professional qualification ( Project Management Process Improvement Office, 2003).

Risk treatment and management concept namely, risk control, risk control oxers opportunities to implement solutions that support risk avoidance, prevention and reduction. The risk avoidance technique would be not to own process. In reality, a minimal amount of risk still exists, but in certain scenarios, risk can be avoided completely. Risk prevention aims to reduce the frequency or likelihood of the event or loss. This might mean preventing process breakdowns by maintenance and inspection schedules. Risk reduction aims to lower the severity of a particular loss that has already occurred. So, all of treatment and management depend on risk level.

4) Process to purpose the new process

The main objective of this research adapted the principle of risk management in order to purpose the new process of establishing occupational standards and professional qualification that shown in figure 3. The process to purpose the new process were summarized and analyze the data starting from establish the context, identify risk, identify situations and risk events, estimate likelihood and impacts, risk analysis and evaluate and purpose risk treatment or

management for each process in order to purpose the new process after that for acquire prototype and proceed to the processes of other professional groups.

## 1.5 Expected Outcome

1.5.1 To mitigate risks of the processes of establishing occupational standards and professional qualification so that it could be completed efficiently according to the target of establishing occupational standards and professional qualification, to be a role model for other occupational standards and professional qualification establishing projects, and to propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency.

1.5.2 Related agencies and professional groups, namely, Thailand Professional Qualification Institute (Public Organization), educational agencies, and other groups related to the establishment of occupational standards and professional qualification, namely, the advisory committee, endorsement board, working group, are able to apply the outcome of risk assessment for the processes of establishing occupational standards and professional qualification related to environmental affairs to improving the processes, as well as further developing and revising educational programs to fulfill requirements of operators.

1.5.3 To push forward changes in implementing environmental affairs made by environmental personnel. These personnel would be able to perform their tasks efficiently, in compliance with competencies and performance criteria.

## 1.6 Definitions of Specific Terms

Professional is defined as individual knowledge, competence, and skills of working that rely on specific expertise and proficiency.

Professional qualification is defined as the act of certifying individual knowledge, competence, and skills of working according to occupational standards. (Thailand Professional Qualification Institute (Public Organization), 2022).

Occupational standards are defined as the act of determining levels of individual professional competency. (Thailand Professional Qualification Institute (Public Organization), 2022).

Competency is defined as the act of applying knowledge, skills, and competence to accomplishing jobs. (Thailand Professional Qualification Institute (Public Organization), 2022).

Key purpose is defined as the overall scope of work at a professional group level, describing characteristics of each occupation's goal that is different from other occupations. (Thailand Professional Qualification Institute (Public Organization), 2022).

Key role is defined as the scope of each aspect of work in professional groups, aiming to achieve the key purpose of each occupation. (Thailand Professional Qualification Institute (Public Organization), 2022).

Key function is defined as the scope of roles and responsibilities of specific functions in professional groups, expecting that it could be performed by personnel in order to achieve the key role. (Thailand Professional Qualification Institute (Public Organization), 2022).

Unit of competence is defined as the scope of outcome, with availability of the start and finish points, while being able to be implemented by only individual or groups of people in each professional group. (Thailand Professional Qualification Institute (Public Organization), 2022).

Element of competence is defined as the small component of the unit of competence. (Thailand Professional Qualification Institute (Public Organization), 2022).

Performance criteria are defined as the scope of performance, of which the outcome can be measured and evaluated based on the element of competence. (Thailand Professional Qualification Institute (Public Organization), 2022).

International standard classification of occupations is defined as the classification of occupations in Thailand based on the international standard by National Statistical Office Thailand, consisting of the occupation name and code.

Thailand Professional Qualification Framework: TPQF is defined as the levels of professional qualification in Thailand as announced by the Institute for the accreditation of professional qualification. (National Qualifications Framework Committee, 2017).

Working group is defined as the group which establishes occupational standards and professional qualification, necessarily comprising more than half of operators, or specialists, or experts in each professional group.

Endorsement board is defined as the group which endorses the establishment of occupational standards and professional qualification; such as not less than 3 representatives of associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in each professional group; not less than 2 experts in each professional group; 1 representative of each related government organization and not less than 1 organization; and 1representative of the Institute, totaling not less than 9 persons. The endorsement board is responsible for endorsing occupational standards and professional qualification before being submitted to Thailand Professional Qualification Institute Committee.

Risk assessment in this study is defined as the act of providing details of activities in each process of establishing occupational standards and professional qualification, identifying risks, and analyzing possible risks, followed by assessing possibilities of risks and determine levels of risk (very low, low, moderate, high, very high) before entering into the process of risk management and risk response. (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000; Sanguan ChangChat, 2004).

This study explores the consideration of risk management based on the principle of risk management, including risk acceptance, risk avoidance, risk mitigation, reduction of scale of risk impact, transfer of risks to other related factors, and turning risks into development opportunities.

Project Risk Management becomes more prominent in the management of both medium and large projects as the two types of projects require a large quantity of resources. There are also constraints in terms of budget and operation timeframe. The more uncertainties and constraints, the more risks. Thus, the project operator needs to consider the risks in terms of costs, techniques and methods, capital constraints, and risks that the project operation finishes as planned. The risk management framework may be implemented through planning, risk identification, risk analysis, planning of risk response, follow-up and control of risk management or cautious planning of risk management in appropriate process which must take into account the organizational culture to use qualitative data for decision-making, equipped with morals and ethics,

professionalism, and the operation standard must be continuously improved for higher quality. The success factor of the risk management of a project is the success of the project in terms of accomplishment of the objectives and goals or ability to successfully operate under the budget, timeframe, and technical constraints currently facing based on efficiency and effectiveness. The risk management of a project is important and inevitable. Although the decision through Feasibility Study will ensure the confidence in success that risk can be eliminated and ensure that the project will meet the set goals or objectives. The project operation may also pose risks and may affect the success of the project. In terms of management of budget risks, expenditure risks, schedule risks, and technical risks, without attention, rectification planning, or follow-up and assessment, serious results may occur with the project. Therefore, the project manager or leader must stress importance of risk management by integrating it in the project management plan. Risk assessment, risk analysis, risk prioritization and control will ensure success. A project is a set of activities to operate any issue in the future by using limited resources to operate and meet the success under the limited timeframe which is the operation in the future. Therefore, risks can happen all the time due to uncertainties and constraints of project resources. The project management must handle the project risks to mitigate the project problems and operate to fulfill the success according to the set goals effectively and efficiently (Sanguan ChangChat, 2004).

Risk management is defined as the act of taking the outcome of risk assessment to control the processes at risk, and managing risks based on the principle of risk management so as to be able to implement the processes of establishing occupational standards and professional qualification until achieving the objectives and targets of establishing occupational standards and professional qualification which risks for this research focus on significant risks mean the sample provided information of mostly, so it was concluded that there was a risk.

# CHAPTER 2
# LITERATURE REVIEW

The study on the risk assessment and the establishment of occupational standards and professional qualification related to environmental affairs explored related concepts, theories, and researches through the analysis and synthesis of previous academic works in order to conduct the study in accordance with the research objectives. The contents comprised the following:

2.1 The situation of environmental quality in Thailand

2.2 The 12th National Economic and Social Development Plan (2017 – 2021).

2.3 The industrial groups with potential for development.

2.4 The professional qualification system and the process of establishing occupational standards and professional qualification.

2.5 The principle, definition, and significance of the risk assessment, as well as the principle of the risk treatment.

2.6 The principle of the risk treatment and the risk treatment guideline.

2.7 Related researches.

2.8 The summary of related concepts, theories, and researches.

## 2.1 The situation of environmental quality in Thailand

According to the report which had monitored significant changes in environmental situations during 2015-2016, it was found that the deteriorated areas included soil, water, forest, mineral, marine & coastal resources, biological diversity, coastal water quality, waste, climate change & disaster, natural environment & artistic work, changes in soil resources and land utilization. Due to the expansion of community, buildings, and agricultural area, and inappropriate land utilization with its capability, it was more likely to face problems of organic and saline soils. Agricultural chemical use to improve productivity and lack of appropriate soil nourishment resulted in soil

deterioration. Top 4 natural and environmental resources in decline that should be addressed in an expedited manner (Office of Natural Resources and Environment Policy and Planning, 2008) consisted of the following:

1) Forest resources – This involves losses of forest area, imbalance of ecological system, lack of biological diversity, flooding, landslide, and drought. Over the past 50 years (1965-2015), forest area tended to be declined continuously. In 2015, forest area in Thailand was reported at 102.12 million rais of land, representing 31.57% of the country's total area, a 0.17% decrease from 2014.

2) Water resources – This involves runoff decline, a small amount of water in reservoirs, higher consumption of water in manufacturing companies, lack of water resource management mechanism, expansion of agricultural area, and water demand for economic purposes. The amount of rainwater in Thailand was 1,550 millimeters per year on average, or approximately 800,000 million cubic meters. In 2014-2015, accumulated average amount of rainwater tended to be declined. Overall amount of rainwater in the country was lower than the average value. In 2014, the average amount of rainwater was 1,150 millimeters in the northern region (the average value of 1,215 millimeters), and 1,021 millimeters in the central region (the average value of 1,182 millimeters), showing less amount of rainwater than the average value and previous years.

3) Waste – This involves an increase in waste volume as a result of rising consumption from population and income growth, a growing number of tourists and electronic waste, lack of proper waste management, a large number of hazardous and electronic wastes dumped together with municipal solid waste. In 2015, the economic growth rate achieved 3.10%. In 2015, the volume of solid waste reached approximately 26.85 million tons or approximately 73,560 tons per day. The waste generation per person per day increased from 1.11 kilograms per person per day in 2014 to 1.13 kilograms per person per day. Electrical and electronic wastes were likely to increase continuously each year from 357,000 tons in 2012 to 384,233 tons in 2015. Most common electrical and electronic wastes included 106,335 tons of televisions (27%), followed by 34,799 tons of air-conditioners (19%), and 65,765 tons of refrigerators (17%) (Pollution Control Department, 2022).

4) Marine & coastal resources – This involves coastal erosion, especially in the area of the Gulf of Thailand, from structures constructed in the sea, sand movement, and

climate change, as well as changes of waves, wind speed, and tidal currents. The coastal erosion further expanded to nearby areas, causing damages against the beach. The coast of Thailand was approximately 3,148 kilometers in length, covering the Gulf of Thailand and the Andaman Sea in a total of 23 provinces, consisting of the Gulf of Thailand measuring about 2,055 kilometers in 17 provinces, and the Andaman Sea measuring about 1,093 kilometers in 6 provinces. Every province experienced the coastal erosion, while the eroded area was about 11,300 rais of land. The upper part of the Gulf of Thailand showed a critical level of erosion, having more than 5 meters per year and 207 kilometers in length in 13 provinces, representing 12%, while the Andaman Sea showed a critical level of erosion, having more than 5 meters per year and 23 kilometers in length in 5 provinces, representing 2% (Office of Natural Resources and Environment Policy and Planning, 2008, 2017). In 2015, a survey of coastal changes conducted by the Department of Marine and Coastal Resources reported that the existing erosion problems had not been solved, covering about 168 kilometers in length, consisting of about 160 kilometers of the Gulf of Thailand, and about 8 kilometers of the Andaman Sea, while some coastal area had been protected by erosion preventive structures to alleviate the said problem, consisting of 484 kilometers of the Gulf of Thailand, and 81 kilometers of the Andaman Sea.

Based on the aforementioned situation of environmental quality, the environmental problems were mostly affected by the development of local projects and activities related to environmental affairs. In 2016, there were 1,759 development projects which required an environmental impact assessment ( EIA) approval, involving community service and accommodations, mine, energy, transportation, industry, petrochemical industry, and water resources and agricultural development. There were 589 approved projects, representing 33.48% . These projects were associated with declining natural resources as mentioned above. There were 1,214 projects of community service and accommodations, representing 69% , being associated with waste problems, and 5 projects of water resources and agricultural development, representing 0. 3% , being associated with water resources (Office of Natural Resources and Environment Policy and Planning, 2017).

The analysis made by the Office of Natural Resources and Environmental Policy and Planning (Office of Natural Resources and Environment Policy and Planning, 2017) revealed that most natural resources tended to be declined mainly because natural

resources and environmental management in Thailand remained unchanged, continuing to rely on the Promotion and Conservation of National Environmental Quality Act, B.E. 1992 (The Government Gazette, 1992) , as a key basis for governance. This required a revision on the environmental fund, the mechanism of preparing the environmental impact assessment ( EIA) , and the strategic environmental assessment ( SEA) . Moreover, the application of fiscal and financial tools, and the development of laws relevant to other resources; such as forest, water, mineral, and so on, had been under construction. In addition, the organizational structure for natural resources and environmental management was mainly subject to the administrative structure of the Ministry of Natural Resources and Environment. A few organizations had been founded to take charge of specific environmental affairs independently and flexibly. The promotion of people sectors and private sector' s roles and the resources management remained unclear. Furthermore, fiscal and financial tools for environment had not been concretely developed, for example, there had been unavailability of the environmental tax, the improvement of environmental fund structure for efficient use, the collection of waste disposal and wastewater fees, and so on. Importantly, it was also essential to raise awareness of people. Therefore, in the case that the above institutional structure remained unchanged, the natural resources and environmental situation in the near future could be expected to be in the same direction.

## 2.2 The 12th National Economic and Social Development Plan (2017 – 2021)

The development under the 12th National Economic and Social Development Plan was connected with the 20-year National Strategy in the form of transforming long-term strategy into practice. Each strategy in the 12th National Economic and Social Development Plan determined issues of development, including operating plan, and significant projects to be implemented concretely during the first 5 years of driving the National Strategy in order to prepare people, society, and economic system of the country to be able to accommodate changes properly. Meanwhile, the Development Plan also determined the concepts and mechanism of driving and

monitoring results clearly so as to ensure progressive and efficient development for sustainable well-being in Thai society. (National Economic and Social Development Board, 2017a).

The key development issues in the 12th National Economic and Social Development Plan (National Economic and Social Development Board, 2017b) involve to prepare manpower and enhance capability of populations of all ages, and focus on developing people of all ages in all dimensions to become high-performance human capital amid remarkable changing situation, i.e., to enter the aging society at the end of the 12th National Economic and Social Development Plan. From 2015, working-age populations continued to become decreased, resulting in labor shortage, low labor productivity, and problems regarding knowledge, skills, and attitudes of labor which did not meet requirements of the labor market. Moreover, the development includes to maximize the quality of education at all levels and lift up learning levels by developing the quality of basic education, comprising managing small-sized schools, improving learning management system, and developing the quality of teachers in the entire system, as well as maximizing the quality of education in specific fields, and developing the dual system or cooperative education to facilitate the preparation of skillful people for the labor market. (National Economic and Social Development Board, 2017b).

The 12th National Economic and Social Development Plan formulated 6 strategies as follows: 1) Enhance and develop potential of human capital; 2) Create a just society and reduce inequality; 3) Strengthen economy and sustainable competitiveness; 4) Promote environmental friendly growth for sustainable development; 5) Reinforce national stability for prosperity and sustainability; 6) Improve governmental administration, corruption protection and good governance; and 4 strategies aiming to develop strategic foundations and mechanism for supporting the accomplishment of the aforementioned 6 strategies as follows: 1) Advance infrastructure and logistics; 2) Develop science, technology, research, and innovation; 3) Develop regions, cities, and economic zones; and 4) Promote international cooperation for development.

Some strategies related to human resources development include the 1st strategy – Enhance and develop potential of human capital, and the 3rd strategy –

Strengthen economy and sustainable competitiveness. The relations could be summarized as described below (Thailand Development Research Institute, 2017).

**The 1st strategy**: **Enhance and develop potential of human capital**

The strategy " Enhance and develop potential of human capital" had a development guideline associated with 3 main issues as follows: Guideline 3. 2 – Develop potential of human capital to possess skills, knowledge, and capability to live a value life, and item 3.2.3 – Encourage workforce to possess occupational knowledge and skills to fulfill requirements of the labor market, comprising the following operations: to develop the workforce training center in compliance with the standards of professional qualification system and national skill standards, establish the occupational standards for potential industry groups, and evaluate skill levels of workforce based on competencies. In this regard, the occupational standards established during the fiscal year 2012-2016 put emphasis on potential industry groups according to the National Strategy ( The 11th National Economic and Social Development Plan, 2012-2016) (National Economic and Social Development Board, 2017a). which divided the industry groups into 3 main groups, namely, industry, agriculture, and service. In addition, 6 strengthened and competitive industry groups in Thailand include the following: 1) Rubber product; 2) Processed foods; 3) Petrochemical and plastic; 4) Biodiesel and ethanol; 5) Automobile and auto parts; and 6) Electrical and electronics. In addition, 5 industry groups that should be developed in the future because of its contribution to economic value of the country are comprised of the following: 1) Clean energy; 2) Healthy products; 3) Aviation and space; 4) Biochemical; and 5) Creativity and innovation. The occupations which accommodate the establishment of the ASEAN Economic Community involve the liberalization of trade in goods and services. The occupations as per the policy of creative economy for the fiscal year 2017 would emphasize the professional groups in S-Curve according to the 20-year National Strategy, the 12th National Economic and Social Development Plan, and Thailand 4.0 policy.

**Public-Private Collaboration Project**

The policy of the government to move the country forward through Public-Private collaborative mechanism presented the collaboration between the public sector, private

sector, and civil society in jointly supporting and encouraging grassroots economy to achieve growth energetically, stably, and sustainably through the establishment of "Social Enterprise" . The Public-Private Collaboration Project put emphasis on taking public issues into consideration. Leaders of all parties gained opportunities to express their opinions at a neutral stage, seek solutions, decide how to solve problems together systematically, and come up with a consensus. Strengths or advantages of each party, or "the best of both worlds", were utilized to make a difference and move Thailand forward firmly and sustainably. The 12 public-private steering committees include the following: Innovation and Productivity Enhancement Group (D1); SMEs & Start-up, and SE Supporting Group (D2); Tourism and MICE Supporting Group (D3); Export and Outward Foreign Direct Investment Promotion Group (D4); Future Industry Development Group (D5); Modern Agriculture Development Group (D6); Income-Generating and Domestic-Spending Stimulation Group (D7); Investment Attraction and Infrastructure Development Group (E1); Vocation Quality Improvement Group (E2); Grassroots Economy and Public-Private Collaboration Development Group (E3); Regulation and Public Mechanism Revision Group (E4); and Basic Education and Leadership Development Group (E5). The analysis revealed that the operations of National Council for Peace and Order complied with (E2) Vocation Quality Improvement Group (Thailand Development Research Institute, 2017).

Table 2.2-1 Workforce average growth rate (2016-2025) classified by S-Curve

| S-Curve | Workforce average annual growth rate (%) |
|---|---|
| **The First S-Curve** | **4.77** |
| Next-Generation Automotive | 2.58 |
| Smart Electronics | 2.26 |
| Affluent, Medical and Wellness Tourism | 5.26 |
| Agriculture & Biotechnology | 7.40 |
| Food for the Future | 5.52 |
| **The New S-Curves** | **4.33** |
| Robotics | 4.94 |

| S-Curve | Workforce average annual growth rate (%) |
|---|---|
| Aviation & Logistics | 9.74 |
| Biofuels & Biochemical | 11.62 |
| Digital | 9.55 |
| Medical Hub | 0.81 |

Source: Office of the Education Council (2017)

Table 2. 1 indicated that the industry groups which were likely to achieve substantial workforce growth rate were Biofuels & Biochemical, Aviation & Logistics, and Digital industry groups, representing the annual growth rate of 11.62%, 9.74% , and 9.55% , respectively. As the investment promotion policy contributed to the said industry groups, the investment and employment became increased. It was remarkable that the substantial workforce growth rate was mostly reported in the New S-Curves which required huge investment and long-term development. Therefore, the workforce had substantially increased in number at the early stage, resulting in the substantial workforce growth rate. Nevertheless, most of the First S-Curves were existing industry groups employing rather high number of workforces. Therefore, the workforce growth rate might not be quite high, compared to the New S-Curves (Office of the Education Council, 2017).

## 2.3 The industrial groups with potential for development

Considering the economic outlook for selecting potential economic activities, national workforce development would depend on the following factors: ( 1) The policy of the government; and (2) The economic outlook of the country. According to the analysis of current economic development along with the economic forecasts, it was found that current economic development was highly consistent with the country' s development. As for the ranking of economic activities by GDP, top 15 ranks include the following: ( 1) Wholesale, retail, automobile & motorcycle repair, personal care products, and household supplies; (2) Agriculture, hunting, and forestry; ( 3) Real estate, renting, and business activities; ( 4) Shipping, warehouse, and

transportation; (5) Food and animal feed production; (6) Financial services mediator; (7) Education; (8) Electrical & electronics supplies; (9) Mining; (10) Hotel & restaurant; (11) Automobile & auto parts production; (12) Electricity, gas, and water supply; (13) Construction; (14) Livestock, aqua farming, and fishery; and (15) Textile (TRIS Corporation Limited, 2017).

Over the past period, the workforce supply did not meet with the demand, adversely affecting the country's development. As a result, Thailand's labor productivity could not be improved, causing Thailand to be stuck in a middle-income trap for over 50 years. In the past, Thailand had adopted 3 economic models, starting from an agricultural-based model or Thailand 1.0, followed by a light industry model which imported machinery, but mainly focused on employing low-wage labor, and changing into an advanced industry model or Thailand 3.0 which caused Thailand to face problems of inequality and middle-income trap for a long time. The government led by Prime Minister Prayut Chan-ocha initiated to adopt Thailand 4.0 Model in order to solve problems of Thailand 3.0, aiming to move the country toward prosperity, security, and sustainability in a concrete manner. Thailand 4.0 Model aimed to move the economy forward with the innovation of 5 S-Curves. The determination of S-Curves in Thailand 4.0 was in accordance with the New S-Curves determined by the cabinet as follows: 1) Robotics; 2) Aviation and Logistics; 3) Biofuels and Biochemical; 4) Digital; 5) Medical Hub (TRIS Corporation Limited, 2017).

In terms of competition in the industry, bio agro-industry is related to advanced technology and there is not yet opening up of free trade market. As a result, it lacks competitive advantage in terms of marketing and costs. In terms of the government's role, the government stresses the formulation of target framework and promotional policy to develop the country into the Bio-based Economy and determine continuous and various supporting measures. But the government still assumes a major role in not opening up commercial free market especially the context of the ingredients of bio raw materials and strictly applies to the regulations on the cultivation of bio plants in the country. In terms of the role of opportunities, it is possible to have both positive and negative impacts by covering important issues such as evolution and continuous progress of bio technology, requests from the global society from greenhouse gas conditions or global warming, as well as protest or

conservation groups who require knowledge and practical guideline to create clear perception about bio products both at the national and regional levels.

Moreover, study was conducted on the demand trend of labor force in the labor market classified by top 10 occupations ( 2017-2021) . (National Statistical Office, 2017) conducted the study of the demand trend of labor force in the labor market in Thailand between 2017-2021 as follows:

1. Cultivation of garden plants and farm plants for commerce 19.90%
2. Sellers of goods in shops 6.66%
3. Sellers of goods on streets and at markets 3.69%
4. Drivers of cars, vans, and motorcycles 3.45%
5. Sellers of other goods 2.92%
6. Cattle breeders 2.63%
7. Workers in agriculture, fishery, and forestry 2.60%
8. Plant cultivation for subsistence 2.26%
9. Male chefs/female chefs 2.04%
10. Miners and construction workers 1.72%

The report “The Future of Jobs” by “World Economic Forum” (World Economic Forum, 2020) compiled the 10 skills in demand in the labor market worldwide in 2020 covering all professional fields and all levels of work from operation to management and which consisted of the following:

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

As for Thailand, it is the country which is abundant with natural resources. The population’s occupations are therefore different in each area such as agriculture,

industry, tourism and services. In order to upgrade the labor force's ability so that it can compete with foreign labor force and international recognition, the occupational standards are established. The agencies involved in establishing occupational standards include Ministry of Labour, Ministry of Industry, Ministry of Education, Council of Science and Environment Professionals, and Council of Engineers, etc.

The classification of occupational standards in Thailand is under the responsibility of Ministry of Labor who assigns Department of Employment as the principal agency for the operation. In 2001, Department of Employment (Department of Employment, 2001) prepared the documents classifying occupational standards in Thailand. The objectives were to improve the occupation information in Thailand to be more correct and complete, enable all sectors to have proper knowledge and understanding of occupation information and convenience to utilize in various aspects relevant to labor management, increase efficiency in storing the information relevant to occupations, and serve as the database of occupations in Thailand. It started with the survey and collection of data of the types of work from establishments and the analysis to define occupations, determine the code of occupations using the criteria and structure following the International Standard Classification of Occupations ( International Standard Classification of Occupations: ISCO 1988) to achieve internationalization and ability to compare or share occupation information with other countries.

The classification of international occupation standard takes into consideration Skill as well as Skill level and Skill specialization. The skill classification takes into account the education levels, and skills acquired from trainings or working experience. The use of education levels to divide the skills does not mean that all work requires education from formal educational institutes only. Skills are therefore divided into 4 levels as follows:

1) Level 1 means those who graduate at the primary level

2) Level 2 means those who graduate at the secondary level

3) Level 3 means those who graduate at occupational secondary level, with vocational certificates, high vocational certificates, and diplomas

4) Level 4 means those who graduate with B.A. degrees and higher

Types of occupations used to analyze the initial classification consist of 10 main classifications as follows:

1) Classification 0 Armed forces occupations

2) Classification 1 Legislators, senior officials, managers

3) Classification 2 Professionals

4) Classification 3 Technicians and associate professionals

5) Classification 4 Clerical support workers

6) Classification 5 Service workers and shop and market sales workers

7) Classification 6 Skilled agricultural and fishery workers

8) Classification 7 Craft and related trades workers

9) Classification 8 Plant and machine operators and assemblers

10) Classification 9 Elementary occupations

The classification of occupations according to ISCO is divided into Major groups, Sub major groups, Minor groups, and Unit groups. The code is determined in each level as number sets from 1 to 6 digits. The occupational code of each digit will show the relation between occupations. Apart from the classification of occupational standard in Thailand under the operation of Department of Employment, Ministry of Labour, there are also Skill Standard and Testing Development Bureau, Department of Skill Development that promotes skills for Thai labor force on a par with international standards. It consists of 4 divisions namely Skill Standard System Development Division, Skill Standard Setting Division, Skill Standard Testing Division, and Skill Standard Promotion and Competition Division. Each division has the following duties and responsibilities (Department of Employment, 2001):

1) Skill Standard System Development Division is responsible for the following: ( 1) Study, analyze, conduct research on relevant labor situations ( 2) Determine the guideline and form of standard development ( 3) Coordinate with relevant agencies in implementing skill standard (4) Compile academic information on skill standard and (5) Follow up and assess performance.

2) Skill Standard Setting Division is responsible for the following: (1) Survey the needs of labor market in order to establish skill standard ( 2) Analyze competency ( 3) Determine and develop national skill standard (4) Determine and certify skill standard of

those who earn their living (5) Establish the registration system of the skill standard, and (6) Support the determination and development of ASEAN/international skill standards.

3) Skill Standard Testing Division is responsible for the following: ( 1) Develop the pattern and criteria of the testing of skill standard (2) Develop the quality of skill standard testing examiners (3) Supervise skill standard testing (4) Set up and supervise the skill standard testing center (5) Promote establishments to employ those who pass the standard testing as their employees.

4) Skill Standard Promotion and Competition Standard is responsible for the following: ( 1) Promote the public and private sectors to utilize in agencies ( 2) Promote or organize skill competition at the regional, national, ASEAN, and international levels ( 3) Develop the technical competition sub-committee ( 4) Use technology, techniques, strategies, and patterns of competition in the training process, training courses, and human resource development.

National Skill Standard (Department of Skill Development, 2023) means academic specifications used to measure skills, knowledge, abilities, and attitudes of people in work.

Levels of National Skill Standard:

Level 1 People with working skills and knowledge at basic level. They are able to work under their foreman's supervision

Level 2 People with skills, knowledge and abilities at intermediate-level, who can use tools and equipment properly.

Level 3 People with skills at advanced level. They are able to analyze and solve problems as well as applying new technologies in practice.

They may be more than 3 levels in same categories as needed by technological change.

The agencies relevant to occupational standard process that may involve environmental professions include Department of Industrial Works, Council of Engineers, Council of Science and Technology Professionals. Each agency has the following role and duty as follows:

Department of Industrial Works, Ministry of Industry

Department of Industrial Works is responsible for industrial promotion and development. But due to industrial growth, resources are exploited resulting in waste

from production process such as water pollution, air pollution, and industrial waste. Therefore, it stipulates pollution controllers attached to factories by considering the types and sizes of factories. The controllers must pass the accreditation registration by Department of Industrial Works to have the qualifications of controllers by law. The environmental personnel attached to factories include controllers of toxic environment prevention system and operators of toxic environment prevention system Department of Industrial work as the details in Table 2.3-1 (Department of Industrial work, 2017).

Table 2.3-1 Environmental personnel attached to factory

| Controllers of toxic environment prevention system | Operators of toxic environment prevention system |
|---|---|
| 1. Environmental manager<br>2. Controller of water pollution treatment system or consultant company<br>3. Controller of air pollution treatment system or consultant company<br>4. Controller of industrial waste pollution treatment system or consultant company | 1. Operator attached to water pollution treatment system<br>2. Operator attached to air pollution treatment system<br>3. Operator attached to industrial waste pollution treatment system |

Source: Department of Industrial work (2017)

The controllers of toxic environment prevention system must have either of the following qualifications as follows: (Table 2.3-1)

1) Graduate at least with B.A. degree in engineering, sanitation or environment, or B.A. degree in environmental science and must pass the standard testing from standard testing agency and must be registered with Department of Industrial Works

2) Graduate at least with B.A. degree in engineering or science with at least 18 credits of environmental study and must pass the standard testing from standard testing agency and must be registered with Department of Industrial Works

3) Graduate at least with B.A. degree in engineering or science that is not 1) or 2) , must pass the training with the course on the controllers of toxic environment

prevention system organized by training agency, must pass the standard testing of standard testing agency, and must be registered with Department of Industrial Works

Table 2.3-2 Environmental courses with countable credits

| | |
|---|---|
| Management | - Energy Conservation and Management<br>- Environmental Audit Process and Practice<br>- Environmental Contamination Chemo dynamics<br>- Environmental Management System<br>- Environmental Pollution<br>- Environmental Impacts Assessment<br>- Environmental Risk Assessment<br>- Environmental Policy, Laws and Economics<br>- Environmental Health Sanitary Science<br>- Environmental Science<br>- Environmental System Management |
| Chemistry and biology for environmental | - Biology for Environmental<br>- Chemistry for Sanitary<br>- Chemistry for Environmental<br>- Environmental Microbiology<br>- Environmental Analysis<br>- Environmental Chemistry<br>- Environmental Organic and Surface Chemistry<br>- Environmental Sampling and Analysis<br>- Environmental Laboratory<br>- Microbiology for Environmental<br>- Microorganisms in Water and Wastewater |
| Environmental | - Analytical Methods and Experimental System in Environmental Engineering<br>- Business Strategy for Environmental Management<br>- Clean Production Technologies<br>- Cleaner Technology<br>- Ecology |

| | |
|---|---|
| | - Environmental Sanitation |
| | - Fate and Transport of Contaminated Pollutants |
| | - Geographical Information Systems and Remote Sensing Application |
| | - Integrated Pollution Prevention |
| | - Industrial Ecology |
| | - Industrial Pollution |
| | - Project for Environmental Engineering |
| | - Public Health Engineering |
| | - Risk Assessment |
| | - Safe Transportation Management |
| | - Sanitary Engineering |
| | - Site Remediation |
| Environmental model | - Environmental Quality Models |
| | - Environmental System Modeling |
| | - Process Modeling |
| Air pollution | - Design of Air Pollution Control Systems |
| | - Air Pollution Control Technology |
| | - Air Pollution Control |
| Water and wastewater treatment | - Advanced Wastewater Treatment Process |
| | - Advance Water and Wastewater Treatment Process |
| | - Advance Water Quality Management |
| | - Groundwater Quality Management |
| | - Unit Operation of Water and Wastewater |
| | - Unit Process of Water and Wastewater |
| | - Water Supply |
| | - Water and Waste Analysis |
| | - Waste Water Treatment Technology |
| | - Water Work Design |
| | - Waste water Treatment |
| | - Water Quality Management |

| | |
|---|---|
| | - Water and Waste Treatment |
| Waste and hazardous waste | - Hazardous Waste Management<br>- Human Waste Management<br>- Integrated Solid Waste Management<br>- Industrial Waste<br>- Solids Waste<br>- Solids Waste Management<br>- Solids and Hazardous Waste Management<br>- Toxic Substance and Hazardous Waste Management<br>- Technology of Solid and Hazardous Waste Treatment |

Source: Ministry of Industry (2016)

**Pollution Control Department**

Pollution Control Department is an agency responsible for recommendations leading to the formulation of policies and plans to promote and conserve environmental quality in pollution control, recommendations to determine environmental quality standard and pollution control standard from original sources, formulation of environmental quality and standard action plan to control, prevent, and rectify environmental problems, as well as follow-up, and inspection of environmental quality, and reporting the relevant pollution situations. The relevant laws include Enhancement and Conservation of National Environmental Quality Act B.E. (1992), Regulation of the Office of the Prime Minister on coordination to enforce environmental laws B.E. 2007, law and standard on air quality and noise, and law and standard on water quality, etc. (Pollution Control Department, 2022).

**Council of Science and Technology Professionals**

Council of Science and Technology Professionals was set up by Ministry of Science and Technology responsible for promotion of science and technology professionals to attain standard. The main objective of the establishment of Council of Science and Technology Professionals is to promote and control science and

technology profession with the guarantee of career advancement, authorize the issuance of regulations to promote and develop knowledge, skill, and competency to attain standard. The analysis of environmental impact in the field of science and pollution control, characteristics of controlling science and technology profession, and environmental impact analysis in the field of science and pollution control consist of 2 features as follows (Council of Science and Technology Professionals, 2022):

1) Scientific analysis of environmental impact will cover reporting of environmental impact analysis, follow-up of inspection of environmental impact, and performance assessment

2) Pollution control will cover inspection analysis, system design, system operation, system maintenance, management, administration, counseling on water, air, and noise pollution, vibration, hazardous waste, solid waste and sewage.

Those who request the license of science and technology control profession in the field of environmental impact analysis in science must have the following qualifications:

1) Specialist must graduate not lower than B.A. degree in science, environment, ecology, environmental health, sanitation, or other fields deemed by Council of Science and Technology Professionals Committee to be relevant and experienced in performing duties relevant to promotion and conservation of environmental quality

2) Expert must graduate not lower than B.A. degree in science and must study the environmental impact analysis not fewer than 3 credits. In case of expert in specific field of health impact assessment, the person must study the health impact analysis in various aspects not fewer than 12 credits.

The license of control science and technology professionals in pollution control consist of 6 types namely 1) Controller of water pollution 2) Controller of air pollution 3) Controller of noise pollution and vibration 4) Controller of hazardous waste 5) Controller of solid waste and sewage 6) Other controllers as defined by the sub-committee.

Those who request for the license of science and technology control professional in pollution control must have the following qualifications: Knowledge in science and technology profession, graduation with degree, diploma, or certificate equivalent to the degree in science and technology recognized by Council of Science and Technology Professionals and must study the course on pollution control not fewer than 6 credits. If

those who request the license have the education qualification with the credit combination that does not meet the set criteria, they have to attend trainings on pollution control as determined by Council of Science and Technology Professionals.

Moreover, Council of Science and Technology Professionals provides the opportunity for those who pass the registration as specialist from Office of Natural Resources and Environmental Policy and Planning. Those who pass the registration as controllers of water pollution treatment system, controllers of air pollution treatment system, and controllers of industrial waste management system from Department of Industrial Works, and those who pass the education and experience relevant to noise pollution control and vibration, control of solid waste and sewage, as well as those with knowledge and experience in environmental impact assessment (EIA) or the analysis of environmental health impact assessment ( EHIA) can submit the request for the professional license in the field of environmental impact analysis in science and pollution control from Council of Science and Technology Professions. Registration of science and technology control professionals in the field of environmental impact assessment in science and pollution control. consist of 28 types of license as follows: 1) Specialist 2) Controller of water pollution 3) Controller of air pollution 4) Controller of hazardous waste 5) Controller of solid waste and sewage 6) Controller of noise pollution and vibration 7) Expert in health impact assessment 8) Expert in occupational health and safety 9) Expert in air quality 10) Expert in noise and vibration 11) Expert in solid waste and sewage 12) Expert in hazardous waste 13) Expert in water quality 14) Expert in wastewater management 15) Expert in oceanography 16) Expert in hydrology 17) Expert in underground water 18) Expert in fresh water ecosystem 19) Expert in marine and coastal ecosystem 20) Expert in fishery resources 21) Expert in aquaculture 2) Expert in terrestrial ecosystem 23) Expert in water resources 24) Expert in soil resources 25) Expert in geology 26) Expert in agriculture 27) Expert in environmental pollution 28) Expert in geoinformatics. Those who wish to register as science and technology control professionals must pass the test with the test scores not less than 60%. Then, they must submit the request for the license and the testing and their transcript showing the courses that are consistent with the requested field. (Council of Science and Technology Professionals, 2022).

## 2.4 The professional qualification system and the process of establishing occupational standards and professional qualification

According to a study on National Qualifications Framework (NQF) (Thailand Development Research Institute, 2017) in 4 countries and ASEAN region, namely, Australia, New Zealand, South Korea, Hong Kong, and ASEAN countries, it was found that the main objective of the NQF was to enhance lifelong learning of citizens in the country by integrating the NQF of general education into the NQF of vocational education through a key mechanism of facilitating learners to create learning paths so as to obtain a degree as required, i.e., recognition of prior learning (RPL), and credit transfer for avoiding overlapped learning. The criteria for classifying levels of qualification based on the NQF of each country would rely on essential knowledge and skills for work as required by employers based on the advices from the industrial sector or the private sector in each country participating in developing the NQF. The characteristics of NQF and criteria of classifying levels of qualification based on the NQF could be summarized as shown in Table 2.4

Table 2.4-1 The characteristics of NQF and criteria of classifying levels of qualification based on the NQF of Australia, New Zealand, South Korea, Hong Kong, and ASEAN region

| **Country/Region** | **Characteristics of NQF** | **Levels of qualification / Criteria** |
|---|---|---|
| Australia | Australian Qualifications Framework (AQF) is a single system which integrates learning paths of each education system, and determines levels of qualification & related details similarly for all education systems. | 10 levels based on the criteria:<br>- Knowledge<br>- Skills<br>- Application of knowledge and skills |
| New Zealand | New Zealand Qualifications | 10 levels based on the |

| Country/Region | Characteristics of NQF | Levels of qualification / Criteria |
|---|---|---|
| | Framework (NZQF) is a central point for connecting learning outcome of each education system, sharing the same levels of qualification & related details, but not integrating learning paths of each education system. | criteria:<br>- Knowledge<br>- Skills<br>- Application of knowledge and skills |
| South Korea | Korean Qualifications Framework (KQF) integrates levels of qualification of each education system through the development of national competency standards, placing emphasis on connecting between industrial demands and qualifications. | 8 levels based on the criteria:<br>- Knowledge<br>- Skills<br>- Competency |
| Hong Kong | Hong Kong Qualifications Framework (KQF) connects between each education system, determining basic learning unit and specific learning unit pursuant to the SCS in order to meet requirements of the country's industrial sector. | 7 levels based on the criteria:<br>- Knowledge<br>- Process<br>- Application/Independence/ Responsibility<br>- Communication/Information Technology/Calculation skills |
| ASEAN | ASEAN Qualification Reference Framework (AQRF) – The basic principle is to operate on a voluntary basis without any impact on the NQF of participating member countries, as | 8 levels based on the criteria:<br>- Skills and knowledge<br>- Application and responsibility |

| Country/Region | Characteristics of NQF | Levels of qualification / Criteria |
|---|---|---|
| | well as providing a basis for developing the NQF in countries having no NQF. The AQRF gives significance to the quality assurance system and standards so as to build credibility for the NQF in each country. | |

Source: Thailand Development Research Institute (2017)

To ensure that qualifications under the NQF be reliable and gain recognition both domestically and internationally was carried out through a mechanism of qualification certification and quality assurance, and education & training service providers which had to be formally registered with related agencies. Moreover, each country had collaboration with international organizations or agencies related to the NQF in order to jointly exchange information and advices on the development of NQF in own country. Roles and responsibilities of the regulatory agency for NQF and collaboration with other agencies could be summarized as shown in Table 2.4-2

Table 2.4-2 Roles and responsibilities of the regulatory agency for NQF and collaboration with other agencies of Australia, New Zealand, South Korea, Hong Kong, and ASEAN

| Country | Regulatory agency for NQF | Collaboration with other agencies |
|---|---|---|

| Country | Regulatory agency for NQF | Collaboration with other agencies |
|---|---|---|
| Australia | AQF is under the supervision of Ministry of Education & Training and Ministry of Industry & Science. Roles and responsibilities of related agencies in each education level are determined as follow:<br>1) Agencies in charge of quality assessment and qualification certification: Vocational education and training = Australian Skills Quality Authority (ASQA); Non-university higher education = Tertiary Education Quality and Standards Agency (TEQSA).<br>2) Agencies in charge of qualification development: Vocational education and training = Registered Training Organizations (RTOs); Higher education = education service providers. | - To ensure that qualifications meet with requirements of the industrial sector, employers, and society, the agencies in charge of quality assessment and qualification certification work with the industrial sector and operators in order to exchange information and work together under MOU.<br>- Regulatory agencies for education units collaborate with one another in order to operate in the same direction. |
| New Zealand | Regarding NZQF, New Zealand Qualification Authority (NZQA) is a main agency responsible for:<br>- Managing the NZQF.<br>- Assessing the quality of education institutes and curriculum of secondary education and non-university higher education. The university quality assessment is to be made by CUAP and AUA which attend meetings with | NZQA works closely with several agencies, namely, senior executives in education units in order to formulate strategies of education agencies, higher education commission in order to support high performance education institutes, Ministry of |

| Country | Regulatory agency for NQF | Collaboration with other agencies |
|---|---|---|
| | NZQA. | Education in order to achieve a program of certifying and inspecting education standards, and Immigration Bureau in order to share the information of education qualifications abroad. |
| South Korea | Regarding KQF, Korean Research Institute for Vocational Education and Training (KRIVET) is responsible for the implementation and development based on national competency standards established by Ministry of Employment and Labor. KRIVET is a national research institute in charge of conducting research and developing professional competency of South Korea through the qualifications system and education program. | KRIVET collaborates with several agencies as follows:<br>- Ministry of Employment and Labor in implementing and developing national competency standards.<br>- HRD Korea in promoting the development of professional skills and national qualifications tests.<br>- Chamber of Commerce and Industry in developing qualifications in accordance with industrial requirements. |
| Hong Kong | Regarding HKQF, Education Bureau (EDB) is responsible for formulating the | EDB works with several agencies as follows: |

| Country | Regulatory agency for NQF | Collaboration with other agencies |
|---|---|---|
| | policy, strategy, and development guideline by nominating Qualifications Framework Secretariat (QFS) to be in charge of developing, implementing, and promoting HKQF quality assurance unit as follows:<br>- HKCAAVQ is responsible for certifying and registering qualifications, and assessing the quality of curriculum and education & training service providers.<br>- QAC is in charge of quality assurance for higher education program and above proposed by institutes supported by UGC.<br>- JQRC is in charge of quality assurance for minor programs of 8 member institutes. | - The industrial sector in establishing the ITACs in order to develop the SCS and ensure that qualifications meet with requirements of domestic industrial sector.<br>- Build cooperation networks with international organizations through entering into MOU in order to develop the NQF. |
| ASEAN | ASEAN Board | Chairman is from Philippines, and Vice Chairman is from Indonesia. Academic assistance is provided by Australia – New Zealand Free Trade Area (AANZFTA). |

Source: Thailand Development Research Institute (2017)

**Certification system of professional qualification in Australia**

Australia develops the Australian Qualification Framework (AQF) as the national professional framework that covers the linkage and transfer of the educational qualification from the levels of school, vocational school, higher education, and professional training. AQF is also used to increase potential and strengthen the labor sector, and direction of labor force development according to the announced qualification framework.

Australian Qualifications Framework Advisory Board (Australian Qualifications Framework (AQF) Advisory Board, 2007) gives the definition of "Qualification" as any type of educational qualification to formally guarantee that an individual undergoes learning channel or is efficient and who shows the unique characteristics or expertise in line with the needs of the industrial sector or the society. Therefore, the AQF serves as the core to determine the basic qualifications for those who wish to enter profession, take path to profession, and change the path to a new career of learners. AQF issues the certificate of professional qualification according to Australia's qualification framework which is divided into 3 sectors of accreditation according to the educational structure as follows:

1) School Sector

2) Vocational Education and Training Sector

3) Higher Education Sector

The 3 parts of the educational structure will be the issuers of the certificate of the educational qualification which can be compared with the professional qualification at the level determined by AQF. In the case of vocational study and training, the curriculum will be developed according to the framework of AQF by Industry Skill Council and divides the qualification into 6 levels as follows:

1. Certificate 1
2. Certificate 2
3. Certificate 3
4. Certificate 4
5. Diploma
6. Advanced Diploma

The curriculum or training package to acquire the certificate of each level of qualification consists of 3 main components according to the development of training package as follows:

1) Competency standard
2) Assessment guideline
3) Qualification framework

The accreditation process is determined by Department of Industry and the professional qualification from the training will be accredited by Registered Training Organization (RTO) which appears in the details of the determination of each level of qualification.

The Australian government sets up Registered Training Organization (RTO) as the organization to register trainings and supervise training institutes. Those meeting the standard will be registered and educational institutions can accept the individuals who have attended the trainings in those institutions.

The instruction curriculum has 3 major characteristics as follows:

1. Training Packages are the instruction curriculum recognized at the national level and developed by the industrial sector to produce the labor force that meets the demand of the industrial sector. This curriculum consists of many certificates depending on the types, levels at the end of the training, and expertise.

2. Accredited courses are organized with reference to the skill needs of the industry, enterprise, and community. Apart from the training held in the Training Packages, it is the course that is developed by Registered Training Organizations (RTOs) and certified from the trainers at the state level which is in accordance with the national standard. The share of theory and practice in the learning will depend mainly on the fields or occupations and the skill levels that need to be developed.

3. Workplace-based programs and courses in which establishment can join the training curriculum to develop the skills of their employees. They are organized by Registered Training Organizations ( RTOs) and can respond to the needs of both employers and employees. They provide the opportunity for employees in establishments to gain access to learning and receive credits from the learning while working. At the same time, the establishments will have employees with more needed

skills. The organized training curriculum is therefore yet another path that allows the employees to have higher educational qualification.

Training Package is developed for human resource development and in response to the training needs of the industry or the industrial group. The training package consists of skill training and necessary knowledge to ensure efficient work with 3 components as follows:

1) Unit of competence: It determines the skill and knowledge to ensure efficient operation and the use for higher efficiency in the context of the workplace.

2) Qualification framework: Group of units of competence will have the range from Certificate I to Graduate Diploma

3 ) Assessment guideline: It is in line with the needs of the industry, as well as qualification as determined by the assessor in the design of assessment process and the method of assessment of the training package which is developed by Service Skills Organizations. SSOs ( formerly operated by Industry Skills Councils) will operate when the industrial sector is in need and identifies the needs of nationally recognized training

SSOs develops and inspects the training package through research and advice from those involved in the industrial sector. The training package is certified by the central government, state government, and local government in Australia and is licensed for usage nationwide in Australia.

Service Skills Organizations is an independent organization which provides professional services under the supervision of Industry Reference Committees (IRCs) and works under the supervision of AISC to develop and review training packages.

SSOs has 6 agencies with funding from the Australian Government Department of Education and Training

SSOs supports participation from the industrial sector while maintaining independence from both the industrial sector and the training sector. SSOs is also an important link for the stakeholders in other industries who wish to participate in the development of the training package. Registered Training Organizations (RTOs) or any organization which works with RTO has the authority to deliver the training package, determine the qualification, and unit of competence. If RTO has the training package or scope of registration, SSOs will improve the training package according to the policy to develop and certify the training process as follows:

- Develop according to the quality standard as set

- Respond to the existing and the future needs of the industry for new skills. After the training package is improved, SSOs will undertake the following:

- Inspect the environmental issues to consider the smart industry, shortage of existing skills and newly required skills, and training needs.

- Develop continuous development plan to ensure that the training package will meet the needs of existing skill and newly required skills in the industry

-Undertake the activities of quality assurance during the development of the components of training package

- Request the certification of the newly improved training package

- Disseminate the training package as rectified in the national registration

- Disseminate the Companion Volume Implementation Guide to allow the service providers to operate according to the training package

The training package with the improved version that does not change the outcome of the components that is already certified can be operated by SSO without certification by Australian Industry and Skills Committee (AISC)

Australian Industry and Skill Committee (AISC) was established by COAG Industry and Skills Council in May 2015 to allow the industry to have a formal role in determining the direction of the policy and decision-making for the educational sector and vocational training.

The AISC committee consisted of industrial leaders from the entire Australia and was established in May 2015 by Council of Australian Governments (COAG) Industry and Skills Council. AISC will serve as the leader and provides the recommendation for the system of Vocational Educational and Training (VET) that will bring out the perspective of the strong industry and will increase the response to the quality and relationship within the business sector.

AISC applies the recommendations from the Industry Reference Committee (IRCs) which consists of those with experience, skills, and knowledge in their own industrial fields. The advice from IRCs will create confidence that the training package will respond to the needs of employers and the new economic age. IRCs receives support from SSO.

In terms of the national qualification framework in foreign countries as mentioned earlier, the key success factors of the national qualification framework include the following:

1) System of all qualifications in the country should be under National Qualification Framework

2) Qualification system is based on the learning results with clear division criteria

3) Classification system of qualification under the definition of the qualification cited from learning results

4) System of credit accumulation and system of credit transfer

5) Clear assessment criteria

6) Clear division of responsibilities of relevant agencies, specific agency is set up with the responsibility of formulating and driving the national qualification framework

7) Declare qualification framework policy as national agenda as it is necessary to seek cooperation from many sectors to upgrade manpower's competency and standard in the country

Occupational standard as declared by TPQI as professional qualification according to the occupational code based on international standard

Thailand Professional Qualification Institute (Public Organization)or TPQI in collaboration with Institute for Population and Social Research, Mahidol University operated the project to study the situations and changes in labor force in Thailand in 2015 by ranking various occupations, according to the announced determination of occupational standard set by TPQI, based on the occupational code according to the ISCO-2008 standard, and combining with the total working population aged 15 years and older on the census day in September 1, 2010 and re-ranked as in Table 2.4-3 (Institute for Population and Social Research, 2015).

Table 2.4-3 Number of Thai working population aged 15 years and older on the census day in September 1, 2010, only those with standard occupational code in accordance with the occupations set by Thailand Professional Qualification Institute (TPQI)

| Standard code ISCO-2008 | Definition of occupation according to standard code ISCO-2008 | Number of working populations on the census day (persons) | Occupations as set by TPQI | Ranking of professional fields | Major professional fields | Minor fields |
|---|---|---|---|---|---|---|
| 2133 | Environmental conservation professions | 6,402 | Inspector of energy usage in building | 32 | Energy and alternative energy | Energy and alternative energy |
| | | | Planner of energy usage | 32 | Energy and alternative energy | Energy and alternative energy |
| | | | Alternative energy technology expert | 32 | Energy and alternative energy | Energy and alternative energy |
| | | | Hazardous substance operator | 38 | Environment and hazardous substances | Environment and hazardous substances |
| | | | Environmental scientist | 38 | Environment and hazardous substances | Environment and hazardous substances |
| 2162 | Landscape architect | 553 | Green space designer | 59 | Green space management business | Green space management business |
| | | | Green space manager | 59 | Green space management business | Green space management business |
| 3131 | Technician to control the machine in energy-generating factory | 3,045 | Alternative energy technology expert | 32 | Energy and alternative energy | Energy and alternative energy |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Solar cell panel technician | 32 | Energy and alternative energy | Energy and alternative energy |
| 3134 | Technician to control the machine in petroleum and natural gas refinery | 3,662 | Operation technician | 43 | Petroleum and Petrochemical industry | Petroleum and Petrochemical industry |
| 3257 | Environment, health, and safety inspector | 7,503 | Non-destructive tester | 22 | Testing and inspection business | Testing and inspection business |
| | | | Safety officer | 64 | Safety in workplace | Safety in workplace |

Note: Total number of working populations at the census day with the occupational codes in accordance with the occupations announced by TPQI on the determination of professional standard equal to 17,094,474 persons

Source: Institute for Population and Social Research (2015)

The literature review and the study of statistics were conducted (Desk review) by the analysis and synthesis of the situations of workforce from the survey of working situations of Thai population between 2000-2015 from National Statistical Office, a main agency in conducting survey and disseminating results. It was found that between 2000-2012, the workforce in Thailand increased. But after 2012, the trend declined. The size of workforce is in relation to the population structure that is moving towards the aging society. The share of population aged 60 years and older gradually increased whereas the share of the population of work-force age and young population decreased. However, although the workforce that used to increase between 2000-2012 tended to decrease, relatively or the share of workforce compared to the total population was at the level that did not change much or approximately 70%. The literature review also revealed that the trend of unemployment was the same as the trend of the number of workforces, or the decreasing trend from 3.6% in 2000 to 0.7% in 2012. It seemed that the unemployment rate tended to rise. In 2015, the unemployment rate was 0.8% (Institute for Population and Social Research, 2015).

In the past 5 years ( 2010-2014) , it was found that there was a change in the distribution of workforce in each region. The share of workforce in the central region and in Bangkok tended to increase while the workforce in the north, the northeast, and the south tended to decrease. In large economic activities, the workforce in the manufacturing sector decreased but the workforce in the agricultural, service, and trade sectors increased. However, in terms of the workforce in the agricultural sector, it was found that the trend of skilled operators in the agricultural sector decreased. The workforce mostly finished junior high school or lower. The workforce of approximately 2 0 % finished the higher education and 15% finished senior high school. The workforce were mostly employees in private companies, followed by those with private business, and household business respectively. Moreover, it was found that more than half of the workforce were informal workers. However, the share of the informal workers experienced decreasing change whereas the formal workers experienced increasing change. Most of informal workers worked in the agricultural sector. In terms of the gender differences, it was found that the rate of participation in the male workforce was higher than the female workforce.(Institute for Population and Social Research, 2015).

In terms of past research, Thailand Development Research Institute studied the guideline to develop the workforce to accommodate the industrial development in the long run. It forecast the demand of labor and supply of workforce, classified by the occupational structure and educational level. The study covered the impact of the industrial development on labor shortage, causes of labor shortage, and solutions to the problems of labor shortage in the industrial sector. It conducted the analysis of the changes of skill composition in 6 industries namely textile, processed food, electronics, plastics, petrochemicals, and automobile and automobile parts. Moreover, there were other similar studies. For example, the forecast of workforce and employment was conducted by Department of Labor Protection and Welfare, the forecast of the labor demand, divided by educational level in each industrial type conducted by Department of Industrial Works, and the study of the workforce demand to plan the development of the country's workforce by Office of the Education Council, Ministry of Education conducted by Thailand Development Research Institute Foundation. It could be said that in the past studies, the forecast focused on the demand of the manufacturing industry and various economic activities or demand and supply of workforce only. No details were

presented in the picture of the production capacity of the educational system and labor demand in each occupational field. The past research studies reflected the continuous inconsistency between the workforce demand and the workforce production in the country. The inconsistency would occur in the future if it was not seriously rectified. Another problem was that various institutes or educational institutions still chose to produce workforce according to the capacity of their own resources. Thus, the problem of unemployment was in parallel with the problem of workforce shortage. (Institute for Population and Social Research, 2015).

The NQF of the aforementioned countries has key success factors as described below.

1) The entire qualifications system of each country should be under the NQF.

2) The qualifications system is based on the learning outcome which clarifies the criteria of classification.

3) Have the system of classifying qualifications under the explanation of characteristics of qualifications based on the learning outcome.

4) Have the system of credit accumulation and credit transfer.

5) Have the explicit assessment criteria.

6) Clearly assign roles and responsibilities of related agencies. Establish specific agencies responsible for implementing and driving the NQF.

7) Announce the qualifications framework to be a national policy because it requires cooperation from several sectors in order to lift up competency and standards of local workforce.

The format of a role model country that can be applied to the professional qualification system in Thailand is Australia, of which AQF is the country's main qualifications framework. The emphasis is placed on collaboration between agencies related to education and labor, co-ownership, and sharing of responsibilities in respect of qualification between Ministry of Labor and Ministry of Education. Such guideline is significant to driving the qualification system emphasizing national competency in the same direction. In addition, AQF also serves as a main agency coordinating and creating competency of learners through work, representatives of employers, or industrial representatives which involve in determining knowledge and skills required from training. Moreover, AQF supports workforce relocation through using the

qualifications framework that encourages motivation and value of recognizing the workforce competency system.

**7 principles of Thailand Professional Qualification framework**

1. Professional qualifications framework
2. Classification code system
3. Occupational standard
4. The process of certificate for individual competency performance of occupational standards

4.1 To certify organization that is responsible for certifying the performance of the parties under the occupation

4.2 To certify a professional standards and occupational standards

5. Quality assurance of professional qualifications
6. Professional qualifications framework related to national qualifications framework and qualifications framework for ASEAN
7. The database of professional qualifications and information technology systems for administration system

**Functional Analysis**

The Functional Analysis of nation innovation system. The approach is applied for estimation and measurement of efficiency and performance of NIS. Unlike well-known inter criteria for the NIS efficiency (Althaus, 2007).

**Development of occupational standard and professional qualification in Thailand**

Thailand Professional Qualification Institute (Public Organization) produced the Occupational Standard and Professional Qualification Manual (Thailand Professional Qualification Institute (Public Organization), 2022) which divides the development of occupational standard and professional qualification into 4 processes namely 1) Determine the needs of professional groups or industrial groups 2) Functional analysis of professional groups or industrial groups 3) Develop the unit of competence and establish the occupational standard and 4) Establish professional qualification according to occupational standard. The operational processes are as follows:

**1) Determine the needs of professional groups or industrial groups**

The establishment of occupational standard or unit of competence of any group of enterprise must start with the determination of the needs of the enterprises or the professional holders by clearly determining the definition framework, definition, economic activities, and goals whether the needs are inside or outside the enterprises. Once the goals are determined, the operation is planned to fulfill the goals of the enterprises and develop the work of the professional holders to have higher outcome.

In determining the needs, it must start with Stakeholder Analysis, Cluster Analysis, Manpower Analysis, Demand-Supply Analysis, Performance Outcome Analysis, certification system of qualification, certificates, trainings, analysis of the requirements of labor standard, requirements of occupational standard, legal requirements or any professional licenses, and environment in making a living in the country. All must be in the form of Information that confirms the correctness and can be reported to the community at the macro level to serve as the information to develop occupational standard in the next process.

**2) Functional analysis of professional groups or industrial groups**

Functional analysis is the Activity or Outcome that creates value added to enterprises at different levels through the principles of functional analysis, classification of activities or behavior in performing tasks from good outcome. The process must be systematically undertaken in detail. Because good outcome consists of combined activities of major and minor work in Productivity, Goods or Product, and Service that integrate necessary knowledge, necessary skills, and competency.

Functional is the group of activities. It is the written explanation that identifies the major work that must comply with the Role to achieve the Purpose of the enterprise by identifying the competency of specific work. Then, the explanation is written in the form of the outcome of routine work. Functional analysis will show the scope of each different occupation according to the role as determined in the enterprise which will make one understand the definition of making a living based on occupational standard what the individual who earns his living must do or possess necessary knowledge and skills, and what is the standard of good outcome. Functional analysis has many techniques and methods depending on the objective of the level of analysis and the size of enterprise or the complexity of the enterprise that may be connected into the value chain with other enterprises. Generally, the basics of the analysis consist of 2 types namely Job/Task

Analysis and Functional Analysis. The details are in Figure 2.1 and there are 4 recommended techniques or methods used for analysis namely 1) DACAM Technique (Developing A Curriculum) 2) Delphi Technique 3) Job/Task Analysis and 4) Functional Analysis. The manual explains only the Functional Analysis.

The results of the functional analysis (Details in Figure 2.1) are mostly written in the form of narration which is activity-based outcome as Key Function which is Key work and Unit of Competence which is the Element of Competence. There are details of the criteria of the implementation, individuals' qualifications, necessary knowledge and skills, work scope, and evidences used to designate the criteria or standard to measure the assessment of individual's performance to achieve various objectives.

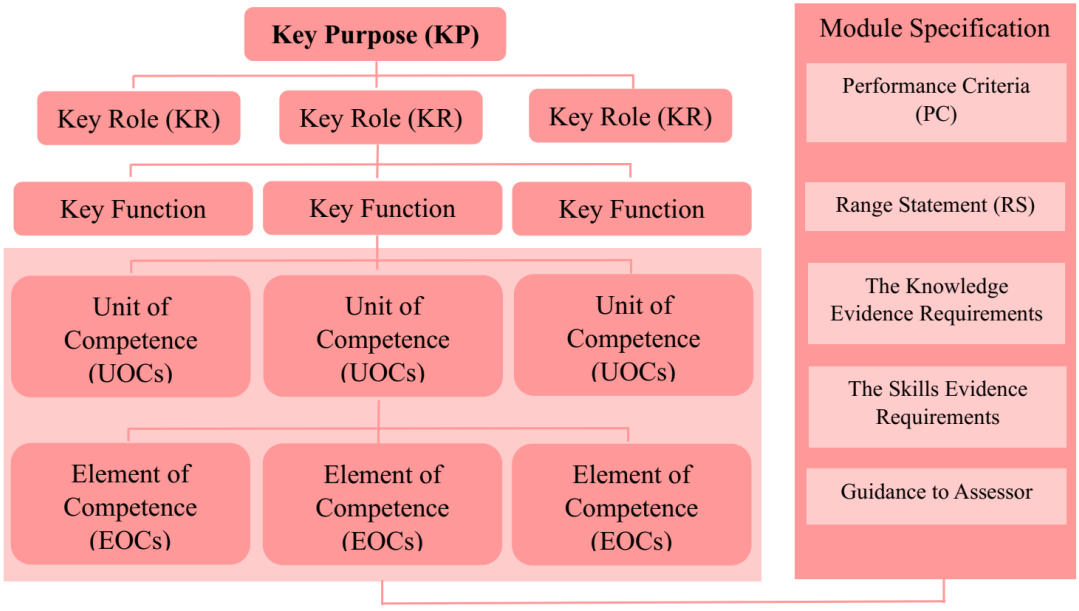



Figure 2.4-1 Functional Analysis

Source: Thailand Professional Qualification Institute (Public Organization) (2022)

**3) Develop the unit of competence and establish the occupational standard**

Occupational standard establishment is the demand of the enterprises and professional holders who jointly operate to create a central standard used to determine the desired qualifications at work by focus on the work outcome. Good outcome is called competency or professional competency derived from the functional analysis in enterprise or enterprise group which is determined as the key activity or Key Role

consisting of more than 1 person who cooperates with each other and divides responsibility to each individual who must perform the task, Key Function is determined and consists of Unit of Competency which identifies only one person that can accomplish a task by him/herself according to the job descriptions that are difficult or easy, complicated, and with different responsibilities, combined to create the standard that an individual must be able to do called Occupational Standard (As in Figure 2.4-1).

**4) Establish professional qualification according to the occupational standard**

Establishment of professional qualification determines the levels and links of professional competency to certify an individual's competency according to the occupational standard by considering the congruity with the professional qualification framework ( Qualification Framework) which explains the desired qualifications in employment in various dimensions to know the scope of responsibility, the scope of job description, and the results of work that needs to be done to determine the qualification framework and ability that one individual can accomplish alone. In terms of clearly determining the scope of the job description in one profession, Thailand has prescribed the framework as the qualification level called Thailand Profession Qualification Framework (TPQF) which has in total 8 levels. In establishing professional qualification, one must understand the desired quality in the 8 levels of professional qualification framework. Later, the determined needs of establishments in enterprise groups are considered. One has to read in detail the job description, the level of difficulty or easiness of work, scope of responsibility, and the verb and object features of work as explained in the Unit of Competency and then classified into group called "occupational standard and professional qualification. "Then, the professional fields, occupational fields, and professional qualification levels are determined. In determining occupations, consideration should be made on the congruity and connection, international standard occupational classification ( International Standard Classification of Occupational- 08: ISCO – 08) and classification of occupational standard (Thailand) by Department of Employment.

**Principles to write occupational standard**

1) Functional Map: In the search of key responsibility, the Functional Analysis is used as a basis of Tree diagram Analysis by Top to Down analysis. It starts with the analysis of Key Purpose in order to divide into Key Role which may consist of the role or mission in many aspects of an enterprise group. Then, the analysis of the Key Role is conducted to divide into Key Function or the combined activity to achieve the Key Role in enterprises. It comes from the same, main objective or what is called Functional Map consisting of Key Purpose, Key Role, and Key Function. ( Details in Figure 2.4-2)

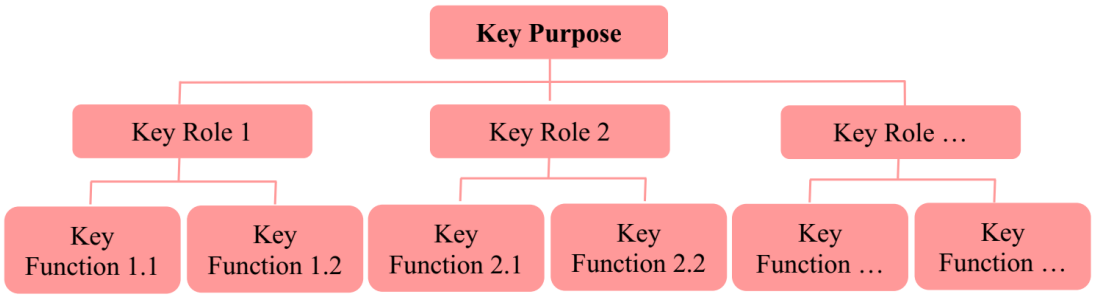



Figure 2.4-2 Chart of the Key Purpose

Source: Thailand Professional Qualification Institute (Public Organization) (2022)

1) Principle of writing messages and job description in the chart of job description and unit of competence

The writing of job description, messages, or words in the Functional Analysis is useful and consistent with the objectives or job description. They are concise sentences which are easy to understand, correct, complete, consistent, applicable, with the same action each time, and with the same good outcome each time. The sentence must start with a verb that shows “behavior”, “action”, or “do” to determine what an individual must be able to do. The action must be followed by what needs to be done or objective of doing which is the object (Objective) to show the verb of action “what needs to be done into outcome”, “do for what?”, “manage for what?” in order to devise the evidence of work and expand the work scope to see responsibility and correct work methods. The sentence must show the “Condition” to ensure that the work has scope, and level of responsibility. In summary, the good sentence structure must be written in the following pattern:

Verb + Object + Condition

2) Analysis and determination of the Key Purpose

The determination of Key Purpose is the important beginning for the analysis to find the professional competency of individuals in the target enterprise. The Key Purpose is to determine the common Vision of enterprises to ensure commonly successful enterprises according to the country's vision of the country's needs in the economic and social development plan, in accordance with the government's promotional policy, the strategic plans as announced from various government agencies or reports from economic research institutes or other promotion and development plans that constitute the direction of the global economic system to which the enterprise must respond (Details in Figure 2.2). The meaning is summarized as follows:

The Key Purpose is the common vision of the economic sector of an enterprise group that will determine the goals or intention to efficiently produce output with economic activities and resources to respond to the needs of those who benefit from the output in and outside the enterprise group. The pattern of writing the Key Purpose (Details in Figure 2.2) is as follows:

Goal Statement + Objective Statement + Economics Context

Goal Statement is the sentence or statement of an enterprise group that conveys "what to do"to fulfill the common goals, how to do together, how to do. The example of the sentence starts with for example upgrade…develop…move towards……manage…. construct……. etc.

Objective Statement is the sentence or statement of an enterprise group that conveys "what is to be done" to achieve the objectives of the needs to do what activities with what resources in what part of basic infrastructure and in what part of value chain of the enterprise group. The examples of the sentence include upgrade…personal ability (individual or thing that is upgraded …) develop …with the products based on innovation and creativity (product is something that is done to

develop…) move towards …excellence services (services are the things that are done for excellence...).

Economics Context is the sentence or environment that accommodates an enterprise group to achieve the set goals. The examples of the sentence include upgrade . . . personal ability with international competency based on innovation and technology, developed . . . with innovative and creative products . . . for export to Europe, move towards……excellence services ... based on Thai culture and charm.

3) Analysis and designation of the Key Role

The Key Role is the designation of the framework of the main economic activities (Economic Activity) which is operated to create value for an enterprise group. If the Key Purpose is compared to Vision, the Key Role is compared to Mission but it is the mission of the enterprise group. It is to determine the role in the overview of the enterprise group of the economic activities to ensure that the enterprise group achieves the goals according to the Key Purpose. It consists of more than 1 Key Role, that is, there must be more than 1 economic activity that creates value added to the resources of the enterprise group. The activity must create value added and promote future value creation (details as in Figure 2.4 - 2)

The designation of the Key Role must write to clearly show the mission, duty and responsibility, and scope of economic activity by dividing into different roles and in line with the objectives or context in the Key Purpose that can be developed into strategies, tactics, or functions of the role in each dimension of the enterprise group.
It must be written to show the outcome of the role or the outcome from the activity of the role. The information of the report on the needs of the enterprise group must be jointly considered by which the consultant requests the brainstorming working group to analyze from the old experience and forecast what is to be done. The message or short narration is written which leads to the same understanding of what is to be done together by adhering to the writing structure of " Verb + Object + Condition" or according to the recommendation.

"Verb + Object + Context/Condition"

4) Analysis and designation of the Key Function

The Key Function is the end of the Functional Analysis. It is the part that needs to be analyzed to find the Performance Competency and then to determine as the Occupational Competence and the Profession Competence. It serves as the analysis and identifies the major results that respond to the Key Role in each dimension of the enterprise group. It stipulates that the role must have outcome that is useful, and have clear value that can be determined as the outcome that shows or measures work assessment. Each 1 role must be able to determine the job functions that are clearly different. Although the job descriptions are the same, the job functions must have sufficient work content to determine the job functions and the job functions must be independent from one another but answer to the same Key Role (meaning one does not have to wait for the outcome of 1 finished job function before waiting for the outcome of another job function. Others can do and are combined to form an outcome that respond to the particular role) by adhering to the writing structure as follows:

"Verb + Object+ Condition" or according to recommendation

"Verb +Object+ Context/Condition"

The Key Function is the outcome of an individual's work that identifies the specific job description on responsibilities, scope of work, use of resources and asset in various forms to respond to the needs of the Key Role.

5) Analysis and determination of Unit of Competence

Unit of Competence is the outcome of occupation which has sufficient quality and quantity to combine into the Key Function in 1 occupation ( including all levels of qualification). It should not exceed 200 units of competence. The establishment of Unit of Competence has the following components as follows:

5.1) Unit of Competence has the principle of writing job description with Verb + Object+ Condition (in case the outcome at the "Process")

5.2) Element of Competence is a minor work or the Key Step in order to create outcome of the Unit of Competence with the following characteristics:

(1) Criteria of implementation by only 1 person

(2) In UOC, there are 2-5 units of EOC

(3) Must be able to assess clearly

( 4) In 1 unit of competence, there are 2-5 units of element of competence. The principle to write a job description is Verb + Object + Condition

5.3) Performance Criteria is the requirement or condition of the standard that indicates the quality of work with the following characteristics:

(1) It must be something that can be implemented and not advice

(2) It must be able to clearly conduct measurement and assessment

(3) It must be the requirement or major condition at work

( 4) It must use the work outcome as the top line with the principle of writing job description of Verb + Object +Condition

5.4) Range Statement is performing duty under the requirements, practical methods, or conditions used to exercise profession in order to have the outcome according to UOC as follows:

(1) Determine the level of quality and quantity of work

(2) Condition to practice 5W1H

(3) Equipment, tools, and materials

(4) Caution on safety and impact on work performance

( 5) Methods that are proved to be reliable, appropriate, and acceptable

5.5) Evidence Requirements include work and knowledge evidences (Evidence Requirements). They must be the outcome that can be recorded and stored. Assessment Guidance is the guideline to measure performance in line with the narration of the element of competence.

5.6) Assessment Guidance is a clear assessment guideline to measure performance or behavioral objective that must clearly be in line with the narration of EOC. The assessment tools must have the following characteristics:

(1) Focus on Learning Process

(2) Criterion Reference

(3) Focus on Crucial Outcome

(4) Integration of relevant competencies

(5) Use of diverse methods

Assessment Tools are the things used to record, store, or show the evidence of performance of professions that are fair and appropriate to the unit of competence with the sufficient quantity and quality to decide the competency of those who sit for the assessment by the assessment tools that will link the performance criteria as determined in the unit of competence. Assessment tools can be selected to fit the set competency.

**Analysis of educational qualification framework in Thailand and in foreign countries**

The research project to drive the manpower development based on the professional qualification system towards the outcome and impact on the educational sector in Thailand by TRIS Corporation Ltd. (2020) was to study the analysis of the educational qualification framework in Thailand and in foreign countries by establishing the professional qualification framework improved from the formerly 9 levels to 8 levels and improved the details of the composition of qualification levels in accordance with the ASEAN Qualifications Reference Framework ( ASEAN Qualifications Reference Framework: AQRF). In the Seventh AQRF Committee Meeting and the Seventh AQRF Committee Meeting and Workshop between 28 – 30 October 2019, the AQRF passed the resolution to approve the report of the comparison of Thailand's national qualification framework towards the ASEAN qualifications reference framework.

The improved national qualification framework identifies the competency in 8 levels which is in line with the ASEAN qualifications reference framework (AQRF). The education qualification determines the basic level of education which has the highest level of competency at level 4, vocational education at the level 4, high vocational education at the level 5, B.A. degree or equivalent at the level 6, M.A. degree or equivalent at the level 7, and Doctoral degree at the level 8 The classification of the 8 levels is in line with the professional qualification framework and the national skill standard. The determination of the competency of the standard 8 levels will result in the comparison of the standards in terms of education, occupational standard, and skill development standard based on consistency, which is comparable in the future, and which increases the education opportunity for Thailand's personnel.

While there are 3 countries which are approved with the reports of the National Qualification Framework towards the ASEAN Qualifications Reference Framework namely Thailand, Malaysia, and the Philippines, other countries are in operation in different processes. Singapore has not established its national qualification framework but has established Singapore Workforce Skill Qualification (WSQ) and used it as the principle in professional qualification. The comparison level of the professional qualification framework in some member countries may not be classified to be compatible with the AQRF and some countries still jointly use the framework.

## 2.5 The principle, definition, and significance of the risk assessment, as well as the principle of the risk treatment

The principle, concept, and process of risk management comply with ISO 31000:2009 guideline. The basic principle of risk management based on ISO 31000:2009 places emphasis on setting up key targets of several processes, while supporting comprehensive and harmonious viewpoint toward risk management that is applicable throughout the organization. The risk management principle is the connection between framework and practices so as to link to operating targets through management activities. The risk management concept of ISO 31000:2009 is newly introduced to assure that various processes are contributed by the risk management continuously and efficiently. In other words, the risk management is a key component of strategic management and planning, operating result reporting process, and value & culture.

Risk assessment is defined as to provide details of activities in each process of establishing occupational standards and professional qualification, identify risk issues, analyze possible risks, and assess the risk probability and impact in order to calculate outcome and determine risk levels (very low, low, moderate, high, very high), and further proceed to the risk management and risk treatment processes.

Event Identification compiles events that may happen to an organization both from internal and external factors such as management policy, personnel, operation, finance, IT system, regulation, laws, accounting system, and taxes in order to understand the events and the situations and in order to enable executives to efficiently formulate the guideline and the policy of the management of potential risk (ISO, 2009b).

Risk Assessment classifies and ranks the importance of the existing risks by assessing the Likelihood and the Impact with the ability to assess risks from both external and internal risk factors(ISO, 2009b). In establishing the occupational standard and professional qualification, the details of the activities in each process are determined in establishing the occupational standard and professional qualification, undergo the risk identification and the analysis of potential risks, as well as the assessment of likelihood of risks and the magnitude of impact in order to move towards the process of risk management and treatment

Risk treatment involves how to manage risks based on the risk treatment principle, comprising risk acceptance, risk avoidance, risk probability mitigation, risk impact mitigation, transfer of risk to other related factors, and turning risk into development opportunities.

Risk management is defined as to apply risk assessment outcome to controlling processes at risk, and managing risks based on the risk management principle so as to enable the process of establishing occupational standards and professional qualification to achieve its objective and target (R. V. Kolluru, 1994); (R. V. Kolluru, S Bartell, R Pitblado and S Stricoff,, 1996)

Project risk management became increasingly significant to managing both medium and large-sized projects because these projects required numerous resources, and had restrictions in respect of budget and operating period. The more uncertainties and restrictions, the more risks the project faces. Therefore, project managers need to consider risks in respect of expenses, approaches, capital restrictions, and risks of completing the project within the schedule.The risk management framework could be implemented by planning, identifying risks, analyzing risks, responding to risks, monitoring and controlling risk management, or planning risk management carefully and properly, with consideration on the organizational culture, using the qualitative data for decision-making, being ethical and professional, and improving the quality of operating standards continuously. The success of the project risk management is to successfully achieve objectives and targets of the project, or to be able to accomplish the project within budget and schedule, as well as dealing with existing technical restrictions efficiently and effectively (Sanguan ChangChat, 2004); (Dawn Henry, 2002); (PMI Europe, 2001); (Project Management Process Improvement Office, 2003).

## 2.6 The principle of the risk treatment and the risk treatment guideline

Risk assessment is the International Standard which provides principles and generic guidelines on risk management that can be used by any public, private or community enterprise, association, group or individual mean is not specific to any industry or sector. It can be applied throughout the life of an organization and a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets. It can be applied to any type of risk, positive or negative consequences. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed. This standard be utilized to harmonize risk management processes in existing and future standards. It is not intended for the purpose of certification (SW, 2009).

Risk management is to prevent threats against the project. Risks can be derived from several causes, especially from the project limitation and uncertainties due to changing environment of the project, resulting in miscalculation of the project activities. As a consequence, if such delay is acceptable, it is evident to increase the budget, causing the following impacts: Expenses exceeding the target, postponed termination date, and damages against the business or project reputation. In case of requiring additional resource allocation, the project expenses exceed the limit in the end. Therefore, risk management is significant. Even though risks are not possible to be completely eliminated, this can help control problems of the project so as to avoid severe problems that are difficult to solve or damage the organization. (Sanguan ChangChat, 2004).

Risk means uncertain event that may occur in the future. If so, it will have negative impact on reaching the objectives or mission of an organization. In other words, risk is the opportunity for mistake, loss, unexpected event, and undesired event so that it hinders operation from reaching the set objectives (Lindley DV, 2006).

Risk Factor is the cause or reason of risk that hinders any operation from reaching the set objectives. Risk should be able to be identified as for the cause, the

reason, and the time of occurrence. Risk identification is crucial as it will ensure the determination of the appropriate measures of risk management (John P. Kindinger and John L. Darby, 2000).

Risk Assessment classifies and ranks the importance of the existing risks by assessing the Likelihood and the Impact from both external and internal risk factors. (John P. Kindinger and John L. Darby, 2000).

Risk Response is operated after an organization identifies its risks and assesses the significance of the risks by using appropriate methods to respond to the risk in order to reduce loss or the likelihood of risk at the level acceptable to the organization (Dawn Henry, 2002).

**Classification of types of risks** (ISO, 2009b)

1) Strategic Risk: It is the risk that involves the formulation of strategies, policies, action plans with impact on the direction, main mission, and the accomplishment of objectives and goals, possibly derived from the changes of external factors (such as politics, economy, changes in situations, use of services, and others) and internal factors (such as organizational restructuring, work style reform), as well as risks derived from bad decision-making or inappropriate application of the decision.

(2) Operational Risk: It involves operation in each process or activity, being equipment or personnel, as well as risk involving data management, IT, and other types of information and knowledge which impact effective and efficient operation.

(3) Financial Risk: It involves financial management and control, financial decision-making, as well as budget management, either from internal factors (such as budget allocation, investment liquidity management) or external factors ( such as changes of interest rates, exchange rates) which impact financial status and efficiency in an organization's work process.

(4) Compliance Risk: It derives from violation or inability to comply with laws, rules, regulations, requirements, as well as inappropriate existing laws or rules and regulations which are obstacles to operation and may impact the organization's reputation and image.

**Risk management process**

Risk management process based on ISO 31000:2009 include 5 main processes as follows: Identify risk factors; analyze alternatives for treatment of risk and the best risk response; apply the risk management plan into practice; control and monitor outcome; and review & make improvement when necessary. The model of ISO 31000:2009 includes the following: Establishing the context; risk identification; risk analysis; risk evaluation; and risk treatment. However, risk identification, risk analysis, and risk evaluation can be incorporated into risk assessment. The implementation is made based on the overall risk management process. In addition, it is necessary to carry out communication and consultant regularly, as well as monitoring and reviewing when necessary (Hulett David T, 2001).

**Types of risk**

1) The risk of the management system – This type of risk is possibly derived from external factors, namely, politics, illegal acts, receiving complaints on the agreement, whereas internal factors probably involve personnel and learning limitations. Normally, the risk of management system is comprised of problems regarding competency, experience, organizational culture, and team management skills.

2) The risk of the project schedule – This type of risk is to be unable to complete the project within schedule and allocated budget, involving time, people, money, and material. This type is similar to the risk of the management system, but to be more specific, for example, to consider how to jointly solve problems during the last process when time and resources are in decline inevitably.

3) The expense related risk – This type of risk is to have no budget for completing tasks as assigned within schedule, possibly because of inaccurate forecast of activity expenses, incorrect pricing, and wrong decision-making.

4) The technique-related risk – This type of risk is related to operations of buyer's unit. In this regard, the operating system is unable to operate as stipulated or as required by buyers. With regard to the operation unit, the operating system is unable to produce as stipulated or as per specifications as required by customers.

**Framework for characterizing risk**

Think about any type of activity, for example an investment, the operation of a system, the design of a new product, giving a speech, or exploring a new area. Looking into the future, the activity can lead to different consequences (C) in relation

to some values such as health, lives, the environment and economic assets. Today we cannot say what these consequences will be; there is uncertainty. These two elements are the two main features of the risk concept: consequences C in relation to the values of interest and related uncertainty (U). There is no universal agreement on understanding risk in this way, but it represents a general perspective on risk, capturing most other common definitions of risk, and it is in line with the definitions and recommendations of, for example, the Society for Risk Analysis (SRA, 2015b); (ISO, 2009b); (PSA-N, 2016).

The idea is to make a clear distinction between the concept (here risk) and how this concept is described, measured or characterized, in line with measurement theory Trochim W, Donnelly JP (2008) A probability distribution of the number of fatalities, as a result of the activity, is an example of such a risk characterization. The ways risk can be characterized are many and, in the following section, alternative approaches and methods will be presented and discussed, highlighting the knowledge dimension as discussed in Section 1. The characterizations need to address both C and U; we need to specify C and find ways of representing or expressing the uncertainties. The (C, U) set-up is general and allows for both positive (desirable) and negative (undesirable) consequences. There is always at least one negative consequence (outcome) when talking about risk.

An activity is to be interpreted here in a broad sense to also include natural phenomena. The consequences are often seen in relation to some reference values (planned values, objectives, etc.). In a project, the issue of interest could be risk related to not meeting the defined cost target.

The consequences C are then to be defined as the deviation between the target and the actual cost, and U relates to uncertainty about this deviation.

1) General theory about risk characterizations

To characterize risk, a risk assessment is conducted. The characterizations need to meet the needs of the risk assessment and of the decision making the assessment is to support. There are, however, some fundamental ideas and principles to be followed, that are generic and applicable to all types of situations. These we discuss in this paper and in the following sections. Firstly, we address the consequences C. Then we will look at the uncertainties U.

1.1) Describing the uncertainties U

The quantities C' introduced in the previous section are unknown and thus, subject to uncertainties; they are either observables or parameters of probability models. The challenge next is to represent or express these uncertainties. Basically, for doing this, there are two ways of thinking:

a) Seek to obtain a characterization of the uncertainties that to the extent possible are objective or intersubjective, reflecting the evidence available.

b) Provide a subjective characterization of the uncertainties by the risk analysts, reflecting their knowledge and judgements, often on the basis of input from other experts.

**Recommended approach**

To characterize the uncertainties about the unknown quantities C', three elements are needed:

1) Subjective (also referred to as a knowledge-based, judgmental) probabilities P, or related interval (imprecision) probabilities

2) A judgement of the strength of the knowledge K (SoK) supporting these probabilities

3) The knowledge K

We write for short (P, SoK, K). A subjective probability P of an event A is interpreted with reference to a standard: if a probability of say 0.10 is assigned, the assessor has the same uncertainty or degree of belief that the event A will occur as drawing at random a specific ball out of an urn comprising 10 balls. We often write P(A|K) to show that the probability is conditional on the knowledge K. The knowledge comprises justified beliefs (SRA, 2015b), often founded on data and information, and expressed through assumptions. If the assessor assigns a subjective interval probability, for example [0.1, 0.2], this means that the assessor is not willing to be more precise than the interval expresses, given the available knowledge K. Hence the probability is judged higher than randomly drawing a specific ball out of an urn comprising 10 balls and less than randomly drawing a specific ball out of an urn comprising five balls.

To evaluate the strength of knowledge, we need to address issues such as:

1) The reasonability of the assumptions made

2) The amount and relevancy of data/information

3) The degree of agreement among experts

4) The degree to which the phenomena involved are understood and accurate models exist

5) The degree to which the knowledge K has been thoroughly examined

(For example, with respect to unknown known; i.e., others have the knowledge, but not the analysis group)

To rank risk events on the basis of the three dimensions of probability, impact and knowledge is difficult. The following approach has been suggested (Aven T, 2017).

1. Very high risk: Potential for extreme consequences, relatively large associated probability of such consequences and/or significant uncertainty (relatively weak background knowledge)

2. High risk: The potential for extreme consequences, relatively small associated probability of such consequences and moderate or weak background knowledge

3. Moderate risk: Between low and high risk. For example, the potential for moderate consequences, and weak background knowledge.

4. Low risk: No potential for serious consequences. For the risk management, such a ranking is, however, not essential.

The point is rather that the various features of the risk events have been highlighted and summarized, and this can be done without transforming the information to a one-dimensional scale. Judgements are needed in any case.

**Risk conceptualization**

Several attempts have been made to establish broadly accepted definitions of key terms related to concepts fundamental for the risk field; see e.g., A scientific field or discipline needs to stand solidly on well-defined and universally understood terms and concepts. Nonetheless, experience has shown that to agree on one unified set of definitions is not realistic. This was the point of departure for a thinking process conducted recently by an expert committee of the Society for Risk Analysis (SRA,

2015b), which resulted in a new glossary for SRA (SRA, 2015a, 2015b). The glossary is founded on the idea that it is still possible to establish authoritative definitions, the key being to allow for different perspectives on fundamental concepts and to make a distinction between overall qualitative definitions and their associated measurements. We will focus here on the risk concept, but the glossary also covers related terms such as probability, vulnerability, robustness and resilience

Summarize the risk definition text consider a future activity (interpreted in a wide sense to also cover, for example, natural phenomena), for example the operation of a system, and define risk in relation to the consequences of this activity with respect to something that humans value. The consequences are often seen in relation to some reference values (planned values, objectives, etc.), and the focus is normally on negative, undesirable consequences. There is always at least one outcome that is considered as negative or undesirable (SRA, 2015b).

**Overall qualitative definitions of risk**

(a) the possibility of an unfortunate occurrence,

(b) the potential for realization of unwanted, negative consequences of an event,

(c) exposure to a proposition (e.g., the occurrence of a loss) of which one is uncertain,

(d) the consequences of the activity and associated uncertainties,

(e) uncertainty about and severity of the consequences of an activity with respect to something that humans value,

(f) the occurrences of some specified consequences of the activity and associated uncertainties,

(g) the deviation from a reference value and associated uncertainties

These definitions express basically the same idea, adding the uncertainty dimension to events and consequences. ISO defines risk as the effect of uncertainty on objectives (ISO, 2009b). It is possible to interpret this definition in different ways

The overall qualitative risk concept, we acknowledge that any tool we use needs to be treated as a tool. It always has limitations and these must be given due attention. Through this distinction we will more easily look for what is missing between the overall concept and the tool. Without a proper framework clarifying the

difference between the overall risk concept and how it is being measured, it is difficult to know what to look for and make improvements in these tools (Aven, 2012).

**Risk management principles and strategies**

The process can be broken down into the following steps (in line with what one finds in standards such as ISO 31000 and most risk analysis text books (ISO, 2009b).

i. Establish context, which means for example to define the purpose of the risk management activities, and specify goals and criteria.

ii. Identify situations and events (hazards/threats/opportunities) that can affect the activity considered and objectives defined. Many methods have been developed for this task, including checklists, HAZOP and FMEA.

iii Conduct cause and consequences analysis of these events, using techniques such as fault tree analysis, event tree analysis and Bayesian networks.

iv. Make judgements of the likelihood of the events and their consequences, and establish a risk description or characterization.

v. Evaluate risk, to judge the significance of the risk.

vi. Risk treatment

Risk management is closely related to policy and policy analysis. A policy can be defined as a principle or plan to guide decisions and achieve desirable outcomes, and the term applies to international organizations, governments, private sector organizations and groups, as well as individuals. The development and operation of policies are often structured by the following stages inspired by decision theory (ISO, 2009b); (ISO, 2009a).

1. Problem identification—the recognition of an issue that demands further attention

2. Generating alternatives, analysis

3. Processing covering aspects like policy instrumentation development, consulting, deliberation and coordination

4. Decision-making

5. Implementation

6. Evaluation (assessing the effectiveness of the policy)

Linking stage 6 with 1, the process is referred to as the policy cycle. It has similar elements as we find in the quality and project management field for ensuring continuous improvement—plan, do, study and act. The above steps (i)–(vi) for the risk analysis process can also be structured in line with this cycle. The risk field provides input to the elements of the policy process for example by:

1) Conceptualization and characterization of the problem/issue, covering aspects like objectives, criteria, risk, uncertainties, knowledge and priorities.

2) Structuring the problem by clarifying and highlighting key principles (e.g., the precautionary principle) and dilemmas, such as the balance between development and value creation on one side and protection on the other.

3) Statistical data analysis to identify those hazards/threats that contribute the most to risk, and in this way guide the decision making on where to most effectively reduce the risk.

4) Risk assessments and in particular Quantified Risk Assessment (QRA) of alternative potential developments (for examples technological arrangements and systems), to be able to compare the risk for these alternatives and relate them to possible criteria, and other concerns such as costs

5) Risk perception and related studies, providing insights about how different actors perceive the risk and what concerns they have regarding the risk and the potential consequences.

**Risk criteria**

Risk management is about balancing different concerns, profits, safety, reputation, etc. In general, one considers a set of alternatives, evaluates their pros and cons, and makes a decision that best meets the decision-makers' values and priorities. In this process, it is common to introduce constraints, in particular related to safety aspects, to simplify the overall judgements and ensure some minimum level on specific areas, to avoid the consideration of too many variables at the same time (ISO, 2009a) (ISO, 2009b).

**Risk Components**

Risk has two components, that is, uncertainty and consequences. Some experts view risk in terms of its impact either positive or negative on objectives. There are pure and speculative risks. Speculative risks are those risks that provide an

opportunity for gain or loss while pure risks have to do with the chance of either loss or no loss but no gain (Geldenhuys, 2006) The management activities of organizing, coordinating, planning, controlling and directing have been an integral part of risk management. The process of identifying, prioritizing and treating risks has been a common practice among organizations. However, an integrated or enterprise approach to the treatment of risk is now been practiced instead of the traditional risk treatment (silo) or risk transfer through insurance or other financial products (Meulbroek, 2002). the level of risk management implementation differs among business enterprises, especially the banking industry depending on the corporate risk culture and risk appetite (Jorion, 2009).

**The core principles of risk management**

The core principles of risk management, risk identification, risk analysis, risk control, risk financing and claims management, they are certainly not the only ones to rely on them in their daily thinking and decision-making for professionals who practice formal risk management processes based on these tried-and-true principles, a periodic review can be both reinforcing and refreshing. It's also valuable for lay people to learn about the principles of risk management so they can gain a deeper understanding of why they and their organizations make the choices they do. Using an everyday example is a great way to educate people on risk management principles, so they can then apply these guidelines to real-world operational issues and situations. (Jody Moses, 2022).

1. Risk identification, property — either the car itself or someone's property. There is also a risk of financial loss if proper liability insurance is not in place or if the driver gets a speeding ticket, and so forth.

2. Risk analysis, this stage involves gathering data and considering the meaning of the data points over a span of time. An analysis of the identified risks begs one to ask: How often could this adverse event happen (frequency)? And if it does happen, what's the worst way it could turn out (severity)? In our car scenario, the worst that could happen is loss of life. Additional analysis may determine that the risk of being in an auto accident is low because the driver is never on the highway or only drives in good weather during daylight, on roads with speed limits of 30 miles per hour or less, in a well-maintained car, etc. The analysis part of the risk management

process should take you through several what-if scenarios and help you arrive at the potential frequency and severity of an event.

3. Risk control, risk control oxers opportunities to implement solutions that support risk avoidance, prevention and reduction. The risk avoidance technique in our car example would be not to own a car nor ride in a car. In reality, a minimal amount of risk still exists, as you could be hit by a car as a pedestrian or injured while using mass transit, but in certain scenarios, risk can be avoided completely.

Risk prevention aims to reduce the frequency or likelihood of the event or loss. This might mean preventing car breakdowns by following maintenance and inspection schedules, keeping air in the tires and gas in the tank, and following all driving laws.

Risk reduction aims to lower the severity of a particular loss that has already occurred. For example, it might mean ensuring property This fourth principle focuses on the economics of risk. Risk financing is a way to cover any financial losses that the implemented risk control techniques did not prevent from happening. In our example, even with all the proper maintenance on the car, safe driving, etc., an accident can still occur. By having appropriate auto insurance, funds are generated by the insurance company to pay for the loss — in this case, damage to the car

4. Claims management, whereas risk financing is about managing the financial impact, claims are about managing the harm done. When a loss occurs, a claim may be filed to recover damages. In the car example, a claim may be filed with the insurance company of the driver at fault to recover for the damage that occurred. If the driver at fault was not insured, a dixerent course of action may be necessary to hold the driver personally responsible for the damage Risk management continues to evolve, but these basic principles are as applicable as ever. It’s also important to keep in mind that the process is meant to be cyclical, rather than linear. Lay people and risk management professionals alike must constantly monitor their environments for new potential dangers, measure the exicacy of current risk mitigation techniques, and, based on the latest findings, repeat the five-step process outlined in the basic principles.

**7 risk management principles for better results** (Australian Institute of Project Management, 2023)

Building a good risk management plan will help protect your company’s resources, reputation, and people. In addition, each organization communicates risk

differently, and has their own internal culture and risk management protocol. The risk management process should integrate both the internal and external context when planning for risk.

Projects of all sizes require risk management in some form. If you think of your project as a road, risks are potholes and sharp bends. Risk management is learning the roads, examining the conditions of the route you're about to take and any potential issues. It isn't enough to be prepared for the damage if the risk were to occur. A vital part of the role of a project manager, is to put in place strategies to avoid, manage, and recover from risk.

All industries and organizations manage risk a little differently. However, there are 7 key risk management principles that you can draw on when you're looking at integrating a risk management plan into your project.

**Risk management principles**

1. Ensure risks are identified early. This is probably the most important principle of risk management – make sure you're ahead of the game by completing your risk assessment before the project commences. Identify the cause of a potential risk and design preventative measures and a response if it was to occur. After risks have been identified and sourced, risk needs to be measured.

2. Factor in organizational goals and objectives. Ensure your risk management plan ties in with your organization's overall goals and objectives. If a risk that you have flagged, does end up occurring how will it impact the organization, financially and reputationally? Each organization is going to have different desired outcomes and priorities and these should be integrated into the risk management plan. The risk strategy should be consistent with the overall goals and culture of the organization.

3. Manage risk within context. Context is extremely important when considering project risk, as each organization will have different tolerance levels to risks. Various factors (political, technological, legal, societal, etc.) will impact organizations and industries differently. For example, one organization might be particularly vulnerable to its legal environment, while another may need to consider their societal impacts more closely.

In addition, each organization communicates risk differently, and has their own internal culture and risk management protocol. The risk management process should integrate both the internal and external context when planning for risk.

4. Involve stakeholders. planning for risk, it's important to call on the expertise of those who will be involved in the project (e.g team members, contractors), as well as experts within your organization that can provide you with advice for planning for risk (e.g senior managers).

Throughout the risk management process, stakeholders should be involved in the decision-making process. By drawing on stakeholders for your risk planning, you will identify and gain insights into potential risks you may not have considered.

5. Ensure responsibilities and roles are clear. While the risk management plan may be owned by one individual such as the project manager or change manager, it should be operated with transparency and visibility. Everyone should know the role they play in mitigating risk and responsibilities should be clear and inclusive throughout the risk management process.

Allow different voices to be heard and encourage questions and discussion. The more people that are participating, the more risk can be managed creatively and effectively. Each team member needs to be dynamic, flexible, and responsive. Everyone should be empowered to deal with risk at their own level.

6. Create a cycle of risk review, identified the risks and made a risk management plan or strategy, it's important not to have a set and forget mentality. During each step in the process, all risks should be evaluated and any interventions or preventative measures should be implemented if needed. Keeping everyone in the loop related to the project by reporting on the risk and communicating any changes with stakeholders in a timely fashion. By reporting throughout the project, you may be able to step in and address any problems that arise before they come to fruition.

7. Strive for continuous improvement, a project has been completed, review how your risk management plan went and whether there was any room for improvement. Always strive to adapt to how you manage risk and take these learnings with you to your next project.

Risk management should be fixed in all the organization's activities and processes in relevant way, effective and well-organized. The process of risk

management should become apart and not separate from organizational processes, risk management should be surrounded into the developmental policy, strategic planning and review, and change management process. There should be an organization-wide risk management plan to ensure that the risk management policy is implemented and that risk management is fixed all of the organization's activities and processes (SW, 2009).

## 2.7 Related researches

The study on occupational standards and professional qualification of some countries initially considered the congruity in respect of professional performance, especially member countries of the ASEAN Economic Community that could be role models for Thailand, and the countries, of which occupational standards and professional qualification could be taken as a good example, consisted of Hong Kong, New Zealand and Australia.

**New Zealand's occupational standards and professional qualification**

NZQF determines qualifications framework applicable to all educational agencies in both public and private sector. Key characteristics of New Zealand professional qualification system are as described below. (Thailand Development Research Institute, 2017).

1) Apply to education levels, ranging from secondary level, vocational level, and higher education level. The NZQF is applicable to all educational agencies which provide educational services from secondary level to higher education level in both public and private sector.

2) Be flexible. People in this system are able to choose various learning paths. As the system is commonly used in various types of educational agencies, people in this system are provided with multiple options, for example, those who were awarded with the certificate level 3 could choose their learning paths, namely, continue to study bachelor's degree, diploma, and certificate. Each path of further study has different advantages and disadvantages. To have multiple options enables those who wish to continue their study to choose the most appropriate option for them.

3) Develop under the cooperation between NZQA and related people in the education sector.

4) Be the qualification system which places emphasis on the outcome of those who are in the qualification system.

5) Be the qualification system which measures learning volume by "credit". The credit in the system indicates the period of learning. Learning paths consisted of classroom learning, apprenticeship, and other methods of evaluation.

**Examples of occupations and professional qualification consistent with or similar to Solid Waste Management**

NZQF determines a group of occupations related to Solid Waste Management; such as Solid Waste Disposal, and Recycling and Recovery. Details are as described below.

**Solid Waste Disposal**

Solid Waste Disposal is comprised of 4 levels of qualification, namely, level 2.7-1. Details of qualification level and unit of competence of Solid Waste Disposal can be summarized as below.

Table 2.7-1 Summary of qualification level and unit of competence of Solid Waste Disposal

| Solid Waste Disposal | | |
|---|---|---|
| Level | Code | Unit of Competence |
| 2 | 23567 | Express knowledge on waste disposal |
| 2 | 23568 | Express basic knowledge on waste landfill |
| 2 | 23569 | Explain and control animals and waste sites |
| 2 | 23572 | Explain and clean vehicles at the landfill |
| 2 | 23573 | Explain the odor and how to control the odor at the landfill |
| 2 | 23582 | Control traffic at waste sites |
| 3 | 23570 | Explain, operate, and oversee the drain |
| 3 | 23571 | Express knowledge on filling up the landfill |
| t3 | 23574 | Oversee vehicles for waste compression over the landfill |
| 3 | 23575 | Oversee water storage at the landfill |

| Solid Waste Disposal | | |
|---|---|---|
| Level | Code | Unit of Competence |
| 3 | 23756 | Express knowledge on daily closing a cover of the landfill |
| 3 | 23758 | Inspect and control volume of waste |
| 4 | 23577 | Explain leachate and how to store leachate, as well as the disposal system |
| 4 | 23579 | Explain, prepare reports, and record the waste control |
| 4 | 23580 | Control operations at the landfill |
| 4 | 23581 | Identify, separate, and control waste |
| 4 | 23583 | Explain and provide maintenance for the gas system |
| 5 | 23854 | Express knowledge on environmental control for the landfill |

Source: Thailand Development Research Institute (2017)

**Recycling and Recovery**

Recycling and Recovery is comprised of 3 levels of qualification, namely, level 1, 2, and 4. Details of qualification level and unit of competence of Recycling and Recovery can be summarized as shown in Table 2.7-2.

Table 2.7-2 Summary of qualification level and unit of competence of Recycling and Recovery

| **Solid Waste Disposal** | | |
|---|---|---|
| Level | Code | Unit of Competence |
| 1 | 24248 | Identify and provide details of plastic for recycle purpose |
| 2 | 22765 | Explain the definition of zero waste |
| 2 | 24241 | Demonstrate knowledge on glass retrieval |
| 2 | 24242 | Identify and sort glass cullet for recycle purpose |
| 2 | 24243 | Demonstrate knowledge on glass packaging reuse |
| 2 | 24244 | Sort glass packaging for recycle and reuse purpose |
| 2 | 24245 | Use bottle washing machine to clean glass packaging for |

| Solid Waste Disposal | | |
|---|---|---|
| Level | Code | Unit of Competence |
| | | reuse purpose |
| 2 | 24246 | Identify and sort paper for recycle purpose |
| 2 | 24249 | Sort plastic in the sorting plant |
| 2 | 24250 | Demonstrate knowledge on contaminants in plastic and removal of contaminants from plastic in the sorting plant |
| 2 | 24251 | Demonstrate how to use the plastic granulator and related knowledge |
| 2 | 24252 | Demonstrate how to use the plastic crushing machine and related knowledge |
| 4 | 24247 | Demonstrate knowledge on sorting types of paper for recycle purpose |
| 4 | 24253 | Demonstrate knowledge on the sorting plant control and plastic retrieval |

Source: Thailand Development Research Institute (2017)

**The process of requesting for professional qualification certification in New Zealand**

The process of requesting for professional qualification certification in New Zealand involves the qualification system which measures learning volume by "credit". The credit in the said system demonstrates the learning period of learners. Learning paths include classroom learning, apprenticeship, and other evaluation methods. New Zealand's qualification system measures learning by credit. 1 credit of qualification is equivalent to 10 hours of learning, including the period of directly interacting with instructors and trainers, learning, doing exercises, and doing apprenticeship. General learners can earn 120 credits within 1 year. The NZQF can be proposed by higher education institutes. Expired qualification is either extended or invalid, depending on the review. Learners have to possess qualifications for application completely before the expiration of the qualifications, and the expired qualifications are unusable.

**Australia's occupational standards and professional qualification**

Australia' s occupational standards and professional qualification or AQF is under the supervision of Ministry of Education and Training, and Ministry of Industry and Science. Roles and responsibilities of related agencies in each education level are determined as follows: (Thailand Development Research Institute, 2017)

1) The agencies in charge of quality assessment and qualification certification are comprised of the agency for vocational education and training called Australian Skills Quality Authority (ASQA), and the agency for non-university higher education called Tertiary Education Quality and Standards Agency (TEQSA).

2) The agencies in charge of qualification development are comprised of the agency for vocational education and training called Registered Training Organizations (RTOs), and the agency for higher education called education service providers

Examples of occupations and professional qualification consistent with or similar to Solid Waste Management

Australia determines a group of occupations related to Solid Waste Management; such as Waste Management. Details are as described below.

Waste Management is comprised of 4 levels of qualification, namely, level 2-5. Details of qualification level and unit of competence of Waste Management can be summarized as below.

Table 2.7-3 Essential skills of CPP20411 Certificate II in Waste Management

| Essential skills | Qualifications as required by industry/enterprise |
|---|---|
| Communication | - Listen to and understand work-related advices, guidelines, and recommendations.<br>- Communicate clearly and disseminate information accurately.<br>- Read and interpret working paper; such as OHS paper.<br>- Write down for note-taking and document preparation.<br>- Realize requirements of staff member from working in team.<br>- Have basic calculation skills for measuring and counting purpose.<br>- Create and use networks. |

| Essential skills | Qualifications as required by industry/enterprise |
|---|---|
| | - Share information with colleagues.<br>- Carry out negotiations; such as job roles and limitations.<br>- Possess adequate knowledge; such as OHS knowledge. |
| Teamwork | - Work independently and work in team.<br>- Work with several individuals and teams.<br>- Utilize knowledge on own roles as a part of team.<br>- Identify and apply strengths of other team members.<br>- Give recommendations |
| Problem-solving | - Develop practice guideline and have creativity in solving problems at work.<br>- Demonstrate independence and creativity in identifying problems.<br>- Solve individual or team problems.<br>- Use calculation skills for problem-solving; such as managing time and use of resources.<br>- Test hypothesis with consideration on work context.<br>- Listen to and make decisions on concerns at work.<br>- Solve problems regarding customers' concerns from work obligations. |
| Creativity at work | - Solve and adjust situations.<br>- Have creativity in solving problems to comply with related practice guidelines and agreements.<br>- Analyze and seek rare opportunities.<br>- Propose alternatives acquired from work.<br>- Transform ideas into practice.<br>- Develop ideas for creative problem-solving.<br>- Strategically develop creativity in the long term. |
| Planning & management | - Collect, analyze, and manage information.<br>- Use fundamental business system for planning and management. |

| Essential skills | Qualifications as required by industry/enterprise |
|---|---|
| | - Use intelligence properly.<br>- Be able to use creativity and make decisions under job roles.<br>- Involve in improving and planning continuously.<br>- Participate in or setting up job target clearly, and hand over the job.<br>- Determine or apply existing resources.<br>- Allocate people or resources as required in the workplace.<br>- Manage time and set priorities.<br>- Improve resources allocation to cope with emergency situations. |
| Self-management | - Have self-motivation.<br>- Express own ideas and visions within team or in relation to own responsibilities.<br>- Be able to integrate own ideas, values, and visions into values and requirements of the unit.<br>- Monitor and evaluate own operating results.<br>- Take responsibilities appropriately with job level. |
| Learning | - Gain wide access to new knowledge and technological learning.<br>- Learn various situations, including informal situations.<br>- Involve in continuous learning.<br>- Learn to cope with changes.<br>- Learn new skills and techniques.<br>- Be accountable for own learning.<br>- Support other people's learning; such as sharing information.<br>- Apply learning approaches in various types.<br>- Develop own learning approaches.<br>- Participate in developing learning plan; such as taking part in evaluating results. |
| Technology | - Use work-related technologies and tools. |

| Essential skills | Qualifications as required by industry/enterprise |
|---|---|
| | - Possess skills in using basic technology for information management.<br>- Apply new technologies.<br>- Use knowledge on occupational health and safety for technological use. |

Occupational standard and professional qualification consistent or similar to the field of waste management and hazardous substances

**1) Occupation of garbage collector attached to garbage truck level 3**

Those who pass this level can perform specific work and comply with the safety requirements of the transfer of waste, infectious waste, and smartphone waste into a garbage truck, can transfer waste from the garbage truck, and perform relevant work. The details of the competency as in Table 2.7-4

Table 2.7-4 Example of the competency details of garbage collectors attached to garbage trucks

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| Collect and transfer waste | Can collect and transfer infectious waste and household waste into garbage truck | 1. Study and correctly use the grinding system of garbage truck as required by organization | |
| | | 2. Collect and transfer bags of household waste and infectious waste from roadside into garbage truck and know the technique of controlling the lifting | May use manpower to collect waste or use lifting equipment |

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| | | equipment (if there is installation) | |
| | | 3. If the garbage truck is blocked by waste, it must be cleaned both inside and outside and if there is a problem, it must be solved | Find the cause of problem and solve the problem |
| | | 4. Inspect the automatic crushing system in the garbage truck when the truck is full | |
| | | 5. Before taking the trip, equipment must be cleaned and the lifting equipment must be orderly kept. | |
| | Transfer waste from garbage truck and proceed with relevant documents until completion | 1. Park garbage truck in safe and stable area for transfer of waste | |
| | | 2. Install the open-close system at the back of the garbage truck and the MGB lifting equipment (if there is installation) in the determined position | |
| Collect and transfer waste | Transfer waste from garbage truck | 3. Can serve as operator to close the blade | |

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| (continued) | and proceed with relevant documents until completion (continued) | system and to close the back of the garbage truck | |
| | | 4. Inspect to ensure that the MGB lifting equipment (if there is installation) is in the position that is ready for transfer | |
| Prepare documents | Prepare documents related to waste collection and transfer | 1. Compile and prepare documents related to waste collection and transfer | |
| Maintain equipment and tools | Maintain equipment and tools | 1. Clean and maintain the non-technical aspects of the truck as determined | Cleaning can be undertaken every day at interval |
| | | 2. Use and store the equipment for operation as determined | Such as gloves, helmets, shoes, first-aid kit, broomsticks, and spade in the case of service provided for fire engine, leak prevention gown, leg prevention gown |
| | | 3. Can operate waste | Such as |

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| | | management as required by organization | classification and labelling of the size of waste and weight of hazardous materials |

**Emergency relief workers in collecting liquid and hazardous waste level 4**

In terms of the standard for entrepreneurs in the business of collection and transfer, as well as equipment used in liquid and hazardous waste industry, 'entrepreneurs' include driving for superiors and business owners. Those who pass this standard can explain the emergency of liquid and hazardous waste and the risks when the emergency occurs, can respond to the emergency, and can completely analyze the overview of the emergency. The example of the details of competency as in Table 2.7-5

Table 2.7-5 Example of the competency details of emergency relief workers in collecting liquid and hazardous waste

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| Explain the types of liquid and hazardous waste | Can explain the types of goods, liquid, and hazardous waste in case of emergency during collection | 1. Explain the impact, scope, and types of emergencies derived from wastewater and hazardous waste | |
| | | 2. Collection of liquid and hazardous waste must identify Class 3 of | |

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| | | hazardous goods (Flammable liquid is unde the section of regulations transport of dangerous goods 2005) | |
| | | 3. Collection of liquid and hazardous waste must identify Class 6 of hazardous goods (Under the section of regulations of transport of dangerous goods 2005 as well) | |
| | | 4. Explain the types of risk occurred with hazardous goods, hazardous liquid, and hazardous liquid waste | Injury or health risk, injury or health risk in public places, damage to possessions, or environmental risk |
| Respond to emergencies | Demonstrate the process of response in case of emergency derived from liquid and hazardous waste | 1. Demonstrate the process of response in case of emergency derived from relevant type of waste based on the manual | |
| | | 2. Must report emergency after completion of task as designated | |

| Unit of Competence | Element of Competence | Performance Criteria | Scope |
|---|---|---|---|
| | Complete analysis of emergency from collection of liquid and hazardous waste | 1. Analyze the situation leading to emergency and perform duty during emergency as designated | |
| | | 2. Give advice and perform duty to mitigate risk of emergency as designated | |

**The research about professional qualification**

The research project to drive manpower development with professional qualification towards the outcome and impact on the educational sector (TRIS Corporation Limited, 2020) was conducted with the processing and data analysis acquired from the survey. The main issues in the various topics are summarized as follows:

1. Use of professional qualification system

The organizations that apply the professional qualification system the most are educational institutions, followed by establishments, and the least are government agencies. Only a small number of establishments and government agencies have applied the system. Yet, some are considering or may apply it in the future. If one looks at the score level of application, one will see that the trend is still in the same direction. That is, educational institutions constitute the group that apply the professional qualification system the most but do not exceed the moderate level (score = 3.0909). Most apply it to modify the instruction content. Some apply it to assess the learning outcome and modify the teaching methods respectively. The application for validation is still little. Many who have not applied it are considering, pending on study. Some still mainly use the criteria of TPQI and are not certain if they can design the different curriculum.

In terms of application to assess learning outcome and modify teaching methods, some have not applied it but are considering, pending on studies. Some think that the existing teaching and assessment methods are already suitable. Therefore, they do not change it but rather use the information for their consideration. The reasons that some educational institutions do not apply the professional qualification system are numerous. The most answer is that some professions have already had supervision system in place such as professional associations for example architectural profession. The other reason is that the application of professional qualification system does not affect work in the labor market or compensation of the use for validation is still little. It is found that most executives do not have the policy to use other regulations. Moreover, some are under consideration, some study the criteria development, and some do not understand the methods of validation. Moreover, the qualification system is not widely known or recognized by educational institutions. However, the use of professional qualification system for the validation is currently little. But in foreign countries, many educational institutions are interested in the use of validation in the future, including for formal education, non-formal education, and informal education.

2. Outcome and impact from the use of professional qualification system

The survey results revealed that the outcome and the impact on the organization that uses the professional qualification system mostly impact educational institutions but the score level is not very high (scores = 2.9429). As for establishments and government agencies, the impact exists but little. In terms of outcome and impact, the most part is the impact on the organization that applies the professional qualification system. As for the educational institutions, it is found that their good reputation and image increase on the whole with increased popularity. As for establishments and government agencies, the outcome is to create motivation in personnel development or continuous management. As for the changes in an organization's internal process, it was found that the most impact is awareness and interest in seeking knowledge and personnel development. As in the case of establishments, it was found that there is interest in personnel development. As for government agencies, the impact is on the awareness and interest in seeking relevant knowledge,

the changes in the levels of policy/action plan. In considering the in-depth interviews, it was found that the changes in an organization may be different. Some organizations may focus more on other standards. Or in come case, personnel are not motivated to teach according to occupational standard, or they have too much work to devote themselves in the study of professional qualification system, etc. The impact on the students who complete their education after the use of professional qualification system in instruction reveals that it helps the graduates to possess the qualifications, knowledge, and skills that correspond more to the labor market and with the ability to learn, and adapt themselves quickly to keep abreast with the new knowledge and skills. Moreover, the graduates can be selected for work. The in-depth interviews revealed that in selection for work, there are other factors apart from professional qualification system such as knowledge of the employer's professional qualification system, importance placed on the employer's professional qualification system, etc.

3. Problems and obstacles that impact the use of professional qualification system The problems and obstacles of each group of organizations are different. Educational institutions have the problem of personnel's readiness the most. For example, the lack of personnel with appropriate knowledge and qualification, followed by the organization's readiness in other aspects such as rules and regulations, and capital support. Moreover, there are the issues of occupational standard such as the testing criteria is too difficult, the assessment documents are too many, the explanation of the fields of the professional qualification system is hard to understand, and many others. Establishments also have the problem of occupational standard that is not properly established. For example, it does not cover all details of the required work or in some case the establishments do not want their employees to possess all occupational standards but they rather want knowledge in various fields. As for government agencies, the main problem is personnel.

The studied of the recognition of the Foundation Degree qualification for pharmacy technicians the case study (Herrera, Brown, & Portlock, 2013) they said the Foundation Degree (FD) is a work-related, intermediate-level higher education qualification. The issues recognition can affect to the success in attracted students where the literature suggests that uptake should be adequate. These represented a case

study at first-time which explored for applying to the FD for technicians' pharmacy. The purpose with stakeholders is one-to-one and group interviews, the FD in Medicines Management (University of Portsmouth). Founded the qualification was considered fit for purpose that was the key findings, although of limited value due to basic skills being provided by other training courses. This had a negative effect on the recognition of the FD. Dissemination information about the program was impaired and a lack of awareness about exist. For the further research is needed to fully describe for this situation, particularly the benefits of this education form.

The study of policy tensions for young people in vocational education and training: the General National Vocational Qualifications was the one of the most notable developments in post-compulsory education and training policy has been established GNVQ (General National Vocational Qualification) in England and Wales. The new qualifications have attracted a considerable amount of popularity in the few years, they have nonetheless been the subject of much critical comment. This paper is provided the principal with policy process, GNVQ policy on in-depth interviews with key informants. The four interrelated of 'policy tensions' during the development phase- the tendency for 'academic' privilege education over 'vocational' training and education, the government conflict that potential between strategic imperatives for long and short term objectives of political, the difference of aims of the education and employment departments and the contours of the connection which a quango similar with the NCVQ has sponsoring department(s)- shaped the direction in which GNVQs advanced and their contributed subsequent infirmity on implementation (Williams, 1999).

Hauxwell (2002) studied a national vocational qualification in the operating theatre: participants' perspectives effects on relationship of staff in two hospitals that was qualitative study, the impact of implementing on a level 3 National Vocational Qualification (NVQ) in Operating Department Practice. Data was gathered on 'perspectives on teaching, learning. Some unexpected results were aspect produced. This little explored area of healthcare, the educational and contexts are described. As the research literature was reviewed, include the historical development of NVQs studied, meaning debates, and impact studies discussion. The methodology is approaching a case study, data gathered by 40 structured interviews that were taped and transcribed. The interview majority was the NVQ had had a positive effect on the working relationship

between two main staff groups, with some re-motivation of longer-serving staff members reported. The strong evidence aspects of the implementation of the NVQ had contributed to the overcoming of traditional barriers between two staff groups. A new area, this study makes a contribution to the literature on NVQs. It also expands the research about the impact of NVQ implementation on the way people work together in operating theatres.

**Functional Analysis**

The studied of functional analysis results across a known and unknown assessor Meindl, Denton, White, Miller, and Casey (2017). Commonly, functional analyses are conducted by a trained clinician with the unfamiliar participant. This unfamiliarity might influence the outcome of the analysis, potentially leading to function misidentification. This examination study was responded of two participants during functional analyses that conducted by a known and unknown assessor. The influence of familiarity was observed across both participants; however, with extended exposure to the functional analysis was respond became similar across assessors for both participants. Mainly, conclusions different regarding function may be drawn at several points during this analysis. The findings are discussed with regard to the participant–assessor history influence and recommendations are provided regarding a functional analysis conducted.

Watson, Ray, Turner, and Logan (1999) studied Teacher-Implemented Functional Analysis and Treatment: A Method for Linking Assessment to Intervention, one of the main issues in school-based interventions is determining what data type need to be collected so that a designed appropriate treatment. Functional assessment/analysis shown an effective method to linking with intervention and assessment. In spite of the advantages potential of using functional assessment/analysis in the school setting, demonstrations procedures of functional-based are relatively rare in the literature of school psychology. Consequently, the purpose was to illustrate the way in functional methodology could be used setting in the school by training teachers that result from the analysis to functional analysis procedures implement and treatments. The integrity for both the analysis and intervention were high and the targeted self-injurious behavior was reduced to near zero. The potential advantages were the discussion of training teachers to implement functional assessment/analysis and supervision for research in applied school psychology practice.

Functional Analysis of Educational Telecomputing: A Case Study of Learning Circles was presented educational change involves changing teachers together with changing students. Computer-facilitated telecommunications provides guideline to change students' learning from the information autonomous memorization of the combining production and information analysis. It provides for changing the teacher role from an isolated authority to learning partner working with a teacher's team. This article provides a functional analysis of a number of electronic global communities called "Learning Circles" that worked together on educational projects mapped by the participants. The information used in this functional analysis are drawn from interactions of over 100 classes that participated on the AT&T Learning Network (Riel, 1992).

The study of the role of Functional Analysis in National Vocational Qualifications: A Critical Appraisal by Jim Stewart & Sally Sambrook that presented providing an evaluation critical of functional analysis and its centrality in the competence philosophy underpinning reform of the UK's national system of vocational qualifications. Definitions of competence are examined to locate functional analysis in its theoretical context. The use and application of the term competence to the vocational qualification (VQ) system are provide an historical context. Eventually, the conceptual model adopted to apply notions of competence and the process of functional analysis is evaluated as part of the critical appraisal (Stewart & Sambrook, 1995).

Using functional analysis techniques to develop educational support plans for students with high support needs by Watson et al. (1999) presented we explored to use functional analysis methodologies to identify the environmental determinants of challenged the behavior for two students with severe disabilities. A student was conducted in an outpatient clinic which was removed from the school setting. The functional analysis was conducted in the classroom setting. These clear hypotheses regarding the controlling contingencies for behavior challenging with two students. The plans of individual support were developed and implement success by personal classroom. The Discussion in terms of using a flexible approach to functional assessment in schools based on the student individual characteristics and the classroom context.

**Risk Assessment**

Risk analysis and assessment within environmental impact assessment is the framework of risk assessment and EIA these processes deal with the forecast of the impacts in the future of the project activities. The decision-making management is the goal of the process that significance, magnitude and character of impacts, the risk acceptant and proposals of mitigation measures. The European Union has encouraged its member's states to apply risk assessment in EIA, especially to extreme events but very little specific guidance is available on how to apply risk assessment in EIA that relate between EIA, risk assessment, technology assessment and social impact assessment. It takes into account the assessment and the decision and includes communication, implementation and monitoring of the selected option. The environmental risk assessment framework can be combined with the general EIA procedure. The EIA addresses processes are structured approach to dealing with mainly on ecological impacts. The aspects on ecological can be assessed beside social and economic requirements (Zeleňáková & Zvijáková, 2017).

The methods of risk analysis are the methodology for the analyze and evaluate of environmental impacts that designed for the environmental impact assessment process for develop assumptions, improvements, implementation and performance. The improving of the implementation process and use of risk analysis methods in environmental impact assessment process, the set objective has been achieved. The risk assessment is a process to determine the nature and scope of risk, and critical for develop policies and strategies. The processes of undertaking risk assessment are identified, estimation and ranking of risks includes potential losses of exposed population, property, services, livelihoods in environment, and assessment potential impacts on society. The client, regulator or elected/government representative will use the assessment for make decision the action course. The concept behind risk assessment is a structured, transparent, scientific process (Zeleňáková & Zvijáková, 2017).

The process of risk assessment is needed to define the information gaps and identified the information of end-users. It completed only the process of generating and using risk information is integrated with institutional processes, communication and trust all parties involved. The risk assessment role is undertaking the analysis, estimate the risk and anticipate the change under several courses of action and provide guidance in the way of precedents, benchmarks, comparisons and solutions. The

developing and communicating with stakeholders and interested parties and data collection of risk identification process. It focused on risk the perceived risk of hazards that have occurred within recent memory. Although, this misses the likelihood of determine events happened many years ago or never happened before, but have occur in the future that may be possible. Properly, the important to engage a systematic approach to determine risks that potential within the range of risk assessment. The important was the existing information that available to ensure and work similarity is not unnecessarily occurring. In order evaluation of existing risk assessment studies, available data and information, and current institutional framework capabilities can provide a large of data and will highlight gaps where further data collection or analysis is required. Data types that different are useful for different aspects of identified risk that can used to building assess and performance of infrastructure under a range of hazard types and intensities which crucial for determining physical vulnerability characteristics (Rovins & A., 2015).

Constraints are referred to as risk criteria, risk acceptance criteria and tolerability criteria of Rodrigues, Arezes, and Leão (2014) and Vanem (2012). The example in Norway, the regulations state about petroleum that the operator has a duty to formulate risk acceptance criteria relating to major accidents and to the environment. This practice is in line of internal control principle, which states that the operator has the full responsibility for identifying the hazards and seeing that they are controlled.

A paper of Aven (2012) is shown if criteria of risk acceptance are introduced as a risk management tool, they should be formulated by the authorities, is the common practice in several countries and industries, in the UK. Acceptance criteria of risk formulated by the industry would not in general serve the interest of the society as a whole. The main reason is that an operator's activity usually will cause negative externalities to society (an externality is an economically significant effect due to the activities of an agent/firm that does not influence the agent's/firm's production, but which influences other agents' decisions). The increased losses for society imply that wants to adopt stricter risk acceptance criteria than those an operator finds optimal in its private optimization problem.

The studied pipeline risk assessment and risk acceptance criteria in the State of Sao Paulo, Brazil. The discussion of this paper is the use of risk assessment (RA) for

analyzing the environmental suitability of natural gas pipelines and highlights RA's linkages with environmental impact assessment. That RA is essential tool when assessing of gas pipelines suitable, and identified risks with such proposed activities should be used as fundamental criteria to determine selection route. So, loss risks related how can reduced pipeline failures. These also contends the risk acceptance criteria are overly permissive when compared to other criteria used around the world. Accordingly, the State should consider how to revise and strengthen its risk acceptance criteria to be up-to-date with international standards (Kirchhoff & Doberstein, 2006).

The studied about improving Risk Assessment: Research Opportunities in Dose Response Modeling to Improve Risk Assessment that presented Substantial improvements in dose response modeling for risk assessment the result from recent and continuing advances in biological research, biochemical techniques, biostatistical/ mathematical methods and computational power. The report provides a ranked set of recommendations for research proposed to advance the state of the art in dose response adjusting. The meeting result of invited workgroup participants charged with the identification for five areas in dose response modeling that could be incorporated in an agenda of national to improve methodology of risk assessment. Topics for leading of emphasis are interindividual variability, injury risk model of assessment, and procedures to incorporate distributional methods and considerations mechanistic into now-standard methods of deriving a reference dose (RfD), reference concentration (RfC), minimum risk level (MRL) or similar dose-response parameter estimates (Zeise et al., 2002).

The study of Risk assessment principles in environmental impact studies that presented about the lack of attention given to health impacts in the environmental impact assessment (EIA) process is discussed and accompany through a study reviewed 39 Environmental Impact Statements (EISs) covered a project type that variety. Although health impacts should have been assessed minimally in all the EISs analyzed, one third of the EISs did not assess them, and another one-third of the EISs performed only partial health used assessments, mostly part, qualitative or cursory quantitative techniques. Only one-third of the analyzed EISs comprehensively assessed potential health impacts and used a scientifically-based risk assessment

technique. It was observed, however, that all these EISs fell into to a few categories of project types. (Arquiaga, Canter, & Nelson, 1992).

Seyed Ali Jozi, Mehrnoush Tabib Shoshtary & Ali Reza Khayat Zadeh studied Environmental Risk Assessment of Dams in Construction Phase Using a Multi-Criteria Decision-Making (MCDM). Method of this study was conducted to identify environmental and human health risks caused by Balarood Dam, in construction phrase. First step, all generate factors of risk were identified using a Delphi Questionnaire. And then identify risk criteria were prioritized once using the Analytical Hierarchy Process (AHP) method and by the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Overview the complex and uncertain nature of decision-making in times of risk, it was necessary to use more than one method for weighting to ensure accuracy of weights. The results from AHP and TOPSIS revealed a mismatch in priorities; an integration method was presented blending Mean-Rank. Accordingly, the results of TOPSIS, factors include cut and fill, explosion, and transportation, were first to third highest-priority risk-generating factors, respectively. The results from the AHP method, factors cut and fill, drilling, and explosion were identified as first to third top-priority risk-generating factors, respectively. The results obtained from the integration method suggested that cut and fill, explosion, and drilling are the most important environmental risks at construction phase. The conclusion found the different weighting methods can lead to different results by which the fate of a decision may be changed and it is essential to control final scores by applying more than one weighting method (Jozi, Shoshtary, & Zadeh, 2015).

Susan Neuman studied integrated environmental risk management in real estate transactions that is traditional risk management, five-step process for managing risks. The outstanding difference between the traditional process and the environmental risk management process lies in the technicality and complexity of step one (identification and analyze environmental risk) and step two (examining the feasibility of alternative risk management, specifically, risk control techniques). The two main differences between the environmental risk management process in the transaction context as practiced today, and a transaction is not involved, and environmental lawyers managing such transactions do consider risk control, but usually stick to indemnification as a risk transfer technique and ignore insurance. There are

policies available that cover the risks that need to be covered, and that can manuscript to fit in the transaction, but care should be taken they cover the risks. Insurance should be considered and applied at least two stages process: at the beginning, during the risk identification and analysis step, in the middle, negotiating the environmental provisions of purchase and sale agreement (Neuman, 1998).

The research of Environmental Risk Assessment of Dams by Using Multi-Criteria Decision-Making Methods: A Case Study of the Polrood Dam, Guilan Province, Iran that presented by Jozi Seyed Ali & Malmir Maryam, the research result finds a dam's construction always imposes some risks to the environment. So, the environmental risks of the Polrood dam, in a northern province of Iran, during its construction phase, were identified, ranked, and evaluated. Identifying the risk factor by Delphi questionnaire and rated by the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Afterward, and applied the Analytical Hierarchy Process (AHP) to classify the risk factors for four major categories, and Expert Choice, used software to weight them. The results Physicochemical; Biological; Economic, Social, and Cultural; and Health and Safety risks were rated with the weights 0.124, 0.080, 0.048, and 0.021, respectively. The physicochemical risks, Erosion and Sedimentation weighted 0.061 and 0.047, respectively, were identified as the most serious risks. The biological risks, the highest negative impact was assigned to Land Cover with the weight of 0.189. In the third category, the most important risk was Population Displacement, weighted 0.114. Workers' Falls with the weight of 0.109 was also determined as the highest risk in the last category. The identified risks and their mitigation will be develop to a plan of risk response (Ali & Maryam, 2014).

The studied reliability rating and reflective questioning: a case study of extended review on Australia's risk assessment of Bt cotton by Fern Wickson is presented the governance of emerging technologies is frequently constructed around risk assessment processes. Even so, when risk assessment as a decision-making tool is applied inherent uncertainties and conflicting social values arise to challenge the adequacy of traditional approaches. The study proposes a framework of risk assessments exposed to a process of 'extended review', incorporating both natural and criteria of social science quality and reflection modes. This framework called 'Reliability Rating and Reflective Question'. Through highlighting errors, misrepresentations, assumptions and embedded value

judgements within the document of risk assessment, the framework of 'Reliability Rating and Reflective Questioning' can serve a tool for gauging and improving the quality of risk assessment, mainly when used a decision-making tool for emerging technologies with high levels of uncertainty and strongly conflicting values (Wickson, 2009).

The study of flood risk assessment using multi-criteria analysis: a case study from Kopili River Basin, Assam, India was presented a multi-criteria analysis (MCA) approach to describe the effective utilization of geospatial techniques for disaster risk reduction at village level in Kopili River Basin (KRB) of Assam State, India. The MCA approach using flood hazard layer derived from the spatio-multi-temporal historic satellite data-sets, socio-economic data, infrastructure and land use vulnerabilities, flood risk zones are derived. The study elucidates 24,837 ha of crop area spread across 95 villages in the KRB falls in high-risk zone, about 39,209 ha distributed in 150 villages falls under moderate-high risk zones and remaining area spread 162 villages is more or less unaffected. The proposed approach can be applied away in other river basins to estimate the flood risk so as to mitigate the disaster risk posed by the floods (S V, Roy, V, & G, 2018).

Total Quality Management of the Product Risk Assessment Process is the article presented about the effort was organized and managed product risk assessment as a consistent and scientifically based process which the specific elements, the client's relationship, and the boundaries of procedure were analyzed and defined. Specific guidance and tools are provided a flowchart for the process, an uncertainty matrix, a precision caveat, contract form of a risk assessment, and a risk assessment questionnaire for customer feedback (Jayjock et al., 1997).

Risk assessment is study about uncertainty is present in all environmental problems, but it is not completely dealt with explicitly. Environmental impact assessments (EIA) most use a number to represent the range values that a measured parameter actually. The decision uses the average (mean) or expected value or, instead, a worst-case value. The implied choice may be traditional or optimistic and is usually internally consistent. When uncertainties are large and important to the outcome of the problem analysis. (Carpenter, 1995)

## 2.8 The summary of related concepts, theories, and researches

With regard to the study on the situation of environmental quality in Thailand, the connection with the 12th National Economic and Social Development Plan (2017 – 2021), the industrial groups with potential for development, the professional qualification system and the process of establishing occupational standards and professional qualification, as well as the principle, definition, and significance of the risk assessment, including the principle of the risk identification, risk analysis and assessment, risk treatment. Related researches ( countries and processes regarded as best practice) , aiming to enhance efficiency of the process of establishing occupational standards and professional qualification, resulting in better environmental quality in the end, the principle of the risk treatment is explored theoretically to improve the aforementioned process of establishing occupational standards. The study involves the principle of the risk treatment and the risk treatment guideline, as well as related researches and include the key word related with functional analysis, key purpose, key role, key function, Vocational Qualification, Professional Qualification. In summary, in order to enhance efficiency of the process of evaluating environmental impact, the study should be conducted to create the management approach from the initial process by evaluating possible risks that are likely to cause the establishment of occupational standards and professional qualification not to achieve the target, with consideration on risk probability and impact. The results of the study revealed that every process tends to be exposed to risks, resulting in the project delay, unfavorable budget spending, technical errors, and failure to implement the process as planned. This complies with the principle of the risk assessment. Finally, the establishment of occupational standards and professional qualification is unable to achieve the target. This is consistent with the objective of the researcher, aiming to explore the risk assessment and the entire process of establishing occupational standards and professional qualification by applying related factors together with concepts regarding the analysis and identification of risks to conduct the risk assessment of the process of establishing occupational standards and professional qualification, and collecting the qualitative data. Next is to analyze, evaluate, prioritize risks of the current process, explore findings of appropriate process or procedure, and propose the process of

creating the risk treatment measure for the process of establishing occupational standards and professional qualification.

# CHAPTER 3
# RESEARCH METHODOLOGY

The risk assessment and development of the processes of establishing occupational standards and professional qualification related to environmental work is implemented in the form of qualitative research according to the research objectives involving the risk assessment and development of the processes of establishing occupational standards and professional qualification related to environmental work and propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency and the research methodology as follows:

3.1 Research Methodology

3.2 Conceptual Model

3.3 Population/Sample-Data Source and Key Informant

3.4 Collecting Data process

3.5 Material

3.6 Data Analysis

## 3.1 Research Methodology

This research was qualitative study through the study of the sample with the selection of their 7 professional fields relevant to environment and the selection of the sample from those specifically involved in the establishment of occupational standard and professional qualification as Key informants such as the consultant team, the working group, and the endorsement board by using the instruments to collect data through semi-structured interview in order to collect primary data together with secondary data from relevant documents and research works, collect information from the interviews with the sample, conduct data analysis with the content analysis, and interpret according to the theory from the process to establish occupational standard

and professional qualification, and then conduct risk assessment in each process to establish the occupational standard and professional qualification, classify according to risk types, summarize the concept of risk assessment on the process to establish the occupational standard and professional qualification, and recommend the process to establish the occupational standard and professional qualification improved and developed from the old process for higher efficiency. This study conducted the analysis by selecting only the issues where risks were found with significant risk indication, risk analysis, and risk assessment. It means that there is the likelihood of risks every time a project is operated and the impact is such that it is impossible to continue the project or exceed the set plan. The analysis was conducted on each issue according to the process to establish the occupational standard and professional qualification as in Table 3.1-1

Table 3.1-1 Establishing occupational standards and professional qualification process

| **Process** | **Objective** | **Aim** |
|---|---|---|
| 1st Publicizing the project to the target group | | |
| 1) Conduct public relations of the project | Publicize to entrepreneurs, personnel in professional groups, relevant government agencies and private sector to know about the project to establish the occupational standard and professional qualification | Combined various media channels of not fewer than 5 work pieces |
| 1.1) Designate public relation media that matches the groups of stakeholders in the professions | Designate public relation media that matches the groups of stakeholders in the professions | Newspaper (with the size not smaller than 6 x 5 column inches), magazine, journal, internet, public relation board, television, radio, press conference, etc. |
| 1.2) Prepare and recommend the information of evidence in operation and coordination with entrepreneurs, personnel in | Invite entrepreneurs, personnel in professional groups, relevant government agencies and private sector, and general | No fewer than 50 entrepreneurs, personnel in professional groups, relevant government |

| Process | Objective | Aim |
|---|---|---|
| professional groups, relevant government agencies and private sector, and general public | public to participate in establishing the occupational standard and professional qualification | agencies and public sector, and general public |
| 2) Recommend the list of individuals and agencies deemed appropriate to the institute | For consideration in the selection and approval as the endorsement board, it consists of not fewer than 3 representatives from associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in the professional groups, no fewer than 2 experts in the professional groups, 1 from each relevant government agency with more than 1 agency, and 1 from the institute, in total no fewer than 9 persons | List of the endorsement board that constitute stakeholders with the qualifications as determined by the project to perform the following duty (1) Provide advice, recommendations, and opinions on the establishment of occupational standard to the consultant team (2) Certify the occupational standard and professional qualification and (3) Certify the assessment process, the assessment results, results of the analysis on the competency assessment test |
| 2nd Studying occupational standards of role model countries | | |
| 1) Study and analyze information relevant to the target professional groups for the consideration of establishing occupational standard and professional qualification | Study information from literature review to use as role model in establishing the competency of occupational standard | Results of study, analysis, synthesis, and comparison |
| 1.1) Study the occupational standard and professional qualification of professional groups which establish the occupational standards as role models in foreign countries in total no fewer than 3 | Study information from literature review to use as role model in establishing the competency of occupational standard | Information of occupational standard and professional qualification of professional groups which establish the occupational standards as role models in |

| Process | Objective | Aim |
|---|---|---|
| countries, of which at least 1 country must be an AEC member (if available) | | foreign countries in total no fewer than 3 countries. Must study in detail each country that is studied consisting of the details in designating the levels of qualification, and the details of occupational standard consisting of Unit of Competence, Element of Competence, Performance Criteria, Range Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance, or the details of other standards that are comparable |
| 1.2) Example of the process to request the certification of individual professional qualification for certification of professional qualification according to occupational standard from at least 1 country | Study the information from literature review as role model in determining the competency according to occupational standard | Example of the process to request the certification of individual professional qualification for certification of professional qualification according to occupational standard from at least 1 country |
| 1.3) Designate and certify the knowledge, ability, or competency of individuals relevant to the professional groups which establish Thai and foreign occupational standard currently used in Thailand | Study the current situations of certification in Thailand | Certification of knowledge, ability, or individual competency |
| 1.4) Information relevant to occupational standard established in Thailand | To study the information relevant to occupational standard established in | Information of industries, roles of public and private sectors, relevant laws, and |

| Process | Objective | Aim |
|---|---|---|
| | Thailand | other information such as policy, action plan, national economic and social development plans, ministerial plans, etc. |
| 1.5) Present the research already studied | Present the research already studied in the form of research works | Research already studied |
| 2) Present the results of analysis | Present the study results to the institute to consider the sufficiency of the information in order to establish occupational standard | Study results consisting of framework, methods, operational plan, roles and duties of various departments, as well as advice or recommendation guideline, and feedback from the endorsement board, the working group, entrepreneurs, personnel and experts in professional groups such as associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others, as well as relevant public and private sectors who participate in total no fewer than 50 persons (excluding the endorsement board, the working group, and the consultant team) |
| 3) Recommend the list of individuals and agencies deemed appropriate to the institute for selection and approval as the working group | To enable the institute to consider the qualifications covering the stakeholders in the professions | List of individuals and agencies deemed appropriate to the institute for selection and approval as the working group |

| Process | Objective | Aim |
|---|---|---|
| 3rd Conducting Functional Analysis to be proposed to the endorsement board for approval | | |
| 1) Establish occupational standard by conducting Functional Analysis to cover the work levels from basic to advanced, operated by: | Conduct Functional Analysis according to the principles | |
| 1.1) Organize workshop and give advice to the working group to prepare the Functional Map | | Functional Map consists of (1) Functional Map at initial stage such as Key Purpose, Key Role, Key Function (2) Functional Map at later stage such as Unit of Competence consisting of Element of Competence, Performance Criteria, Range Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance, identification of the professional code and professional name according to the relevant international standards (if applicable) |
| 1.2) Designate the levels of professional qualification of each occupation in line with Thailand Professional Qualification Framework (TPQF) according to the format of the occupational standard and professional qualification as determined by the institute | To designate the levels of professional qualification of each occupation in line with the TPQF | Qualification levels that are correct according to the TPQF |
| 2) Present the results of the establishment of occupational standard and professional qualification to the endorsement board for consensus approval | To receive recommendations from the endorsement board | Results of approval of occupational standard |
| 3) Organize public hearing to present the results of the establishment of | To receive comments from the stakeholders from all sectors | Comments from stakeholders from all sectors |

| Process | Objective | Aim |
|---|---|---|
| occupational standard and receive comments | | especially entrepreneurs, personnel and experts in professional groups in total no fewer than 50 persons and if necessary, details must be improved from the results of the public hearing to present to the endorsement board for approval once again |
| 4) Recommend the name of at least 3 experts deemed appropriate for selection and approval as quality assessors with the tools used to assess the competency according to occupational standard | To assess the quality of the tools that is correct according to the academic principles from appropriate experts | Appropriate experts and efficient assessment tools |
| 4th Developing assessment tools and evaluating their quality | | |
| 1) Conduct assessment, assessment tools, and test papers used to test knowledge consisting of | Test assessment, assessment tools, and test papers to test knowledge from the sample and make improvement for correctness and appropriateness | Assessment tools that pass the tryout with complete improvement |
| 1.1) Analyze the occupational standard to establish the assessment tools in each unit of competence by classifying into tools to measure knowledge, skills, and others | Select the assessment tools that are appropriate to competency assessment according to performance criteria | Assessment tools that are appropriate to competency assessment |
| 1.2) Designate the assessment methods and construct the assessment tools according to the assessment guideline in all levels of all professional qualifications according to occupational standard covering all performance criteria in unit of competence according to | Designate the assessment methods that are appropriate to competency assessment according to performance criteria | Assessment tools that are appropriate to competency assessment |

| Process | Objective | Aim |
|---|---|---|
| occupational al standard, as well as answers, in confidentiality | | |
| 2) Assess the quality of the assessment tools and the test papers by no fewer than 3 experts, in confidentiality | To assess the quality of the tools that are academically correct from experts which is appropriate | Efficient assessment tools |
| 5th Testing assessment tools with the target group, propose the endorsement board for approval | | |
| 1) Competency assessment test as determined by the professional qualification of the target professional groups with the constructed assessment tools as follows: | Competency assessment test as determined by the professional qualification of the target professional groups with the constructed assessment tools | Efficient assessment tools |
| 1.1) Determine the target group in the testing of the assessment tools no fewer than 3 professional qualifications and no fewer than 10 persons per each professional qualification without those sitting for the assessment to sit for the assessment in the professional qualification undergoing the assessment test except the professional groups who have the levels of professional qualification according to the occupational standard with fewer than 3 professional qualifications | Determine the target group in the testing of the assessment tools | Efficient assessment tools |
| 1.2) Designate the examiners according to the qualifications of the examiners and certified by the institute | To acquire the examiners with the qualifications of the examiners who supervise the assessment process according to the set standard | Assessment process according to the set standard |
| 1.3) Competency assessment test as designated in the professional qualification | Competency assessment test as designated in the professional qualification | Results of assessment test |

| Process | Objective | Aim |
|---|---|---|
| 1.4) Summarize assessment process, assessment results, and analysis of the results of the competency assessment test | To know the assessment process, assessment results, and analysis of the results of the competency assessment test | Assessment process, assessment results, and analysis of the results of the competency assessment test |
| 2) Present the summary of the assessment process, assessment results, and the results of the analysis of competency assessment test to the endorsement board for consensus approval | Know the summary of the assessment process, assessment results, and the results of the analysis of competency assessment test and opinions from the endorsement board | Applicable assessment process |
| 3) Recommend the name of the agency deemed capable to be a certifying body of individual competency according to the occupational standard to the institute with approval from the endorsement board for consideration with no fewer than 1 agency | To know the agency that will serve as the certifying body to conduct competency assessment | Agency that will serve as the certifying body to conduct competency assessment |
| 4) Summarize the results of the establishment of occupational standard and professional qualification | Know the overall results of the establishment of occupational standard and professional qualification in the entire process | Results of the establishment of occupational standard and professional qualification in the entire process |
| 5) Publicize to entrepreneurs, personnel in professional groups, relevant government agencies and the private sector to acknowledge the results of the establishment of occupational standard and professional qualification through various media channels no fewer than 5 work pieces such as newspaper (with the size not smaller than 6 x 5 column inches), magazine, journal, internet, public relation board, television, radio, press conference, etc. | To enable the stakeholders in the professions to know the establishment of occupational standard which is finished and ready for the assessment and certification of individuals | Entrepreneurs, personnel in the professional groups, relevant government agencies and private sector know the results of the establishment of occupational standard and professional qualification |
| 6) Produce the final report according to | Produce the final report | The final report according |

| Process | Objective | Aim |
|---|---|---|
| the process, scope, and operational guideline of the institute | according to the process, scope, and operational guideline of the institute | to the process, scope, and operational guideline of the institute |
| 7) Produce the manual of the use of occupational standard and professional qualification | To acquire the manual of the use of occupational standard and professional qualification | Manual of the use of occupational standard and professional qualification |
| 8) Establish occupational standard and professional qualification according to the format determined by the institute | To acquire occupational standard and professional qualification according to the format determined by the institute | Occupational standard and professional qualification according to the format determined by the institute |
| 9) Construct the assessment tools classified by occupations and professional qualification | To acquire assessment tools classified by occupations and professional qualification | Assessment tools classified by occupations and professional qualification |
| 10) Produce the manual for examiners classified by occupations and professional qualification | To acquire the manual for examiners classified by occupations and professional qualification | Manual for examiners classified by occupations and professional qualification |
| 11) Produce the manual for those who undergo assessment | To acquire the manual for those who undergo assessment | Manual for those who undergo assessment |
| 12) Produce the hard copy of written test papers to test knowledge and other test papers classified by occupations and professional qualification | To acquire the test papers to test knowledge and other test papers classified by occupations and professional qualification | Written test papers to test knowledge and other test papers classified by occupations and professional qualification |
| 13) Enter the information of occupational standard and professional qualification into the database providing services on professional qualification of the institute | Enter the information of occupational standard and professional qualification into the database providing services on professional qualification of the institute | Database |
| 14) Enter the written test papers to test knowledge and other test papers according to occupations and professional qualification classified by unit of competence and performance | Enter the written test papers to test knowledge and other test papers according to occupations and professional qualification classified by unit | Database |

| Process | Objective | Aim |
|---|---|---|
| criteria | of competence and performance criteria | |

## 3.2 Conceptual Model

ISO 31000 and risk analysis text books (ISO, 2009a) (ISO, 2009b) (SW, 2009) (Terje Aven, 2016) define risk analysis (1) Establish context, which means for example to define the purpose of the risk management activities, and specify goals and criteria (2) Identify situations and events (hazards/threats/opportunities) that can affect the activity considered and objectives defined. The methods have been developed for this task (3) Conduct cause and consequences analysis of these events, and impact to activities, objective and goal (4) Make judgements of the likelihood and impact of the events and their consequences, and establish risk characterization (5) Analyze and evaluate risk, to judge the risk significance and (6) Risk treatment. (Figure 3.2-1)

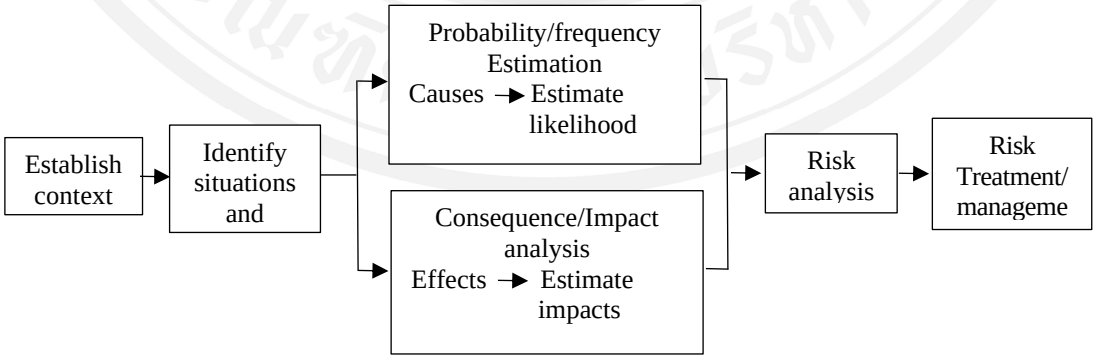



Figure 3.2-1 Risk process

Source: Adapted from R. V. Kolluru (1994); ISO (2009a); ISO (2009b); SW (2009) Terje Aven (2016)

This research is the qualitative research (Wannee Kaemkate, 2008); (Ongart Naiphat, 2008) to conduct risk assessment, and to propose measures of risk management for the processes of establishing occupational standards and professional qualification (Hulett David T, 2001); (John P. Kindinger and John L. Darby, 2000) ranging from the process of formulating operating plans to submitting the complete version of occupational standards and professional qualification. The processes consist of 1) Publicizing the project to the target group, 2) Studying occupational standards of role model countries, 3) Conducting Functional Analysis to be proposed to the endorsement board for approval, 4) Making assessment tools based on occupational standards, and assess quality of tools, and 5) Testing assessment tools with the target group and proposing to the endorsement board for approval (Thailand Professional Qualification Institute (Public Organization), 2022). The prototype of the processes of establishing occupational standards and professional qualification related to environmental works acquired after the improvement of existing process for more efficiency would be proposed.

## 3.3 Population/Sample-Data Source and Key Informant

1) The samples in the study are selected by a stratified random sampling with the following steps (Supang Chantavanich, 2009) (Krejcie, 1970):

( 1) The total of 72 professional groups according to the announcement of occupational standards and professional qualification in the Royal Thai Government Gazette were investigated (Thailand Professional Qualification Institute Executive Committee, 2015).

(2) The total of 72 professional groups selected form the group during the 2015-2017 fiscal years into 54 groups were then classified into ten industrial groups including two groups directly related to environmental works for establishing occupational standards and professional qualification.

(3) The two groups directly related to environmental works comprises 7 professional sub-groups. The 49 key informants from 7 professional sub-groups are selected by a purposive sampling based on the structure of establishing occupational

standards. These key informants were from advisory committee, working group, and endorsement board as described below.

(3.1) advisory committees from 7 professional sub-groups were selected to serve as advisors to the occupational standards establishing project with 3 representatives from each sub-group (a project leader, researcher and a coordinator) totaling 21 samples.

(3.2) working groups representing government or private sector selected by 7 professional sub-groups with 3 representatives for each sub-group totaling 21 samples.

(3.3) one representative of the endorsement board for each professional sub-group comprises representatives of associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in professional groups, including experts and representatives of related government organizations, totaling 7 samples.

Table 3.3-1 Occupational standards and professional qualification classified by 10 industrial groups

| **Industrial group** | **Professional group** |
|---|---|
| 1. Logistics and supply chain | 1) Logistics<br>2) High-speed train & railway system<br>3) Public transport<br>4) Aerospace<br>5) Automotive service |
| 2. Agricultural, food & beverag | 1) Agricultural<br>2) Food & beverage production<br>3) Food business<br>4) Navigation<br>5) Pet care business |
| 3. Real estate & public service | 1) Construction<br>2) Urban planning<br>3) Real estate business<br>4) Property management |

| Industrial group | Professional group |
|---|---|
| | 5) Public utility & public service business |
| | 6) Security guard |
| 4. Service & financial | 1) Retail business |
| | 2) Financial service |
| | 3) Insurance business |
| | 4) Human resource management |
| | 5) Cleaning service business |
| | 6) Research service & consumer survey |
| | 7) Educational service |
| 5. Health, sports & tourism | 1) Tourism, hospitality, & restaurant |
| | 2) Photography business |
| | 3) Salon business |
| | 4) Sports |
| | 5) Healthcare service |
| | 6) Biomedical engineering |
| | 7) Floristry business |
| | 8) Local artifact & handicraft conservation |
| 6. Communication & mass communication | 1) Communication & mass communication |
| | 2) Foreign language & translation |
| | 3) Book & publication business |
| | 4) Advertising & public relations business |
| 7. Digital industry | Information & communication technology and digital content |
| 8. Creative & entertainment industry | 1) Printing industry |
| | 2) Fashion design |
| | 3) Product design |
| | 4) Music business |
| | 5) Performing arts & entertainment |
| 9. Manufacturing industry | 1) Machinery & metallurgical manufacturing industry |
| | 2) Ceramic & porcelain industry |

| Industrial group | Professional group |
|---|---|
| | 3) Textile & clothing |
| | 4) Rubber product |
| | 5) Metal manufacturing & processing industry |
| | 6) Mold manufacturing industry |
| | 7) Plastic industry |
| | 8) Furniture manufacturing industry |
| | 9) Automobile manufacturing |
| | 10) Auto parts manufacturing |
| | 11) Automating system and robotics |
| | 12) Testing & inspection business |
| | 13) Welding industry |
| | 14) Metrology |
| | 15) Occupational safety |
| | 16) Electrical |
| | 17) Jewelry & ornament making |
| 10. Energy & environment | 1) Petroleum & petrochemical industry |
| | 2) Energy & alternative energy |
| | 3) Green space management business |
| | 4) Biotechnology |
| | 5) Environment & Hazardous substances |
| | 6) Petrol station business |

Source: Thailand Professional Qualification Institute Committee no. 262-271/2561, titled the Appointment of the Occupational Standards and Professional Qualification Sub-Committee Logistics and supply chain, Energy and Environment, Agricultural, food & beverage, Real estate & public service, Service & financial, Health, sports & tourism, Communication & mass communication, Digital industry, Creative & entertainment industry and Manufacturing industry

Table 3.3-2 Selection of occupational standards and professional qualification of industrial groups with related to environmental work.

| Industrial group | Professional group |
|---|---|
| 1. Agricultural | 1) Smart farmer |
| | 2) Economic crops (Palm oil) |
| 2. Energy & environment | 3) Petroleum & petrochemical industry |
| | 4) Energy & alternative energy (Energy Management) |
| | 5) Biotechnology (Environment) |
| | 6) Environment & Hazardous substances |
| | 7) Green space management business |

Table 3.3-3 Selection of the samples from the target professional groups based on types of the samples and code.

| Professional group | Sample and Code | | | | |
|---|---|---|---|---|---|
| | Consultant | | | Working group | Endorsement board |
| | Project leader | Researcher | coordinator | | |
| 1. Agricultural | | | | | |
| 1) Smart farmer | 101 | 102 | 103 | 104,105,106 | 107 |
| 2) Economic crops (Palm oil) | 201 | 202 | 203 | 204,205,206 | 207 |
| 2. Energy & environment | | | | | |
| 3) Petroleum & petrochemical industry | 301 | 302 | 303 | 304,305,306 | 307 |
| 4) Energy & alternative energy (Energy Management) | 401 | 402 | 403 | 404,405,406 | 407 |
| 5) Biotechnology (Environment) | 501 | 502 | 503 | 504,505,506 | 507 |

| Professional group | Sample and Code | | | | |
|---|---|---|---|---|---|
| | Consultant | | | Working group | Endorsement board |
| | Projec leader | Researche | coordinato | | |
| 6) Environment & Hazardous substances | 601 | 602 | 603 | 604,605,606 | 607 |
| 7) Green space management business | 701 | 702 | 703 | 704,705,706 | 707 |

## 3.4 Collecting Data process

The collecting data process and preparation process for this study are as follows:

3.4.1 Secondary Data Collection –Data were collected from documents of public agencies, reports regarding environmental quality in Thailand, e.g. the 12th National Economic and Social Development Plan (2017 – 2021), potential industrial groups, (Thailand Professional Qualification Institute Committee no. 262-271/2018, titled the Appointment of the Occupational Standards and Professional Qualification Sub-Committee), professional qualification system (National Qualifications Framework Committee, 2017), and processes of establishing occupational standards and professional qualification, Competency Development Technique (Thailand Professional Qualification Institute (Public Organization), 2022) principle, definition, significance of risk assessment, principle of risk management, risk management guidance (Hulett David T, 2001); (John P. Kindinger and John L. Darby, 2000); (Sanguan ChangChat, 2004), other related studies ( best practice countries and processes, summary of concept, theory).

3. 4. 2 Primary Data Collection –data were collected from semi-structured interviews by 49 key informants based on the structure of establishing occupational standards.

3.4.3 Data for the risk assessment of the establishing occupational standards and professional qualification process related to environmental work - from 3.4.2, an in-depth interview based on the case study theory, records the data of viewpoints and

opinions throughout the interview, focusing on “risks in the processes of establishing occupational standards and professional qualification related to environmental works” were employed.

3.4.4 Next processes are to ensure completeness of data, and to collect additional data in case of insufficient data, or to determine a new source of data in order to acquire an instrument for deciding to summarize prospective ideas.

## 3.5 Material

The data collection in this study is made by the researcher using the semi-structured in-depth interview, focusing on the qualitative interview aiming to find mutual explanation between the researcher and the samples regarding viewpoints toward risk assessment and development of processes of establishing occupational standards and professional qualification related to environmental work as much as possible. The questions are determined based on related issues, and keywords are used to guide the interview. Before the interview, the researcher would prepare the questions by drafting open-ended questions containing keywords which are flexible and ready to be revised in accordance with the situation and each informant. The interview issues and data of interviewees are as shown in Table 3.5-1

Table 3.5-1 Tools used to collect the data based on research objectives

| Objective | Samples/Informants | Data collection instruments |
|---|---|---|
| 1. To conduct risk assessment and develop the processes of establishing occupational standards and professional qualification related to environmental affairs | Project consultant (project leader and coordinator), working group, and endorsement board | Semi-structured in-depth interview |
| 2. To propose risk management guidance for | Project consultant (project leader and | Semi-structured in-depth interview |

| Objective | Samples/Informants | Data collection instruments |
|---|---|---|
| the processes of establishing occupational standards and professional qualification related to environmental affairs | coordinator), working group, and endorsement board | |
| 3. To propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency | Project consultant (project leader and coordinator), working group, and endorsement board | Semi-structured in-depth interview |

With regard to the qualitative data collection, the questions for interviewing project consultants (project leaders' researcher and coordinators), working group, and endorsement board include the following:

Part 1: General information of interviewees responding to the semi-structured in-depth interview, duration of establishing occupational standards and professional qualification, characteristics of implemented projects and value of occupational standards and professional qualification establishing projects.

Part 2: Risk assessment for the processes of establishing occupational standards and professional qualification related to environmental works namely 1) Publicizing the project to the target group 2) Studying occupational standards of role model countries 3) Conducting Functional Analysis to be proposed to the endorsement board for approval 4) Making assessment tools based on occupational standards, and assess quality of tools and 5) Testing assessment tools with the target group, propose the endorsement board for approval. The interview question follows by the objective of the research as follow:

**The question for risk identification**

1st Process Publicizing the project to the target group

Question: “What are the events that hinder the public relations of the project from reaching the target group in accordance with the objectives and goals?”

2nd Process Studying occupational standards of role model countries

Question: “What are the situations that hinder the study and data analysis related to the target professional groups from establishing the occupational standard and professional qualification in accordance with the objectives and goals?”

3rd Process Conducting Functional Analysis to be proposed to the endorsement board for approval

Question: “What are the situations that hinder the establishment of occupational standard, using the technique of Functional Analysis and covering work levels, from basic to advanced, in order to recommend to the endorsement board for approval in line with the objectives and goals?”

4th Process Making assessment tools based on occupational standards, and assess quality of tools

Question: “What are the events that hinder the construction of assessment tools to assess personal competency according to occupational standard and assess the quality of tools according to the objectives and goals?”

5th Process Testing assessment tools with the target group, propose the endorsement board for approval

Question: “What are the situations that hinder testing of assessment tools in order to recommend them to the endorsement board, undertake public relations at the end of the project, and summarize the operation according to the objectives and goals?”

**The question for risk analysis and evaluation**

1st Process Publicizing the project to the target group

Question: “In considering the potential factors and the causes of potential risk and in considering the impact on the objectives of the operation in this process with the number of mistakes (if the mistakes are frequent, the score = 5 and if the mistakes are not frequent, the score = 1) do you think that the occurred damage cannot fulfill the objectives within the set timeframe or cannot undertake any activity while identifying the seriousness (at high level with the score = 5 and the seriousness at low level with the score = 1) and how often do you think the occurred risk in the process

of public relations aimed at the target professional group is likely to happen? If so, will the risk impact the operation to achieve the objectives and impact the next operational processes or not? How?"

2nd Process Studying occupational standards of role model countries

Question: "In considering the likelihood of risk factors, causes of potential risks, and in considering the impact on the objectives of the operation in this process and the number of mistakes (if they are frequent, the score = 5, if not the score = 1) in your opinion does the damage make it impossible to reach the objective within timeframe or undertake the activity (high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion how often is the likelihood of risk during the process of study and data analysis relevant to the target professional groups to establish occupational standard and professional qualification which result in incorrect or insufficient information. If there is such a risk, does it impact the operation to reach the objective and the process of further occupational standard development? How?"

3rd Process Conducting Functional Analysis to be proposed to the endorsement board for approval

Question: "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity (high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion, does the risk found in the process of conducting the Functional Analysis and recommending to the endorsement board for approval have the likelihood of risk which prevents the Functional Analysis from reaching the target and the endorsement board from giving approval. If so, will it impact the operation to reach the objectives and impact the process of further occupational standard development? How?"

4th Process Making assessment tools based on occupational standards and assess quality of tools

Question: "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with

the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity, (giving the high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion how often is the likelihood of risk found in the process of constructing the tools to assess individual competency according to occupational standard and assessing the quality of the tools which prevents the construction of the tools to assess the individual competency according to occupational standard and the assessment of the quality of the tools. If so, will it impact the operation to reach the objectives and impact the process of testing the tools and approval sought by the endorsement board or not? How?"

5th Process Testing assessment tools with the target group, propose the endorsement board for approval

Question: "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity (giving the high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion, how often is the likelihood of risk found in the process of testing the assessment tools to submit to the endorsement board for public relations at the end of the project and performance summary which prevents the testing of the assessment tools to submit to the endorsement board for public relations at the end of the project and performance summary. If so, will it impact the operation to reach the objectives and impact the process of delivering the occupational standard and determining the profession to certify the occupational standard and professional qualification or not? How?"

Part 3: Proposal of risk management guidance for the processes of establishing occupational standards and professional qualification related to environmental affairs. The question is "What is the guideline for management of remaining and newly found risks for each process?"

Part 4: Proposal of the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more

efficiency. The question is "Please give the recommendations on development in occupational standard and professional qualification process for environmental work (Take, Treat, Transfer, Terminate) for each process"

## 3.6 Data Analysis

The content analysis is applied to the data acquired from the semi-structured interview for 3 groups of samples, namely, project consultants ( project leaders' researcher and coordinators), working group, and endorsement board inputs from key informants were classified for further comparison, analysis, and interpretation, coupled with using the documentary data. There are three process to analyze the data as follow.

3.6.1 Establish the context

The data analysis involves data interpretation to find out the meaning from collected data, to gain understanding about the data contents, and to use the cause explanation and linkage of the samples' set of data by linking rationality both directly and indirectly. (Wannee Kaemkate, 2008); (Ongart Naiphat, 2008) The further step is to summarize viewpoints toward risks in each process of establishing occupational standards and professional qualification. (Hulett David T, 2001); (John P. Kindinger and John L. Darby, 2000); (Sanguan ChangChat, 2004). During the interview data acquired from the transcription and note-taking were analyze to gain understanding about the overall content (Supang Chantavanich, 2010). In reference to the above-mentioned processes in conceptual framework, our processes are modified situationally as follow.

1) Identify the processes of establishing occupational standards and professional qualification.

2) Review relation of process objective and objective of establishing occupational standards and professional qualification for each process.

3) Identify the aim of each objective of establishing occupational standards and professional qualification.

4) Define risk issues and risk situation.

5) Define cause and factor of risk issues and risk situation.

3.6.2 Risk analysis and evaluate

Use risk Assessment Criteria for prioritizing the significance risks. (Hulett David T, 2001); (John P. Kindinger and John L. Darby, 2000); (Sanguan ChangChat, 2004). This step consists of two processes as follow.

1) Assessing possibilities of risks from the scale of impact and likelihood in order to calculate total risk scores and determine levels of risk ( 1-5 scale) (Aven T, 2017); (SRA, 2015b); (Vanem, 2012).

(1) Very low risk: No potential, being adequately controlled; no further control measures are required.

(2) Low risk: No potential for serious consequences. Risk assessment is not essential.

(3) Moderate risk: Potential for moderate consequences. Risk assessment is recommended.

(4) High risk: The potential for extreme consequences but risk low probability. Risk assessment is recommended.

(5) Very high risk: Potential for extreme consequences, with high probability. Risk assessment is necessary.

2) Comparing the potential impact on the objective of establishing occupational standards and professional qualification include time and aim.

3) Main idea about the viewpoints toward risks of the processes of establishing occupational standards and professional qualification related to environmental works were captured. If the data was not enough for analyzed as well as determining issues, selecting additional informants.

4) Each significant issue classified and acquire from informant were review in order to further draw conclusions based on the research objectives.

3.6.3 Risk treatment and management

Risk treatment and management can be mixing main actions; transfer, tolerate, treat, terminate or take the opportunity. Transfer; for some risks, the best response may be to transfer them need to be set and should inform your decisions. Treat; by far the greater number of risks will belong to this category. The conclusions from the analysis and evaluate risk, were drawn based on the research objectives aiming to explore risks of the processes of establishing occupational standards and professional

qualification related to environmental works. So, this research adapted the concept of risk management or risk response for set up the risk management related processes of establishing occupational standards and professional qualification that shown in figure 3.6-1 and 3.6-2 (Project Management Process Improvement Office, 2003).

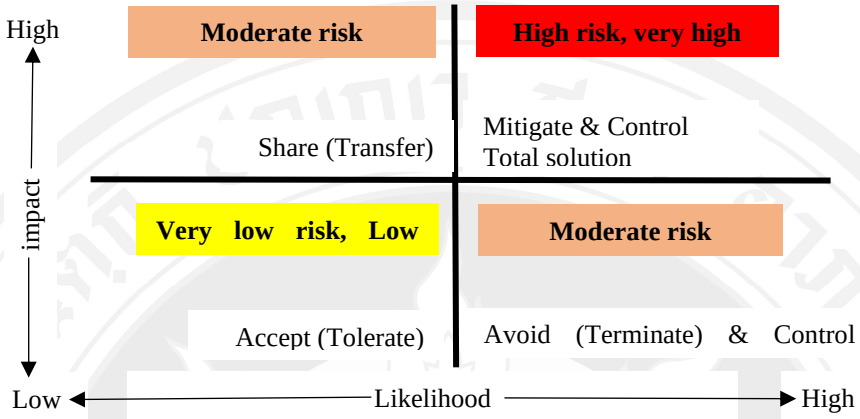



Figure 3.6-1 Risk Treatment and management concept

Source: Adapted from Project Management Process Improvement Office (2003) ISO (2009a)

Risk treatment and management concept namely, risk control, risk control oxers opportunities to implement solutions that support risk avoidance, prevention and reduction. The risk avoidance technique would be not to own process. In reality, a minimal amount of risk still exists, but in certain scenarios, risk can be avoided completely. Risk prevention aims to reduce the frequency or likelihood of the event or loss. This might mean preventing process breakdowns by maintenance and inspection schedules. Risk reduction aims to lower the severity of a particular loss that has already occurred. So, all of treatment and management depend on risk level.

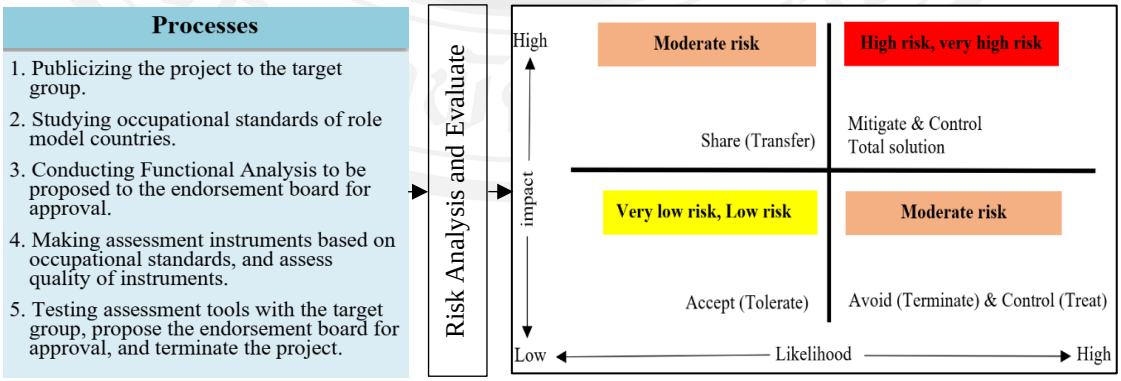


Figure 3.6-2 Risk management for processes of establishing occupational standards and professional qualification

Source: Adapted from Project Management Process Improvement Office (2003) ISO (2009a)

3.6.4 Process to purpose the new process

The main objective of this research adapted the principle of risk management in order to purpose the new process of establishing occupational standards and professional qualification that shown in figure 3.6 - 3 The process to purpose the new process were summarized and analyze the data starting from establish the context, identify risk, identify situations and risk events, estimate likelihood and impacts, risk analysis and evaluate and purpose risk treatment or management for each process in order to purpose the new process after that for acquire prototype and proceed to the processes of other professional groups shown in figure 3.6-3


Figure 3.6-3 Process to purpose the new process

# CHAPTER 4
# RESULTS AND DISCUSSION

Results of Risk assessment and development in occupational standard and professional qualification process for environmental works were presented as follows:

4.1 The data of occupational standards and professional qualification project

4.2 General information of interviewees

4.3 Research result

4.3.1 Risk Identification

4.3.2 Risk analysis and Evaluation

4.3.3 Risk Treatment and management

4.4 Proposed guidance for establishing occupational standards and professional qualification more efficiently

4.5 Discussion

## 4.1 The data of occupational standards and professional qualification project

The data of occupational standard and professional qualification projects consisted of the duration of preparation of occupational standard and professional qualification, characteristics of the operated projects, and the value of the establishment of occupational standard and professional qualification projects. In the study, 7 projects on environment were selected, divided into 2 major groups namely agriculture, and energy and environment in total 7 projects, 6 projects of which had the duration of 365 days and 1 project of which had the duration of 540 days.

The characteristics of the projects were to hire consultants for the 7 projects, divided into hiring by selection method 2 projects, hiring by specific method 1 project, and hiring by general invitation method 4 projects.

The budget of the 7 occupational standard and professional qualification projects totaled 21,603,396 baht, on the average each project had the budget of 3,600,566 baht.

Table 4.1-1 General information of the occupational standard and professional qualification projects

| Occupational standard projects | Project duration | Project type | Budget (baht)) |
|---|---|---|---|
| **Agriculture** | | | |
| 1) Agricultural profession (Smart farmer) | 31 Jul. 2018-31 Jul. 2019 = 365 days | Hire consultant by selection method | 4,140,000 |
| 2) Agricultural profession (Cultivation of economic crop (oil palm)) | 28 Feb. 2018-28 Feb. 2019 = 365 days | Hire consultant by specific method | 1,871,913 |
| **Energy and environment** | | | |
| 3) Petroleum and petrochemical industry profession (Petroleum and petrochemical field) | 28 Mar. 2013-28 Mar. 2014 = 365 days | Hire consultant by general invitation method | 3,955,148 |
| 4) Energy and alternative energy profession (Energy management) | 7 Aug. 2015- 6 Aug. 2016 = 365 days | Hire consultant by general invitation method | 3,350,000 |
| 5) Bio technology profession (Environmental biotechnology | 14 Sep. 2017-14 Sep. 2018 = 365 days | Hire consultant | 2,736,635 |

| Occupational standard projects | Project duration | Project type | Budget (baht)) |
|---|---|---|---|
| technician) | | by selection method | |
| 6) Environment and Hazardous Substance profession (Municipal waste management) | 28 Apr. 2017 -28 Apr. 2018 = 365 days | Hire consultant by general invitation method | 5,549,700 |
| 7) Green space management business profession (Green space management business) | 1 Mar. 2017- 23 Aug. 2018 = 540 days | Hire consultant by general invitation method | 5,996 650 |

## 4.2 General information of interviewees

The interviewees consisted of the Occupational Standard and Professional Qualification Working Group, the Occupational Standard Endorsement Board, and the consultants of the occupational standard and professional qualification projects in total 49 persons.

4.2.1 The consultants operating the occupational standard and professional qualification projects (Consultant) means juristic person registered in Thailand or government agency or academic institute registered at Thai Consultant Database, Ministry of Finance with work and experience in professional fields. The consultants were composed of project managers, researchers, and project secretaries, or project coordinators in total 21 persons.

4.2.2 The occupational standard and professional qualification Working Group (Working Group) means the occupational standard and professional qualification working group which must consist of operators or specialists or experts in the professional groups in the 7 projects in total 21 persons.

4.2.3 The Professional Qualification Endorsement Board (Endorsement Board) means the occupational standard and professional qualification endorsement board such as representatives of associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in professional groups, experts in the professional groups, representatives of relevant government agencies, and 1 representative of the institute. The occupational standard endorsement board is responsible for approving the occupational standard and professional qualification before submission to TPQI Committee for approval for the 7 projects in total 7 persons.

## 4.3 Research results

The study results of the risk indication, risk analysis, risk assessment, and risk management classified by the occupational standard and professional qualification process of the professions relevant to environment. The sample who was key informants were classified according to the role and duty in the occupational standard and professional qualification projects of each group in each process, the details as in Table 4.3-1

Table 4.3-1 The sample classified by occupational standard and professional qualification process

| Process of establishing occupational standards | Samples |
|---|---|
| 1st Publicizing the occupational standards establishing project to be acknowledged by operators, personnel in professional groups, related public and private agencies and propose names of individuals and agencies deemed to be the working group | Consultant |
| 2nd Studying and analyze the data related to the target professional group for consideration of the establishment of occupational standards. | - Consultant<br>- Working group |
| 3rd Conducting the occupational standards by using functional analysis | - Consultant<br>- Working group |

| Process of establishing occupational standards | Samples |
|---|---|
| | - Endorsement board |
| 4th Preparing the assessment, assessment tools, and test papers as follows: To analyze occupational standards for making assessment tools in each unit of competence | - Consultant<br>- Working group |
| 5th Testing assessment tools competencies as stipulated in professional qualification of target professional groups using the assessment instruments, totaling not less than 3 professional qualifications and not less than 10 persons in each professional qualification | - Consultant<br>- Endorsement board |

Based on the process to establish the occupational standard and professional qualification relevant to environmental work, the study results according to objective 1) "To conduct risk assessment and develop the processes of establishing occupational standard and professional qualification related to environmental affairs" and Objective 2) "To propose risk management guideline for the processes of establishing occupational standards and professional qualification related to environmental work", the study results according to the analytical issues could be divided into 3 issues namely 1) Risk Identification 2) Risk Analysis and Evaluation and 3) Risk Treatment/Management. (Hulett David T, 2001); (John P. Kindinger and John L. Darby, 2000); (Sanguan ChangChat, 2004); (ISO, 2009a).

**4.3.1 Risk Identification**

Event Identification compiles the situations that may occur in an agency including internal and external risk factors such as management policy, personnel, operation, finance, IT system, regulations, laws, account system, taxes in order to understand the events and situations and prescribe the guideline and policy of potential risk management that consistent with (Zeleňáková & Zvijáková, 2017) Risk analysis and assessment within environmental impact assessment is the framework of risk assessment and EIA these processes deal with the forecast of the impacts in the future of the project activities. The decision-making management is the goal of the process that significance, magnitude and character of impacts, the risk acceptant and proposals of mitigation measures. The improving of the implementation process and

use of risk analysis methods in environmental impact assessment process, the set objective has been achieved. The risk assessment is a process to determine the nature and scope of risk, and critical for develop policies and strategies. The processes of undertaking risk assessment are identification, estimation and ranking of risks includes potential losses of exposed population, property, services, livelihoods in environment, and assessment of their potential impacts on society. The concept behind risk assessment is a structured, transparent, scientific process.

**1st Process** Publicizing the project to the target group

The researcher posed the following question to the key informants, "What are the events that hinder the public relations of the project from reaching the target group in accordance with the objectives and goals?"

The sample included the consultants who provided the information indicating risks that could be summarized as follows, "The risks found in the process are the risks in 3 issues namely 1 ) Public relations do not reach people in all professional groups 2 ) There is no determined frequency or time appropriate for public relations and 3) Related people do not see the overall picture of the projects."

*The interviewees 101 stated, " Frequency is not determined. The time for public relation is too little. Only 2 times. More time should be added by considering the appropriate number of time and the number of people."*

*The interviewees 102 stated, " The working group and the researchers participating in the project and related people on the whole do not know the roles in the project and do not have the overview of work, process, objective in each process in the entire project. As a result, work in each process is done as told each time by the consultants only."*

*The interviewees 201 stated, "There is too little public relations. It does not have access to the people in the professional groups and does not cover all groups. Documents should be sent to each agency to introduce the occupational standard."*

**2nd Process** Studying occupational standards of role model countries

The researcher posed the question to the key informants as follows, "What are the situations that hinder the study and data analysis related to the target

professional groups from establishing the occupational standard and professional qualification in accordance with the objectives and goals?"

The sample included the consultants and the working group who provided the information indicating risks which could be summarized as follows, " The risks found in this process are the risks in 6 issues namely 1) Too little time for analysis 2) For some countries, there is a lot of information while for others there is not sufficient 3) Lack of knowledge on Functional Analysis 4) Some countries have different contexts of establishing occupational standard 5) The analysis of the competencies from the studies in and outside the country is not complete and does not reflect the differences in professional groups and competencies and 6) Selection of the working group is still specific and does not cover all existing professions."

*The interviewees 101 stated, " Countries are selected by field so one must study foreign countries more than what is determined by the Term of reference. Some countries do not have sufficient information while some have too much information. The details of the TOR should be explained at the delivery installation session. All team members should know. As this is the first project so I do not have experience. Some countries do not have sufficient information so some parts are lacking that can be used to develop occupational standard. Some countries have different contexts in establishing the occupational standard."*

*The interviewees 102 stated, " For the overview of occupational standard, if the private sector uses it, some standard needs to be slightly improved due to different sizes of assessment tools. In general, the private sector will determine the Job description of the employees. Overall, the standard has good details, methods, and concept. The examples of the process of assessment tool test with the minimum requirement are also good."*

*The interviewees 104 stated, " There is little information to select countries. It is necessary to select more countries and more process examples and the information should be in-depth information in order to be analyzed. A lot of information takes a lot of time to extract and analyze for the exact issues. The competencies from the study of foreign countries are different in each area and in some countries the information used for analysis is collected in small quantity so it is*

*not complete and does not reflect the differences of professional groups and competencies."*

**3rd Process** Conducting Functional Analysis to be proposed to the endorsement board for approval

The researcher posed the question to the key informants as follows, "What are the situations that hinder the establishment of occupational standard, using the technique of Functional Analysis and covering work levels, from basic to advanced, in order to recommend to the endorsement board for approval in line with the objectives and goals?"

The sample included the consultants, the working group, and the endorsement board who provided the information indicative of risks which could be summarized as follows, "The risks found in the process are the risks in 8 issues namely 1) The number of times is too little so it should be added by considering the number of times and persons as appropriate 2) Someone should lead in order to bring out the idea of each one 3) The groups who attend the public hearing are too broad and diverse, not specific profession 4) In the meeting, most have diverse opinions in conducting the Functional Analysis, corresponding and not corresponding to the issues 5) Meetings are few so informal meetings are held and the analysis has to be accelerated so that the competency issues are missing 6) Diversity of agencies attached to the endorsement board results in different perspectives on the professions 7) Meeting is determined for 1 time. If one cannot attend the meeting, one can send a representative so the information is not continuous and 8) For Functional Analysis, there is no classification according to the types of operation such as the public, private, and independent organization sectors, etc."

*The interviewees 101 stated, " Someone should lead the session to bring out ideas of each individual. The focus group should be held more often. There should be homework and the information obtained last time should be revised and continue the operation. The number of people, and the number of times should be determined. The Tier content of the groups who attend the public hearing is too broad and diverse, not specific professions."*

*The interviewees 105 stated, "Meetings are not held frequently so informal meetings are held and the analysis is accelerated, resulting in some missing competency issues 6) The agencies attached to the endorsement board are diverse so the perspectives*

*on professions are different 7) The meeting to consider the issues is held once. If one cannot attend the meeting, one sends a representative so the information is not continuous and 8) In determining the Functional Analysis, there is no classification of the types of operation such as the public, the private, or the independent organization sectors, etc."*

*The interviewees 105 stated, " The risk is about the number of times and persons which are too little. The meeting in large group expresses different and diverse opinions. There is a lot of information from expressed opinions. The opinions are diverse so sometimes the Functional Analysis can be to the point and sometimes not which requires a lot of time and a lot of meetings."*

*The interviewees 207 stated, "The assessment tool which is the written test paper is not familiar and should change into pictures and practical test paper. But government officials do not read a lot of practical test papers."*

**4th Process** Developing assessment tools and evaluating their quality

The researcher posed the following question to the key informants, " What are the events that hinder the construction of assessment tools to assess personal competency according to occupational standard and assess the quality of tools according to the objectives and goals?"

The sample included the consultants and the working group who provided the information indicative of risks which could be summarized as follows, " The risks found in this process are the risks in 5 issues namely 1) There is no division between those who set the test questions such as academic groups, people in professions and those with well-rounded knowledge 2) Some types of test papers do not fit the target group and are too academic 3) No duty is determined for the examiners 4) Time is not controlled or managed in the assessment test similarly to real assessment and 5) There lacks the analysis of the process of assessment test.

*The interviewees 101 stated, "There is no schedule of the work of examiners. Prior to start working, the examiners must attend real training to be able to work properly according to the examiner qualifications and perform the duty of controlling the examination according to the set standard."*

*The interviewees 105 stated, "Time must be controlled and the assessment content must be consistent with the set standard. Time must be appropriately controlled*

*and managed and the role of the examiners must also be appropriate. Time is not determined, controlled, or managed in the assessment test similarly to real assessment."*

*The interviewees 704 stated, " There lacks the analysis of the process of assessment test."*

**5th Process** Testing assessment tools with the target group, propose the endorsement board for approval

The researcher posed the following question to the key informants, "What are the situations that hinder testing of assessment tools in order to recommend them to the endorsement board, undertake public relations at the end of the project, and summarize the operation according to the objectives and goals?"

The sample included the consultants, and the endorsement board who provided the information indicative of risks which could be summarized as follows, "The risks found in this process are the risks in 7 issues namely 1) The endorsement board does not study in advance and in detail prior to attend the meeting 2) No knowledge is provided on the utilization, the value of occupational standard, and the expected benefits 3) The testing group does not serve as good example 4) The qualifications/skills of the selected examiners are not sufficient for performing their duty 5) No examiner and those who sit for the assessment test are determined to give the Feedback for improvement of the tools 6) No complete assessment tools are determined according to KSA (Knowledge, Skill, Attribute) and 7) Public relations do not cover the group of users. The share is not determined between the public, the private, and the independent organization sectors."

*The interviewees 201 stated, " Some officials are not qualified. Examiners should be trained and assessment test should be undertaken to know and understand the test papers and the assessment process clearly before performing the real duty and control the testing process not to deviate from the issues and exceed the time limit. There should be more examiners."*

*The interviewees 105 stated, " I have appropriately undertaken the competency assessment test as determined by the professional qualification but the assessment test takes a lot of time as the examiner greatly digresses from the issues. Those who sit for the assessment have to wait for a long time. Time should be appropriately allocated. Recommendations from the examiners on those who sit for the*

*assessment should be improved to rectify the test papers and the process for appropriateness."*

*The interviewees 107 stated, " In terms of the recommendations from the found problems, the standards are reviewed several times. The representatives from 3 fields attend the meeting at the same time. But the representative from each field should be separated in the meeting due to different expertise. Each individual does no know all standards. The time for each individual's presentation is too long. If the meeting room is separated, work will become clearer, separated according to expertise with additional comment from the group leader. What is applicable includes business executives of integrated agriculture, wage adjustment. Public relations should be undertaken to send the occupational standard to the agro-industrial group. The JD Smart farm is already appropriate in terms of the number of people but the share of the groups of the private and the public sectors should be appropriately determined and selected according to real interests. Time is limited for the working group to present the performance. The performance should be immediately presented. If the consultant presents performance to the endorsement board, it will make us understand more. The endorsement board should completely participate. If the executive does not have time, a representative can be sent instead."*

*The interviewees 207 stated, " There is too little public relations. Documents should be sent to each agency such as Provincial, District, or Subdistrict Agricultural Extension Offices, and Community Develop Office as introductory documents of occupational standard. Public relations should also be undertaken to local farmers according to the potential of each group so that all can sit for the test."*

*The interviewees 707 stated, "There should be public relations nationwide in each region for farmers, organizations, government officials in departments and divisions. The public relation channels should be determined by rating major media, frequency, interested public, major printed media through internet, website, google."*

*The interviewees 201 stated, "The assessment test acquires the number as set by the objective but in terms of the test results, a small number of people pass the written test as they lack expertise. Government officials assess the practical test papers only the part under their responsibility/routine work."*

**4.3.2 Risk analysis and Evaluation**

The risk analysis and the risk assessment in this research were conducted by interviews and joint risk assessment with the sample by using the criteria of risk assessment according to the activity of each process in establishing the occupational standard and professional qualification derived from the risk identification. Then, the analysis of potential risk is conducted and the likelihood of risks and the scale of the impact on the outcome are assessed according to the objective of each process to calculate the total outcome and determine the risk levels (very low, low, moderate, high, very high) leading to the process of risk management and treatment. (Hulett David T, 2001; John P. Kindinger and John L. Darby, 2000; Sanguan ChangChat, 2004).

The criteria of risk assessment to rank the importance of the risk issues derived from risk identification of the likelihood of risks which may impact the objectives of an operation so that the goals cannot be reached. The assessment of significant risk (Risk evaluation) is the management system risk. Therefore, the assessment comes from knowledge, ability, and experience of the sample by comparing the factors of potential opportunity/causes of all risks with the number of mistakes. If the mistakes are frequent, the score = 5 and if the mistakes are not frequent, the score = 1, etc. and compared with the occurred damage. If the operation does not meet the objective within the timeframe/or activity cannot be undertaken, the great seriousness = 5 (Aven T, 2017; SRA, 2015b); (ISO, 2009a; Vanem, 2012; Warren W. Stippich, 2015).

This part consistent with Rovins and A. (2015) that study the role of risk assessment, undertaking the analysis, estimate the risk and anticipate the change under various courses of action and provide guidance in the way of precedents, benchmarks, comparisons and solutions that can develop and communicated with stakeholders and interested parties. The developing and communicating with stakeholders and interested parties and data collection misses the likelihood of determine events happened many years ago or never happened before, but have occur in the future that possible. Information types that different are useful for different aspects of risk identification that can used.

**1st Process** Publicizing the project to the target group

The researcher interviewed the key informants as follows: "In considering the potential factors and the causes of potential risk and in considering the impact on the

objectives of the operation in this process with the number of mistakes (if the mistakes are frequent, the score = 5 and if the mistakes are not frequent, the score = 1 ) do you think that the occurred damage cannot fulfill the objectives within the set timeframe or cannot undertake any activity while identifying the seriousness (at high level with the score = 5 and the seriousness at low level with the score = 1) and how often do you think the occurred risk in the process of public relations aimed at the target professional group is likely to happen? If so, will the risk impact the operation to achieve the objectives and impact the next operational processes or not? How?"

The sample included the consultants who provided the information for the risk analysis and risk assessment which could be summarized as follows, "From the risks issue found in the process can be carried out analysis and risk assessment on the average at the low and moderate levels in 3 issues namely 1) The groups which are the target of the public relations are numerous, different, and diverse. Therefore, in the meeting, some opinions are directly relevant to the professions but some are not 2) Public relation media, media format, and period do not reach the target group and 3) Relevant persons operate according to the overview of the project while some do not."

*The interviewees 103 stated, "The public relations is undertaken through various media so that many target groups attend the meeting. There are differences and diversities in profession, and education. So, in the meeting, the opinions are directly on the profession while some opinions are not. The related persons provide the information to the project operator that is both relevant and irrelevant to the project overview. There are many issues that are different from the project objectives. It needs time to screen only relevant issues. There is no risk that can impact the project because the information from the target group can be operated according to the processes."*

*The interviewees 201 stated, "Public relation media, media format, period do not reach the target group as intended. I would like to have broader groups. But due to limited period, some have come and it is sufficient for further operation. The groups of which the media reaches can attend the meeting and provide complete information. Most know one another personally, alumni, and those in the profession who already work with one another."*

**2nd Process** Studying occupational standards of role model countries

The researcher posed the question to the key informants as follows: "In considering the likelihood of risk factors, causes of potential risks, and in considering the impact on the objectives of the operation in this process and the number of mistakes (if they are frequent, the score = 5, if not the score = 1) in your opinion does the damage make it impossible to reach the objective within timeframe or undertake the activity (high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion how often is the likelihood of risk during the process of study and data analysis relevant to the target professional groups to establish occupational standard and professional qualification which result in incorrect or insufficient information. If there is such a risk, does it impact the operation to reach the objective and the process of further occupational standard development? How?"

The sample included the consultants and the working group who provided the information of the risk analysis and the risk assessment which could be summarized as follows, "From the risks issue found in this process, we can conduct the risk analysis and the risk assessment on the average at the moderate level in 4 issues namely 1) Incomplete data analysis. Some issues are lacking and not sufficient to conduct the Functional Analysis 2) Summary of Functional Analysis is different and not general 3) Incomplete foreign studies and domestic analysis which do not reflect the situations and are different from the professional group and competency and 4) A lot of information but time for work is little."

*The interviewees 201 stated, "In this process, the risk is deemed little and overall does not affect the process as there is no problem in studying the information in foreign countries. There is basic information from Malaysia and there are sufficient supporting foreign standards. The problem is that the time for the analysis is too little and the PM rather leads the consultants who are not quite independent to work. The number of the working group meeting is too little. The consultants have little knowledge on Functional Analysis. As a result, the summary of the Functional Analysis is diverse, not general, with specific knowledge. So, the analysis is specific. Those with existing knowledge can do it and understand. The consultants hold meetings often. The working group holds meetings according to the timeframe.*"

*The interviewees 105 stated, " There is the chance of the study and data analysis relevant to the target professional groups to establish occupational standard and professional qualification with a lot of information but does not meet the needs. It takes time to filter information and impacts the Functional Analysis because there is a lot of information but little time to work. The study of information in many foreign countries reveals that in some countries the information is sometimes relevant and sometimes not. The domestic analysis is not complete and does not reflect the situation. The professional groups and competency are different. As a result, the data analysis is not complete. Some issues are missing and not sufficient to conduct the Functional Analysis. But it has to proceed first and then improve by finding additional information when conducting the Functional Analysis in the next process."*

**3rd Process** Conducting Functional Analysis to be proposed to the endorsement board for approval

The researcher posed the question to the key informants as follows: "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1 ) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity (high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion, does the risk found in the process of conducting the Functional Analysis and recommending to the endorsement board for approval have the likelihood of risk which prevents the Functional Analysis from reaching the target and the endorsement board from giving approval. If so, will it impact the operation to reach the objectives and impact the process of further occupational standard development? How?"

The sample included the consultants, the working group, and the endorsement board who provided the information of the risk analysis and risk assessment and could be summarized as follows, "From the risk issue found in this process, we can analyze and assessed on the average at the moderate level in 3 issues namely 1) Functional Analysis does not cover the professions 2) It is difficult to summarize the overview. It takes time to make the summary and 3) Functional Analysis is not general, but specific, and does not cover all actual professions."

*The interviewees 101, 103, and 201 gave the same information, "In this process, some part is affected by the previous process. There is a lot of information but once it is filtered, there is little for conducting the Functional Analysis. The number of times to hold the meeting is too little. So, the informal meeting and the additional sub-meeting must be held several times in order to have the results of the analysis that are complete and sufficient. It is difficult to summarize the overview. It takes time to make the summary. The analysis of the standard does not cover the characteristics of those who sit for the assessment."*

*The interviewees 707 stated, " Functional Analysis is not general but specific and does not cover all actual professions. The opinions of the endorsement board on the Functional Analysis show that there is still some risk if the endorsement board does not read the documents in advance prior to the meeting because the information for the Functional Analysis consists of a lot of documents that need understanding. Some endorsement board members do not have basic knowledge on the establishment so they need to understand and study prior to attending the meeting."*

**4th Process** Developing assessment tools and evaluating their quality

The researcher posed the following question to the key informants, "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1 ) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity, (giving the high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion how often is the likelihood of risk found in the process of constructing the tools to assess individual competency according to occupational standard and assessing the quality of the tools which prevents the construction of the tools to assess the individual competency according to occupational standard and the assessment of the quality of the tools. If so, will it impact the operation to reach the objectives and impact the process of testing the tools and approval sought by the endorsement board or not? How?"

The sample included the consultants and the working group who provided the information of the risk analysis and the risk assessment and concluded that "The risks found in the process can be analyzed and assessed on the average at a low level in 2

issues namely 1) The test papers are too academic and too difficult which do not reflect true competency and 2) The assessment tools cannot measure the KSA completely."

*The interviewees 105 stated, "In setting the test papers, they are mostly set by academics and divided according to each profession. In some groups, there are academics and people in the profession. In some groups, there are mostly academics and university lecturers. As a result, the assessment tools cannot completely measure the KSA. Some groups focus on academic written test papers. Some groups clearly focus on practical test papers. So, risks may occur. But it can be rectified. The project can determine the requirement that the quality of the tools comes from experts. The number of the academics can be determined at two-thirds and the other 1 person in the profession to conduct joint assessment, resulting in the assessment of the quality of the tools and the recommendations to improve the questions, the interview guideline and the implementation are also improved to have more KSA. The results will be considered again after undergoing the assessment test again in the next process and then for improvement once again."*

*The interviewees 201 stated, "The assessment method does not match the skill of actual operation. For some profession, the practical assessment should be conducted rather than written test because the people in the profession actually work at the factory floor. The test papers are too academic and too difficult and do not reflect the true competency."*

**5th Process** Testing assessment tools with the target group, propose the endorsement board for approval

The researcher posed the question to the key informants as follows, "In considering the likelihood of factors, the causes of potential risk, and in considering the impact on the objective of operation in this process with the number of mistakes (the frequent mistake having the score = 5, and the infrequent mistake having the score = 1 ) in your opinion will the damage prevent the operation from reaching the objective within the set timeframe or undertaking the activity (giving the high level of seriousness = 5, and the low level of seriousness = 1) and in your opinion, how often is the likelihood of risk found in the process of testing the assessment tools to submit to the endorsement board for public relations at the end of the project and performance summary which prevents the testing of the assessment tools to submit to

the endorsement board for public relations at the end of the project and performance summary. If so, will it impact the operation to reach the objectives and impact the process of delivering the occupational standard and determining the profession to certify the occupational standard and professional qualification or not? How?"

The target group namely the consultants and the endorsement board provided the information of the risk analysis and the risk assessment which could be summarized as follows, "The risks found in this process can be analyzed and assessed on the average at the low and moderate levels in 3 issues namely 1) Lack of knowledge and understanding to utilize the standard, lack of awareness of value of occupational standard 2) Selection of the target group to test the assessment tools may not have sufficient representatives. So, the results of the assessment tool test with the target group does not reflect the appropriateness of the set assessment methods 3) The process of the assessment test form the examiners does not reflect the assessment process that should actually take place."

*The interviewees 105 stated, " Some examiners do not perform their duty which is not in line with the goal of the assessment and do not manage the time. So, the time spent for the assessment test is too long. Those sitting for the assessment test at the end of the line start to get tiered while waiting. Towards the end, the examiners start to get tired as well. For some professions, the model of assessment process does not reflect the real situations for actual utilization. After the assessment test, meeting is held with the consultant team to review the process and use the feedback from those who participate in the assessment test including the examiners and those who sit of the assessment tool test in order to review both the tools and the process before seeking comments from the endorsement board again."*

*The interviewees 107 stated, " Overall, I agree with the operational process as it upgrades the people in the profession to possess the standard. But overall, it focuses on specific group so I am not sure if it is relevant. I think it should start with the industry. Look at the problems and consider what professional standard should be established. For agricultural group, it should be established for a great number of people and with diversity in terms of education, knowledge and ability, and experience such as how to manage fertilizer, how to sell fertilizer, advice to customers, etc. in order*

*to reflect the real people in the profession. Therefore, the selection of the target group to participate in the project may have to be appropriately undertaken."*

*The interviewees 207 stated, " Additional public relations should be undertaken apart from the completion of the standard. Additional knowledge should be provided on the utilization of the standard, the value of occupational standard, utilization, benefits for the target group participating in the public relation session for the summary of the project. People should receive additional knowledge on the utilization of occupational standard before heading home."*

*The interviewees 504 stated, "I am one of those who sit for the assessment test, including practical, written test papers, and interview. I find the test papers too easy. The question jumps from the operation to level 5 or planning. I want a person who really knows to express opinion on the assessment. There should be the selection methods of people with broad knowledge such as from the foundation or people in the profession. Environment has other relevant standards. But there are only a few biotechnology specialists. The process still lacks analysis but the process to certify occupational standard is OK. Therefore, the selection of the target group to test assessment tools may not constitute the sufficient representation. The results of the assessment tool test on the target group therefore do not reflect the appropriateness of the set assessment methods."*

### 4.3.3 Risk Treatment and management

The study results of the Risk Treatment/Management used the analytical principles from the researcher in conjunction with the synthesis of information from the target group for risk management that consistent with (ISO, 2009a); (Warren W. Stippich, 2015); (Sanguan ChangChat, 2004); (Project Management Process Improvement Office, 2003); (PMI Europe, 2001). This research studied the risk management based on the risk management principles namely risk acceptance, risk avoidance, reduced likelihood of risk, reduced scale of the impact from risk, transfer of risk to other relevant factors, and the change of risk into development opportunity. The risk management with the acquired results of risk assessment to control the process where the risk is found and then manage the risk according to the risk management principles that can drive the process to establish occupational standard and professional

qualification can fulfill the objectives and the goals to establish occupational standard and professional qualification.

**1st Process** Publicizing the project to the target group

The target group included the consultants who jointly conducted processing and analysis of the results from the researcher and summarized the information of the risk control and management as follows, "From the risks found in the process there are 3 issues to recommend the guideline of risk control and management namely 1) Should select the group to attend the PR session based on specific professions 2) Determine PR media, media format, period in order to reach the target group and as mass media and 3) Stipulate in the TOR that a meeting should be held to explain to the relevant persons the detailed overview of the project prior to the project operation."

**2nd Process** Studying occupational standards of role model countries

The sample included the consultants and the working group who jointly conduct processing and data analysis from the researcher. The information on the risk control and management is summarized as follows, "From the risks found in the process there are 3 issues to recommend the guideline of risk control and management namely 1) Avoid the risk derived from a meeting with large groups into a meeting with small groups to conduct the Functional Analysis and then summarize the overview to the meeting with large groups 2) Reduce the scale of impact derived from the selection of role model countries that cannot be sufficiently used to conduct the Functional Analysis. The selection of the role model countries with the context similar to Thailand has undertaken from the similar occupational standard before in order to determine more clearly the competency to be general and inclusive of all professions and competencies, and with the operational example with clear prototype and 3) Change risk into development opportunity by making announcement for recruitment of the working group instead of selection, and recommend the name of the consultant via only 1 channel to publicize the project to the general public so that they can consider their own interest and expertise to participate in the project that is relevant to the profession undergoing the establishment of occupational standard."

**3rd Process** Conducting Functional Analysis to be proposed to the endorsement board for approval

The target group included the consultants, the working group, and the endorsement board who jointly conducted the processing and data analysis from the researcher. The information of risk control and management could be summarized as follows, " From the risks found in the process there are 2 issues to recommend the guideline of risk control and management namely 1) Reduce risk by organizing specific training/workshop to acquire knowledge in conducting the Functional Analysis, including the consultant team and the working group and 2) Reduce risk from determining the competency of people in the profession that does not cover the people in actual profession by determining instead the general core competency and the competency classified according to the public, the private, and the independent organization sectors, etc.

**4th Process** Developing assessment tools and evaluating their quality

The target group included the consultants and the working group who jointly conducted the processing and the data analysis from the researcher. The information of risk control and management could be summarized as follows, "From the risks found in the process there is 1 issue to recommend the guideline of risk control and management namely 1) Avoid the risk derived from the assessment method that does not include KSA by designating the appropriate ratio of academic and practical test papers from the established occupational standard to serve as the prototype for the professions with similar qualifications.

**5th Process** Testing assessment tools with the target group, propose the endorsement board for approval

The target group included the consultants and the endorsement board who jointly conducted the processing and the data analysis from the researcher. The information of risk control and management could be summarized as follows, "From the risks found in the process there are 6 issues to recommend the guideline of risk control and management namely 1) Reduce risk by which the endorsement board studies the documents beforehand and express opinions through the documents prior to the meeting 2) Add the measure to create perception of the utilization of the standard, the value of the occupational standard via the media which is appropriate to each profession 3) Reduce risk from having representatives of experts by making a list of experts in each profession, database to recommend them to the consultants in other or similar professions for

utilization 4) Reduce risk from determining the target group for assessment tool test that are not representatives by specifying the criteria to select the target group for assessment tool test in the TOR and allow the endorsement board to participate in the selection and the target group conduct self-assessment before serving as the representatives of the assessment test 5) Reduce risk from acquiring the examiners with irrelevant qualifications by specifying the selection criteria of examiners in the TOR and hold meeting or training to come to the common understanding prior to the assessment test and 6) Reduce risk when the standard is already established but the target group in the profession not participating in the project will be able to know and enter the process of occupational standard certification. This can be done by opening public relation channels and others according to the characteristics of the users."

## 4.4 Proposed guidance for establishing occupational standards and professional qualification more efficiently

The study results recommended the process to establish occupational standard and professional qualification which were improved and developed according to Objective (3) "To propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency". The study results are as follows:

Based on the overall conclusion of the above study results and the details, the analysis could be divided into 3 issues as follows: 1) Risk Identification 2) Risk Analysis and Evaluation and 3 ) Risk Treatment/Management, and classified according to the occupational standard and professional qualification process, as well as classified according to the target group who provided the information. Base on the information form the target group the recommended for the new occupational standard and professional qualification process improved from the old process. The details are in Table 4 .4-1 with shows result and conclusion of the existing occupational standard and professional qualification process, and improvement and development of the new process in addition 4.4-2

Table 4.4-1 Research result

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| **Process 1st** Publicizing the project to the target group | | | | |
| 1) Public relations do not reach people in professional groups and do not cover all groups<br>2) No frequency and period are determined as suitable for public relations<br>3) Relevant people do not know the overall operation of the entire project | Risk level: Low and Moderate<br>1) The target groups aimed by the public relations are numerous, different, and diverse. So, in the meeting, there are both relevant and irrelevant opinions on the professions<br>2) PR media, media format, period do not reach the target group<br>3) Relevant people relevantly and irrelevantly operate the overview of the project | 1) The group attending the PR session should be selected specifically for the professions<br>2) Designate PR media, media format, period to reach the target group and as mass media<br>3) Specify in the TOR that there will be a meeting to explain the detailed overview of the project to relevant people prior to project operation | The group attending the PR session were general farmer, scientist, technologist and academician which should have been oil palm farmers, environmental scientist, biotechnologist, Controller of the pollution etc. | **Additional**<br>1. Designate the selection conditions/criteria and ratio of agencies in professions (public, private, independent organization)<br>2. Designate the PR media, media format, period, conditions to follow up and receive news from the publicized media |
| **Process 2nd** Studying occupational standards of role model countries | | | | |
| 1) Time of the analysis is too little<br>2) In some countries there is a lot of information and | Risk level: Moderate<br>1) Data analysis is not complete. Some issues | 1) Avoid the risk from meeting in large group to meeting in small group to conduct Functional | - The best practice countries are Australia, New Zealand, | **Additional**<br>1. Training/workshop to provide knowledge to conduct |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| in some countries the information is not sufficient<br>3) Lack knowledge on Functional Analysis<br>4) Some countries have different contexts to establish occupational standard<br>5) The study of foreign countries and the domestic analysis are not complete and do not reflect the situations which have different professional groups and competencies<br>6) The selection of the working group is still specific and does not cover actual professions | are missing and not sufficient to conduct Functional Analysis<br>2) Summary of Functional Analysis is different and diverse and not general<br>3) Competencies from the study of foreign countries and the domestic analysis are not complete and do not reflect the situations which have different professional groups and competencies<br>4) There is lot of information but there is little time to work | Analysis and then summarize the overview to the meeting in large group<br>2) Reduce the scale of impact derived from the selection of the role model country that cannot be sufficiently used to conduct the Functional Analysis by selecting the role model country with similar context to Thailand already established from the similar occupational standard in order to determine the competency to be general and cover all professional groups and competencies more clearly, and have operational example with | South Korea, Singapore, Hong Kong, Philippines<br>- The recruited working group should have been from environmental agency, agricultural agencies, energy agencies etc. | Functional Analysis and link it to the study of foreign countries and relevant policies<br>2. Announce recruitment of the working group instead of selection |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| | | clear prototype<br>3) Change risk into development opportunity by announcing the recruitment of the working group instead of selection, and recommend the name from the consultant through one channel to publicize the project to the general public so that they know and consider their own interest and expertise to participate in the project that is relevant to the profession, the occupational standard of which will be established | | |
| **Process 3rd** Conducting Functional Analysis to be proposed to the endorsement board for approval | | | | |
| 1) The number of times is too little and should be increased by | Risk level: Moderate<br>1) Functional Analysis does | 1) Reduce risk by organizing training /workshop for | Core competency of public, private sector, and the | **<u>Additional</u>**<br>Determine the general competency and core |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| appropriately considering the number of times and number of people<br>2) Someone should lead to bring out the idea of each person<br>3) The groups attending the public hearing are too broad and diverse and not specific professions<br>4) Large group in a meeting has diverse opinions in conducting the Functional Analysis, relevantly and irrelevantly<br>5) Meeting is not held often so informal meeting has to be held and the analysis has to be accelerated so the competency issue is missing<br>6) Diversity of the | not cover all professions<br>2) Difficult to summarize the overview. Takes a lot of time to summarize.<br>3) Functional Analysis is not general, but specific group, not covering actual professions | specific professions to provide knowledge in conducting Functional Analysis, including the consultant team and the working group<br>2) Reduce impact from the determination of competency of people in professions which is not inclusive and does not cover the people in actual professions by determining the general core competency (general) and the competency classified by the public and private sector and the independent organization etc. | independent organizations are<br>1) Demonstrate independence and creativity in identifying problems.<br>2) Solve problems regarding customers' concerns from work obligations.<br>3) Make decisions on concerns at work.<br>4) Collect, analyze, and manage information.<br>5) Monitor and evaluate operating results<br>However, specific competency could be different. For example, the competency for | competency classified by the public and the private sector, and the independent organizations, etc. |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| agencies attached to the endorsement board results in different perspectives on the professions<br>7) Meeting is determined to be held 1 time. If not possible to attend the meeting, representative can be sent in place but the information is not continuous.<br>8) Functional Analysis does not classify according to the types of work such as the public and the private sectors, and independent organizations, etc. | | | municipal waste management is<br>1) Prepare before transporting municipal waste<br>2) Load and unload non-hazardous and hazardous municipal waste into vehicles<br>3) Carry out municipal waste transportation<br>4) Control traffic at waste sites<br>etc. | |
| **Process 4th** Developing assessment tools and evaluating their quality | | | | |
| 1) No classification of those who set the test papers such as academics, people in profession, and those with all- | Risk level: Low<br>1) Test papers are very academic and too difficult and do not reflect the | 1) Avoid risk from the assessment method that does not cover KSA by determining the appropriate ratio for | The practice/ academic ratio from assessment tool were 20/80, which instead should have | **<u>Additional</u>**<br>Designate the ratio and the period appropriate for academic and practical test papers |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| round knowledge<br>2) Some types of test papers do not suit the target group and are very academic<br>3) The examiners' operation is not determined<br>4) Time is not determined, controlled, or managed in the assessment test similar to actual assessment<br>5) Lack analysis of the process of assessment test | actual competency<br>2) Assessment tools cannot measure the KSA completely | academic and practical test papers from the established occupational standard as the role model for professions with similar characteristics | been 80/20 and the examiner mostly were from educational agencies which should have been from environmental agencies, agricultural agencies or energy agency etc. | |
| **Process 5th** Test assessment tools with the target group, propose the endorsement board for approval | | | | |
| 1) The endorsement board does not study the details in advance prior to the meeting<br>2) No knowledge is provided on the utilization of standard, value of occupational standard, and benefits<br>3) Testing group is not role model | Risk level: Low and Moderate<br>1) Lack knowledge and understanding on the utilization of standard and the value of occupational standard<br>2) Selection of the target | 1) Reduce risk by which the endorsement board studies the documents in advance and express opinions through the documents prior to the meeting<br>2) Add the measure to create perception of the utilization of | Testing group were university student which should have been representative from environmental agencies, agricultural agencies, energy agency, or private sector related to | **<u>Additional</u>**<br>1. Self-assessment (sample and examiners), meeting/training held to come to common understanding prior to the assessment test<br>2. Set up the database of the list of experts in each profession |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| 4) Selection of examiners based on their qualifications/skills are not sufficient to perform their duties<br>5) Examiners and those who sit for assessment test are not specified to give Feedback to improve the tools<br>6) Assessment tools are not completely determined according to the KSA<br>7) PR does not cover the users and no ratio is determined between the public and the private sectors, and the independent organizations | group for assessment tool test may not constitute sufficient representation. So, the results of the assessment tool test on the target group do not reflect the appropriatenes s of the established assessment methods<br>3) Process of assessment test from the examiners does not reflect the assessment process that should actually take place | standard, the value of occupational standard through the media that is appropriate to each profession<br>3) Reduce risk from having representatives of experts by making a list of experts in each profession and database to recommend to consultants in other or similar professions<br>4) Reduce the risk from determinatio of the target group undertaking assessment tool th constitutes representation by specifying the selection criteria o the target group undergoing the assessment tool in the TOR and allov the endorsement board to participat | environment, agriculture or energy. | 3. Determine the reception of feedback to improve the assessment tools from actual users<br>4. Increase the perception of value and utilization of standard through the media with access to the professional group |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| | | in the selection, ar the target group conducts self-assessment before serving as representatives<br>5) Reduce risk from the examiners' irrelevant qualifications by stipulating the selection criteria of examiners in the TOR and hold meeting and training to come to common understanding prior to the assessment test<br>6) Reduce risk when the standard is established but the target group in the profession not having the opportunity to join the project will be able to know and enter the process to certify the occupational standard. This can be done by | | |

| Risk identification | Risk analysis and assessment | Risk treatment and management | Example and issue found | Recommendations of occupational standard process (new) |
|---|---|---|---|---|
| | | opening more PR channels in other formats according to the characteristics of the users | | |

Table 4.4-2 Proposed new process for establishing occupational standards and professional qualification

| Old process | Proposed new process |
|---|---|
| **1st Publicizing the project to the target group** | |
| 1) Publicizing the projects | 1) Publicizing the projects |
| 1.1) Determine the PR media which matches the stakeholders in the professions | 1.1) Determine the PR media which matches the stakeholders in the professions |
| 1.2)Prepare and present information or evidence in cooperating or coordinating with entrepreneurs, personnel in professional group, relevant public and private sector, and general public | 1.2) Prepare and present information or evidence in cooperating or coordinating with entrepreneurs, personnel in professional group, relevant public and private sector, and general public |
| | 2) Determine the selection criteria including the ratio of representation from government agencies, private sector entitles, and independent organizations |
| | 3) Determine the public relations plan, period, and result dissemination |
| 2) Recommend the list of individuals and | 4) Recruit the working group deemed |

| Old process | Proposed new process |
|---|---|
| agencies deemed appropriate to the institute | appropriate to the institute |
| **2nd Studying occupational standards of role model countries** | |
| 1) Studying and analyze information related to the target group to establish occupational standard and professional qualification | 1) Studying and analyze information related to the target group to establish occupational standard and professional qualification |
| 1.1) Study the occupational standard and professional qualification of the professional groups who establish the foreign occupational standard of no fewer than 3 role model countries, with at least 1 AEC member country (if available) | 1.1) Study the occupational standard and professional qualification of the professional groups who establish the foreign occupational standard of no fewer than 3 role model countries, with at least 1 AEC member country (if available) |
| 1.2) Example of the process to request for the certification of individual professional qualification to certify professional qualification according to occupational standard of at least 1 country | 1.2) Example of the process to request for the certification of individual professional qualification to certify professional qualification according to occupational standard of at least 1 country |
| 1.3) Designate and certify knowledge, ability, or competency of individuals relevant to the professional groups which establish Thai and international occupational standards currently used in Thailand | 1.3) Designate and certify knowledge, ability, or competency of individuals relevant to the professional groups which establish Thai and international occupational standards currently used in Thailand |
| 1.4) Information relevant to occupational standard established in Thailand | 1.4) Information relevant to occupational standard established in Thailand |
| 1.5) Demonstrate past research works | 1.5) Demonstrate past research works |

| Old process | Proposed new process |
|---|---|
| | 1.6) Training/workshop to provide knowledge to conduct Functional Analysis and link to study from foreign countries and relevant policy |
| 2) Present the results of the study and the analysis | 2) Present the results of the study and the analysis |
| 3) Recommend the names of individuals and agencies appropriate to the institute for selection and approval as the working group | 3) Recommend the names of individuals and agencies appropriate to the institute for selection and approval as the working group |
| **3rd Conducting Functional Analysis to be proposed to the endorsement board for approval** | |
| 1) Establish occupational standard using the technique of Functional Analysis by covering the work levels, from basic to advanced, and operated by: | 1) Establish occupational standard using the technique of Functional Analysis by covering the work levels, from basic to advanced, and operated by: |
| 1.1) Organize workshop and give advice to the working group to prepare the chart of job description | 1.1) Organize workshop and give advice to the working group to prepare the chart of job description |
| 1.2) Determine the levels of professional qualification of each profession in accordance with Thailand Professional Qualification Framework (TPQF) according to the format of occupational standard and professional qualification as set by the institute | 1.2) Determine the levels of professional qualification of each profession in accordance with Thailand Professional Qualification Framework (TPQF) according to the format of occupational standard and professional qualification as set by the institute |
| | 1.3) Determine the general core competency (general) and the competency classified by the public and private sectors and the |

| Old process | Proposed new process |
|---|---|
| | independent organizations etc. |
| 2) Present the results of the establishment of occupational standard and professional qualification to the endorsement board for consensus approval | 2) Present the results of the establishment of occupational standard and professional qualification to the endorsement board for consensus approval |
| 3) Organize public hearing to present the results of the establishment of occupational standard and receive feedback | 3) Organize public hearing to present the results of the establishment of occupational standard and receive feedback |
| 4) Recommend the names of at least 3 experts deemed appropriate for selection and approval as the assessors of the quality of the competency assessment tools according to occupational standard | 4) Recommend the names of at least 3 experts deemed appropriate for selection and approval as the assessors of the quality of the competency assessment tools according to occupational standard |
| **4th Developing assessment tools and evaluating their quality** | |
| 1) Conduct assessment, assessment tools, and test papers used to test knowledge consisting of: | 1) Conduct assessment, assessment tools, and test papers used to test knowledge consisting of: |
| 1.1) Analyze occupational standard to construct the assessment tools in each unit of competence by classifying into the tools to measure knowledge, skills, and others | 1.1) Analyze occupational standard to construct the assessment tools in each unit of competence by classifying into the tools to measure knowledge, skills, and others |
| | 1.2) Determine the ratio and duration that are appropriate for academic and practical test papers |
| 1.2) Determine the assessment methods and construct the assessment tools | 1.3) Determine the assessment methods and construct the assessment tools |

| Old process | Proposed new process |
|---|---|
| according to the guideline of assessment in all levels of all professional qualifications according to occupational standard covering all performance criteria in the unit of competence according to occupational standard as well as answers, and in confidentiality | according to the guideline of assessment in all levels of all professional qualifications according to occupational standard covering all performance criteria in the unit of competence according to occupational standard as well as answers, and in confidentiality |
| 2) Assess the quality of the assessment tools and the test papers by no fewer than 3 experts, and in confidentiality | 2) Assess the quality of the assessment tools and the test papers by no fewer than 3 experts, and in confidentiality |
| **5th Testing assessment tools with the target group, propose the endorsement board for approval** | |
| 1) Conduct competency assessment as designated in the professional qualification of the target group with the established assessment tools | 1) Conduct competency assessment test as designated in the professional qualification of the target group with the established assessment tools |
| 1.1) Designate the target group in the assessment tool of no fewer than 3 professional qualifications, no fewer than 10 persons in each professional qualification without those sitting for the assessment to sit for the assessment in the professional qualification undergoing the assessment except the professional group with the level of fewer than 3 professional qualifications according to | 1.1) Designate the target group in the assessment tool of no fewer than 3 professional qualifications, no fewer than 10 persons in each professional qualification without those sitting for the assessment to sit for the assessment in the professional qualification undergoing the assessment except the professional group with the level of fewer than 3 professional qualifications according to |

| Old process | Proposed new process |
|---|---|
| occupational standard | occupational standard |
| | 1.2) Facilitate a meeting for understanding and self-assessment among the testing groups and examiners |
| 1.2) Determine the examiners according to the examiners' qualification as certified by the institute | 1.3) Determine the examiners according to the examiners' qualification as certified by the institute |
| | 1.4) Compile the list of professional experts |
| 1.3) Conduct the competency assessment test as determined in the professional qualification | 1.5) Conduct the competency assessment test as determined in the professional qualification |
| 1.4) Summarize the assessment process, assessment results, and analysis of the results of competency assessment test | 1.6) Summarize the assessment process, assessment results, and analysis of the results of competency assessment test |
| | 1.7) Determine the reception of feedback to improve the assessment tools from actual users |
| 2) Present the summary of the assessment process, assessment results, analysis of the results of competency assessment test to the endorsement board for consensus approval | 2) Present the summary of the assessment process, assessment results, analysis of the results of competency assessment test to the endorsement board for consensus approval |
| 3) Recommend the name of at least 1 agency which is deemed to have the ability to serve as a certifying body of individual competency according the occupational standard to the institute | 3) Recommend the name of at least 1 agency which is deemed to have the ability to serve as a certifying body of individual competency according the occupational standard to the institute |

| Old process | Proposed new process |
|---|---|
| with approval from the endorsement board | with approval from the endorsement board |
| 4) Summarize the results of the establishment of occupational standard and professional qualification | 4) Summarize the results of the establishment of occupational standard and professional qualification |
| 5) Publicize to entrepreneurs, personnel in professional group, relevant government agencies and private sector to know the results of the establishment of occupational standard and professional qualification through various media channels in total no fewer than 5 work pieces such as newspaper (size not smaller than 6 x 5 column inches), magazine, journal, internet, PR board, television, radio, and press conference, etc. | 5) Publicize to entrepreneurs, personnel in professional group, relevant government agencies and private sector to know the results of the establishment of occupational standard and professional qualification through various media channels in total no fewer than 5 work pieces such as newspaper (size not smaller than 6 x 5 column inches), magazine, journal, internet, PR board, television, radio, and press conference, etc. |
| | 6) Create a positive perception benefit through the media outreach to the target group. |
| 6) Produce the final report according to the process, scope, and guideline of operation of the institute | 7) Produce the final report according to the process, scope, and guideline of operation of the institute |
| 7) Produce the manual of the use of occupational standard and professional qualification | 8) Produce the manual of the use of occupational standard and professional qualification |
| 8) Establish occupational standard and professional qualification according to | 9) Establish occupational standard and professional qualification according to |

| Old process | Proposed new process |
|---|---|
| the format set by the institute | the format set by the institute |
| 9) Construct the assessment tools classified by occupations and professional qualification | 10) Construct the assessment tools classified by occupations and professional qualification |
| 10) Produce the manual for the examiners classified by occupations and professional qualifications | 11) Produce the manual for the examiners classified by occupations and professional qualifications |
| 11) Produce the manual for those who sit for the assessment | 12) Produce the manual for those who sit for the assessment |
| 12) Produce the hard copy of the written test papers to test knowledge and other test papers classified by occupations and professional qualification | 13) Produce the hard copy of the written test papers to test knowledge and other test papers classified by occupations and professional qualification |
| 13) Enter the information on occupational standard and professional qualification into the database providing services on professional qualification of the institute | 14) Enter the information on occupational standard and professional qualification into the database providing services on professional qualification of the institute |
| 14) Enter the written test papers to test knowledge and other test papers according to occupation and professional qualification classified by the unit of competence and performance criteria | 15) Enter the written test papers to test knowledge and other test papers according to occupation and professional qualification classified by the unit of competence and performance criteria |

## 4.5 Discussion

Based on the significance and the background of the research problems to produce and develop the personnel in all professional fields, including environmental profession, to have the Knowledge, Skill, Attribute of the persons who perform work

on environment with standard and on a par with international standards, a tool is therefore used to drive the standard which is professional qualification system. The professional qualification system is the center of the certification of manpower' s competency according to the occupational standard in response to the needs of the business and the industrial sectors. It is the mechanism to ensure that individuals are recognized for their ability and receive the professional qualification consistent with the competency, experience, and knowledge to use the professional qualification in the development of their profession for progress.

4.5.1 Occupational standard process in 1st Process consisted of public relations of the project to establish occupational standard and professional qualification to the target group in the profession. The objectives and the goals of this process are to invite the professional groups to express opinions in the establishment of occupational standard and professional qualification. The study results revealed that in this process there was a significant risk. That is, the manual of occupation standard determines the needs of the professional or industrial groups. In the beginning, the establishment of occupational standard or unit of competence for any enterprise group must start with the determination of the needs of the enterprise group or professional holder. There must be determination of the definition framework, definition, scope, economic activities, and clear goals of the needs inside and outside the enterprise group in order to devise the purpose and then formulate the action plan to meet the objectives of the enterprise group and develop the professional holders for higher outcome.(Thailand Professional Qualification Institute (Public Organization), 2022).

The determination of needs must start with Stakeholder Analysis, Cluster Analysis, Manpower Analysis, Demand-Supply Analysis, Performance Outcome Analysis, qualification certification system, certificate, curriculum, trainings, analysis of the requirements of labor standards, requirements of occupational standards, legal requirements, or professional licenses, and environment in exercising profession in the country. All must be in the form of Information that can confirm correctness and report to the community at the macro level in order to serve as the information to develop the occupational standard in the next process(Thailand Professional Qualification Institute (Public Organization), 2022).

The study results revealed that in terms of risk issue, the public relations did not reach the people in the professional groups and did not cover all groups. The relevant people did not know the overview of work in the entire project. There was risk as it was not consistent with the determined manual. Therefore, in some professional fields, there was risk and impacted the next process of professional standard development. The study results show the risk conducted analysis and assessment, and recommended the guideline of risk mitigation, risk management and control. Therefore, the risk was at low and moderate levels. It was also found that in some professions, there was no risk. As the operation followed the manual of occupational standard, there was no risk. It was found that from the review of the past research from foreign standards, the occupational standard related to environment was already established as the role model. For example, New Zealand' s occupational standard and professional qualification, occupation and professional qualification consistent or similar to the household waste management field, Solid Waste Disposal profession and Recycling and Recovery profession etc. Australia's occupational standard and professional qualification, Waste Management profession, occupational standard and professional qualification consistent or similar to waste and hazardous waste management field.(Thailand Development Research Institute, 2017).

4.5.2 Occupational standard process in Processes 3 and 5 were Conduct Functional Analysis to be proposed to the endorsement board for approval and Trail assessment tools with the target group, propose the endorsement board for approval. The manual of the occupational standard determined the functional analysis of the professional groups or industrial groups. Functional analysis consisted of Activity or Outcome that created value added to the enterprise at various levels based on the principles of work analysis, activity classification, or behavior in performing duty from good outcome. The process must be systematically undertaken in detail because good outcome consisted of activities which were major and minor work combined in Productivity, Goods or Product, and Service which integrated necessary knowledge, necessary skills, and competency (Thailand Professional Qualification Institute (Public Organization), 2022).

4.5.3 Functional analysis is the group of activity in writing job description which is important and must follow the Role to achieve the Purpose of the enterprise group. (Kylie Good, 2015; Riel, 1992). It identifies the competency of specific work and is narrated in the form of outcome of routine work. The functional analysis will enable one to see the scope of each profession which is different according to the role as prescribed by the enterprise group. So, the definition of exercising profession from occupational standard is understood as to what the profession exercising people must be able to do, what knowledge and skills are necessary, what is the standard of good outcome. In the Functional Analysis, the outcome is written in the form of narration which is the activity-based outcome as Key Function which is Key work, and Unit of Competence which is minor work. There are the details of the performance criteria, individual qualifications, knowledge, necessary skills, scope of work, and evidences which will be used to designate the criteria or standard in assessing individual' s performance for various objectives (Thailand Professional Qualification Institute (Public Organization), 2022).

4.5.4 In terms of the development of the unit of competence and the establishment of occupational standard, the establishment of occupational standard is the demand of the enterprise groups and the professional holders that jointly operate to achieve the central standard used to determine the desired qualification in performing duty by focusing on the outcome of work with good outcome or what is called work competency or professional competency derived from the functional analysis in enterprises or enterprise groups. It is determined as the Key Activity or Key Role consisting of more than 1 person to cooperate and divide the duty and responsibility that each person must perform. It determines the Key Function consisting of the Unit of Competency which determines that only one person can successfully perform tasks alone. (National Qualifications Framework Committee, 2017).

4.5.5 National Qualifications Framework Committee (2017) desired qualification in employment in various dimensions so as to know the scope of duty, responsibility, job description, and outcome of work that must be done by one person alone, and clear determination of job description in each profession. Thailand determines the framework as qualification level called Thailand Profession Qualification Framework (TPQF) in total 8 levels. In establishing professional qualification, one needs to understand the desired

qualifications in the 8 levels of the professional qualification framework and considers the determined needs of the establishments in the enterprise group by reading in detail the job description, levels of difficulty and easiness of work, scope of responsibility, and verb, objective at work as explained in the Unit of Competence and then arranged in group called "Occupational standard and professional qualification". Then, they will be designated as professional field, field, names of occupation, and levels of professional qualification. The determination of occupations should consider their congruity and linkage according to the international standard occupational classification (International Standard Classification of Occupational- 08: ISCO – 08) and classification of the types of occupational standard (Thailand) by Department of Employment as well (Office of the Education Council, 2017; Williams, 1999).

4.5.6 Personnel competency was developed with the use of Functional Analysis from the study of the occupational standard and professional qualification in foreign countries. It is the study and data analysis in the form of details in determining qualification level and the details of the Unit of Competence, Element of Competence, Performance Criteria, Range Statement, required evidence of work and knowledge (Evidence Requirements), and Assessment Guidance or comparable. Some professional fields in some countries may not have occupational standard and professional qualification that match the particular professional field (Thailand Development Research Institute, 2017) . But there appears the professional competency in occupational standard and professional qualification of the industrial groups such as in Australia, the occupational standard and professional qualification are established in the form of Training Package which has the competency of numerous professional fields and has the professional competency operated in the project. (Watson et al., 1999).

Functional Analysis is the analysis of profession from the brainstorming of the personnel in the professional group to designate the scope of duty and work content by starting from the construction of the Functional Map consisting of Key Purpose, Key Role, and Key Function to set up Unit of Competency, and Element of Competency (Stewart & Sambrook, 1995). .

The study results revealed the risks in the 2 processes namely Functional Analysis does not cover all professions and Functional Analysis is not general, but specific, not covering actual professions. It causes significant risk that impacts the

determination of the qualification of each profession as it is not consistent with the manual of occupational standard establishment as set. Therefore, it is not possible to determine the details in the occupational standard that is consistent with the actual professional groups and impact on the construction of the individual competency assessment tools according to the occupational standard. The test questions are very academic and too difficult, not reflecting the actual competency, and the assessment tools cannot measure the KSA completely. But on the issue, some professional fields do not find the risk issue so it does not lead to the risk identification, risk analysis, and risk assessment. For example, New Zealand' s occupational standard and professional qualification, occupation and professional qualification that is consistent or similar to municipal waste management field, Solid Waste Disposal profession, and Recycling and Recovery profession, etc., Australia' s occupational standard and professional qualification, Waste Management profession, the occupational standard and professional qualification consistent or similar to waste and hazardous substance management field.(Rodrigues et al., 2014; Thailand Development Research Institute, 2017).

4.5.7 In the study to ensure the efficient occupational standard and professional qualification, the study was conducted to construct the management model from the initial process by assessing the situations of the likelihood of risk, and having the trend or impact which will prevent the establishment of occupational standard and professional qualification from reaching the objectives by considering the likelihood of the event and the scale of the impact. The study results revealed that all processes had the likelihood of risks, delaying the project, causing technical mistakes, and the planned process unable to proceed as planned. This is in line with the principles of risk assessment according to the guideline of ISO 31000:2009 (Rovins & A., 2015) basic principles of risk management according to the risk management process of ISO 31000:2009 (SW**,** 2009) and Project Risk Management which is the operational risk that allows the project to complete within the set timeframe. (Dawn Henry**,** 2002) The risk management framework can be operated through planning, risk identification, risk analysis, planning in response to risks, monitoring and control of risk management, or cautious planning of risk management in appropriate process. (PMI Europe, 2001). In terms of operational risk and technical risk, without formulating the action plan for rectification, monitoring, and assessment, serious damage can happen to the project. Therefore, the project

manager or leader must stress the importance of risk management by integrating it into the project' s management plan and conducting risk assessment, risk analysis, risk prioritization and control. It is believed that the project will meet with success. This is in line with the study on risk analysis and assessment, risk control and management, as well as recommendation of the occupational standard process so as to find the appropriate procedure or process for the occupational standard and professional qualification process for environmental personnel according to the principle as summarized in Project Risk Management of Dawn Henry (2002); Project Management Process Improvement Office (2003); Sanguan ChangChat (2004).

4.5.8 The research result that propose the new process for established occupations and professional qualification that consistent with the examples of occupations and professional qualification to community solid waste management of Australia's occupational standards and professional qualification is as follow: ( Thailand Development Research Institute, 2017)

4.5.8.1 Common competency: 1) Demonstrate independence and creativity in identifying problems 2) Solve problems regarding customers' concerns from work obligations 3) Make decisions on concerns at work 4) Collect, analyze, and manage information 5) Monitor and evaluate operating results etc.

4.5.8.2 Specific competency: Prepare before transporting municipal waste 2) Loading and unloading non-hazardous and hazardous municipal waste into vehicles 3) Carry out community waste transportation 4) Control traffic at waste sites 5) Express knowledge on filling up the landfill 6) Oversee vehicles for waste compression over the landfill 7) Prepare the vehicle, tools, equipment before transporting infectious waste 8) Inspect and control volume of waste 9) Plan and manage community waste transportation 10) Identify, separate, and control waste 11) Express knowledge on environmental control for the landfill 12) Separate hazardous community waste that can be recycled 13) Plan the operation of the landfill site and 14) Control operations at the landfill etc.

# CHAPTER 5
# CONCLUSION AND FUTURE RESEARCH

## 5.1 Conclusion

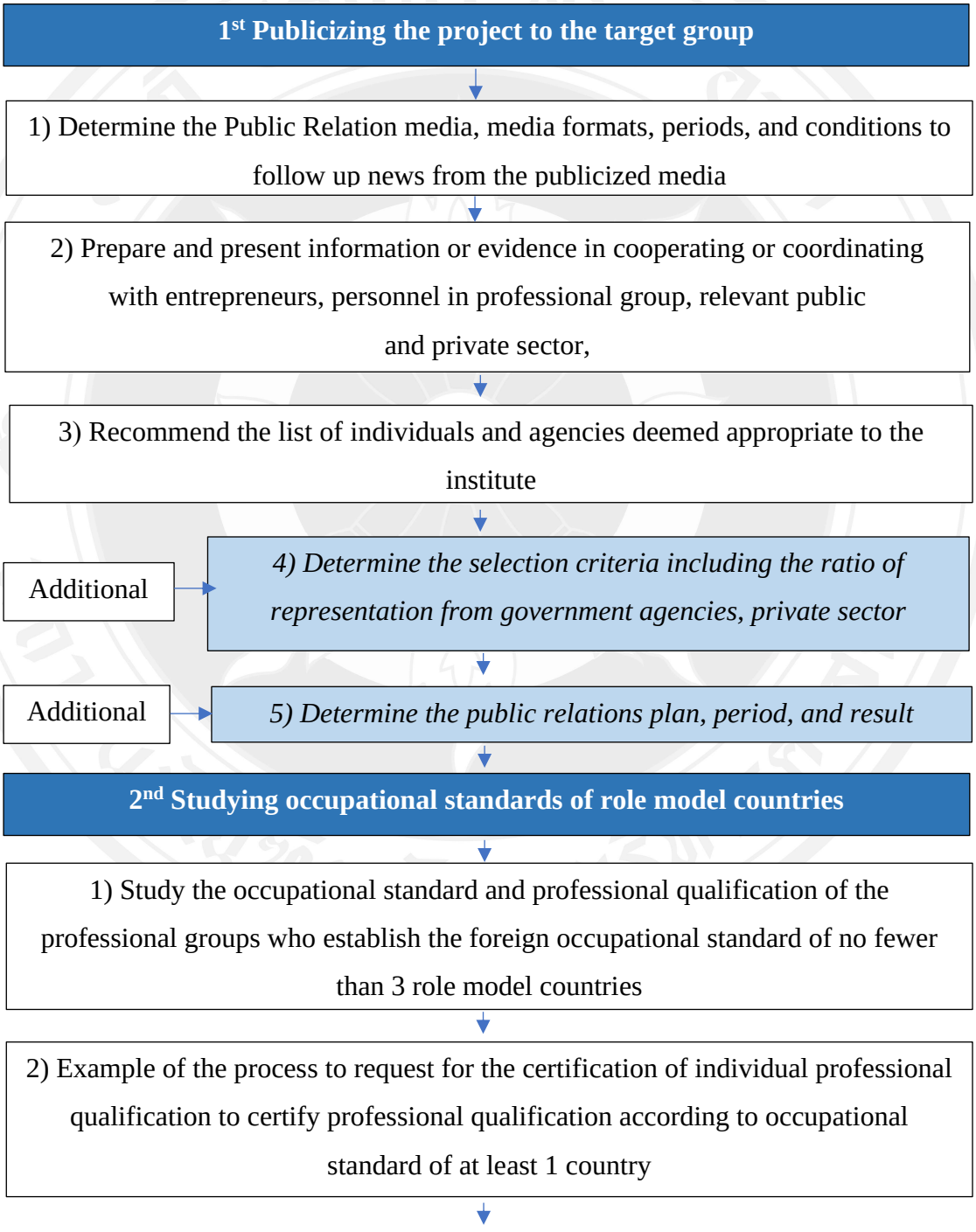
This qualitative research aimed to conduct the risk assessment in occupational standard and professional qualification process for environmental work and develop the occupational standard process, the study results corresponded to the Objective 1) "To conduct risk assessment and develop the processes of establishing occupational standards and professional qualification related to environmental works" 2)"To propose risk management guideline for the processes of establishing occupational standards and professional qualification related to environmental work", and 3) "To propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency.

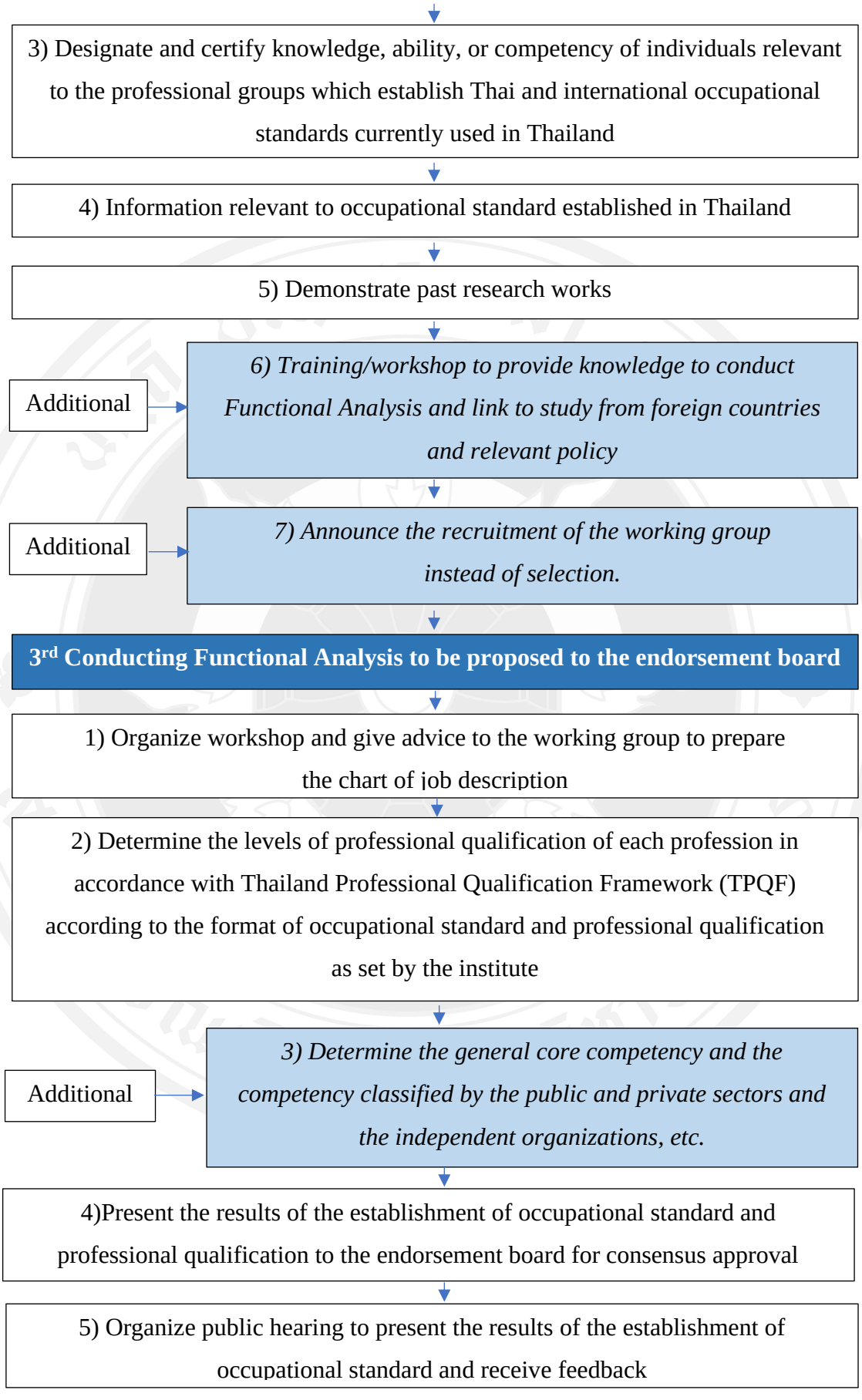
The study collected the data from the Key Informants based on purposive sampling such as the consultants, the working group, and endorsement board in total 49 sample with the semi-structured interviews from 7 professional fields namely 1) Smart farmer 2) Economic crops (Palm oil) 3) Petroleum & petrochemical industry 4) Energy & alternative energy (Energy Management) 5) Biotechnology (Environment) 6) Environment & Hazardous substances and 7) Green space management business.

The data analysis was conducted with the content analysis to conclude and interpret according to the principle of risk assessment and the occupational standard process namely 1) Publicizing the project to the target group 2) Studying occupational standards of role model countries 3) Conducting Functional Analysis to be proposed to the endorsement board for approval 4) Making assessment tools based on occupational standards, and assess quality of tools and 5) Testing assessment tools with the target group, propose the endorsement board for approval.

The study results found the significant risks from the risk indication and risk analysis at low risk level means no potential for serious consequences, risk

assessment is not essential and moderate risk levels means potential for moderate consequences, risk assessment is recommended with risk control and management. The process that was improved and developed from 3 issues namely (1) Risk identification (2) Risk analysis and evaluation and (3) Risk treatment/management, The conclusion of the whole process to propose the new processes of establishing occupational standards and professional qualification as follows:




3) Designate and certify knowledge, ability, or competency of individuals relevant to the professional groups which establish Thai and international occupational standards currently used in Thailand
4) Information relevant to occupational standard established in Thailand
5) Demonstrate past research works
Additional
6) Training/workshop to provide knowledge to conduct Functional Analysis and link to study from foreign countries and relevant policy
Additional
7) Announce the recruitment of the working group instead of selection.
3rd Conducting Functional Analysis to be proposed to the endorsement board
1) Organize workshop and give advice to the working group to prepare the chart of job description
2) Determine the levels of professional qualification of each profession in accordance with Thailand Professional Qualification Framework (TPQF) according to the format of occupational standard and professional qualification as set by the institute
Additional
3) Determine the general core competency and the competency classified by the public and private sectors and the independent organizations, etc.
4)Present the results of the establishment of occupational standard and professional qualification to the endorsement board for consensus approval
5) Organize public hearing to present the results of the establishment of occupational standard and receive feedback

6) Recommend the names of at least 3 experts deemed appropriate for selection and approval as the assessors of the quality of the competency assessment tools according to occupational standard.

**4th Developing assessment tools and evaluating their quality.**

1)Analyze occupational standard to construct the assessment tools in each unit of competence by classifying into the tools to measure knowledge, skills, and others

Additional → *2)Determine the ratio and duration that are appropriate for academic and practical test papers*

3) Determine the assessment methods and construct the assessment tools according to the guideline of assessment in all levels of all professional qualifications according to occupational standard covering all performance criteria in the unit of competence according to occupational standard as well as answers, and in confidentiality

4) Assess the quality of the assessment tools and the test papers by no fewer than 3 experts, and in confidentiality.

**5th Testing assessment tools with the target group, propose the endorsement board for approval.**

1) Designate the target group in the assessment tool test of no fewer than 3 professional qualifications, no fewer than 10 persons in each professional qualification without those sitting for the assessment to sit for the assessment in the professional qualification undergoing the assessment test except the professional group with the level of fewer than 3 professional qualifications according to occupational standard

Additional → *2) Facilitate a meeting for understanding and self-assessment among the testing groups and examiners*

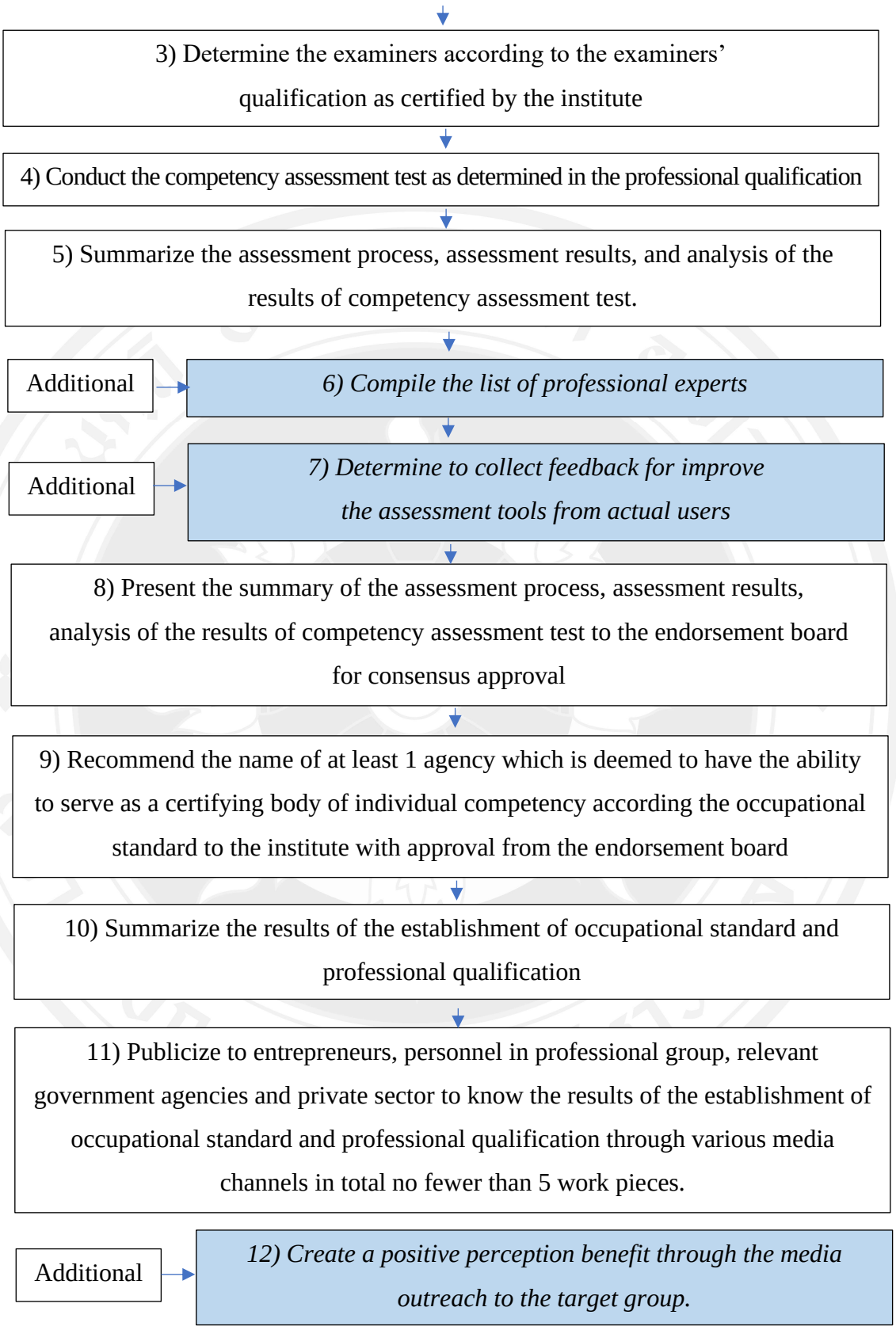



Figure 5.1-1 Conclusion flow chart

## 5.2 Limitation

Based on the study according to the objective (1) " To conduct risk assessment and develop the processes of establishing occupational standards and professional qualification related to environmental works" (2) "To propose risk management guideline for the processes of establishing occupational standards and professional qualification related to environmental works" and 3) "To propose the processes of establishing occupational standards and professional qualification acquired after the improvement of existing process for more efficiency". The limitations in the study were as follows:

5.2.1 Select the occupational standard and professional qualification as the role model profession and as the representative to provide information of the professional groups relevant to environment. It is found that some professional fields have been established for a long time. The selected sample as the Key Informants have changed their affiliation and office so other key informants who can be contacted are replaced.

5.2.2 The sample who are representatives in providing information for professional fields have been established for a long time. The limitation is that the sample cannot accurately remember some process to establish occupational standard and professional qualification so the information is not sufficient or complete. As a result, the process has to be revised and additional interviews have to be conducted.

5.2.3 In risk analysis, after identifying the risk issues in the process to establish the particular occupational standard, most sample assess that " there is no risk" or " the risk is acceptable." Therefore, the risk assessment requiring risk management or recommending the preventive measures can recommend only some professional fields.

5.2.4 The principles establishing occupational standard and professional qualification are widely used in some countries only. Thus, there is a small number of research work to support the study. Therefore, mostly the researcher had to conduct the study, analysis, and discussion based on the relevant principles, theories, and concepts, so if the results are to be expanded, other factors should be studied.

## 5.3 Application for Government Policy

5.3.1 The outcomes of this research hold practical applicability for government agencies involved in manpower policies, such as the Department of Skill Development, the Vocational Education Commission, and other educational bodies. These bodies can effectively utilize the established processes to formulate guidelines for enhancing skill standards, fostering Competency-Based learning, and more. Additionally, this research underscores the potential for streamlining existing procedures for developing occupational standards and professional qualifications. It is advised that these revisions take into account factors such as optimal timing, resource allocation, and budgeting to ensure the efficiency and effectiveness of the standards.

5.3.2 The result of occupational standard and professional qualification process for environmental works are able to apply to changes in implementing environmental works made by environmental personnel. These personnel would be able to perform their works efficiently and able to compliance with functional competencies, and performance criteria.

5.3.3 The new processes of establishing occupational standards and professional qualification are able to apply to other occupational standards and professional qualification related to environmental works or related other field to improving the processes, as well as further developing and revising occupational standards and professional qualification to fulfill requirements of the performance criteria in the occupational standard.

5.3.4 If the results of this research are to be further expanded, the possibility of allocating additional resources such as time, personnel and related resources should be considered. This may have an outcome, impact on various factors. Table 5.3-1 show such factors, propose additional activities and limitations/suggestion from research result.

Table 5.3-1 Factors, propose additional activities and limitations/suggestion from research result

| Research result | Factor | Propose additional activities | Limitation/Suggestion |
|---|---|---|---|
| 1. Determine the selection criteria including the ratio of representation from government agencies, private sector entitles, and independent organizations. | - | Defining sub-objectives and sub-goals in subprocesses | More working step from all processes |
| 2. Determine the public relations plan, period, and result dissemination. | - Operation timeframe<br>- Budget/costs | Increasing of duration time to operate and budget | - The implementation period is only 1-1.5 years.<br>- The budget depended on the approval of the Budget Bureau each year |
| 3. Organize training/workshop to provide knowledge to conduct Functional Analysis and link to study from foreign countries and relevant policy. | - Budget/costs<br>- Operation timeframe<br>- Personnel | More training/workshop | - It is necessary to add manpower and budget for organizing training/workshop.<br>- Rotate the budget and people from other activities to organize training. |
| 4. Announce the recruitment of the working group | - Techniques and | Application channel | - Variety of applicants are expected.<br>- Clear selection |

| Research result | Factor | Propose additional activities | Limitation/Suggestion |
|---|---|---|---|
| instead of selection. | methods | | criteria must be set. |
| 5. Determine the general core competency and the competency classified by the public and private sectors and the independent organizations etc. | - Techniques and methods | Knowledge in Functional Analysis | No database of experts in each profession |
| 6. Determine the ratio and duration that are appropriate for academic and practical test papers. | - Techniques and methods | Find experts in theoretical exams, interviews, practice, etc. | No database of experts in each profession |
| 7. Facilitate a meeting for understanding and self-assessment among the testing groups and examiners. | - Budget/costs<br>- Operation timeframe<br>- Personnel | Set up additional preparation meeting before assessment process. | - Need manpower and budget<br>- Rotate budget and people from other activities to organize meeting. |
| 8. Compile the list of professional experts. | - Personnel | Add manpower to action | Rotate manpower from other activities to survey experts. |
| 9. Determine to collect feedback for improve the assessment tools from actual users. | - Personnel | Add activity and channel to receive feedback | - Need manpower and budget<br>- Rotate manpower from other activities to survey experts. |

| Research result | Factor | Propose additional activities | Limitation/Suggestion |
|---|---|---|---|
| 10. Create a positive perception benefit through the media outreach to the target group. | - Techniques and methods | Add activity and channel | - |

## 5.4 Contribution to SDGs

This study contributes to the achievement of sustainable development goals (SDGs) at least in 3 goals, i.e., Goal 4 quality education, Goal 8 decent work and economic growth and Goal 17 partnerships for the goals (United Nations, 2023).

- Goal 4 QUALITY EDUCATION; Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This study contributes to quality education as the outcomes of this research hold practical applicability for the vocational education commission and other educational bodies that contribute to the comprehensive curriculum design which is based on competency-based learning. and link to formal, informal or non-formal education. It also supports the concept of lifelong learning and necessary skill for work especially environmental works according to the objective of this goal ensuring that all learners receive the knowledge and skills necessary to support sustainable development.

- Goal 8 DECENT WORK AND ECONOMIC GROWTH; Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. This study contributes to employment that meets the knowledge and abilities set in occupational standards which related to the objectives of the goal which are achieving full and productive employment, having decent work for every woman and man, and reducing the proportion of unemployed youth without education and those who have not received training.

- Goal 17 PARTNERSHIPS FOR THE GOALS; Strengthen the means of implementation and revitalize the global partnership for sustainable development. This study contributes to the objective of enhancing policy consistency for sustainable

development from the development of the education sector and manpower sector especially environment, agricultural and energy that related to goals 4 and 8. Achievement of this research work are resulted from multi organization cooperation and enhance the partnership for the goals.

## 5.5 Future Research

Future Research should be enhanced on the occupational standard and professional qualification and utilized to respond to the needs of a particular professional group, whether they correspond to the required competency and whether the relevant agencies and professional groups can utilize them to develop the country's manpower, education, enhanced development and modified instruction curriculum in line with the demand of entrepreneurs. These people can work efficiently, appropriate to their competency, and proper performance criteria.

Expected outcome of this research would like to push forward changes in implementing environmental work made by environmental personnel. These personnel would be able to perform their tasks efficiently, in compliance with competencies and performance criteria and provide to user such as Thailand Professional Qualification Institute (Public Organization), Ministry of Labor, Ministry of Education, vocational, formal, non-formal, Ministry of Higher Education, Science, Research and Innovation, Ministry of Industry Etc.

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# APPENDICE

## MATERIAL: SEMI-STRUCTURED INTERVIEW FORM

**Interview form**

**Risk assessment of occupational standard and professional qualification process for environmental works**

**Objectives**

This interview form is prepared to study the risk assessment and the development of occupational standard and professional qualification process for environmental work in order to acquire the recommendations on the guideline of risk management of the occupational standard and professional qualification process, and recommend the occupational standard and professional qualification process which is improved and developed from the old process for higher efficiency.

**Part 1 Information on the issue of risks in the occupational standard and professional qualification process**

**Elaboration,** please answer the questions that correspond to the fact as much as possible.

**Explanation**

1) Identify the occupational standard process
2) Consider if the objectives of the particular occupational standard process are congruent with the objectives of occupational standard process? How?
3) Identify the goal of each objective and the relevant goal as determined
4) Risk issues/potential risk situations that impact the objectives of the operation in (2) so that the goals set in (3) cannot be reached
5) Consider the factors/causes of risk that result in risk issues/risk situations in (4)
6) Assess risk to rank the importance of risk issues in (4)
   6.1) Compare the likelihood of factors/causes of risk in (5) with the number of mistakes. If frequent, the score = 5, the score = 1, etc.
   6.2) Compare the damage, if the objective cannot be reached within the set timeframe and /or the activity cannot be undertaken, if it is very serious = 5

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| **Preparation** | | | | | | |
| 1) Formulate all the detailed action plan | Determine the period of operations, activities, expected outcome from the activities, and persons responsible for monitoring to ensure that the project proceeds as planned | Detailed action plan | | | | |
| 2) Delivery plan | To determine the delivery according to the conditions as specified in the TOR with clear delivery date for common understanding according to the date as set in the TOR | Delivery plan | | | | |
| 3)Disbursement plan | To determine the period of disbursement and disbursement budget in each installment | Disbursement plan | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| 4) Recommend the names of the individuals and agencies deemed appropriate to the institute | To consider the selection and approval as the endorsement board consisting of no fewer than 3 representatives from associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others in the professional groups, no fewer than 2 experts in the professional groups, 1 representative each from relevant government agency with no fewer than 1 agency, and 1 | List of the endorsement board who are stakeholders with the qualifications as prescribed by the project to perform the following duty (1) Provide advice, recommendations, opinions on occupational standard establishment to the consultant team (2) Certify occupational standard and professional qualification and (3) Certify assessment process, assessment results, and results of the analysis of competency assessment test | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | representative from the institute, in total no fewer than 9 persons | | | | | |
| **1st Process: Public relations of projects** | | | | | | |
| 1) Public relations of projects | Publicize to entrepreneurs, personnel in professional groups, relevant public and private sectors so that they know of the occupational standard and professional qualification establishment projects | Various media channels in total no fewer than 5 work pieces | | | | |
| 1.1) Determine the PR media that matches the stakeholders in the profession | Determine the PR media that matches the stakeholders in the professions | Newspaper (Size not smaller than 6 x 5 column inches), magazine, journal, internet, public relation board, television, radio, press | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | | conference, etc. | | | | |
| 1.2) Produce and present the information or evidence of operation and coordination with entrepreneurs, personnel in professional group, relevant public and private sectors, and general public | To invite entrepreneurs, personnel in professional groups, relevant public and private agencies, and general public to participate in the establishment of occupational standard and professional qualification | No fewer than 50 entrepreneurs, personnel in professional groups, relevant public and private agencies, and general public | | | | |
| 2) Study and analyze the information relevant to the target professional groups for considering the establishment of occupational standard and professional qualification as follows: | Study the information based on literature review as role model in determining the competency according to occupational standard | Results of the study, analysis, synthesis, and comparison | | | | |
| 2.1) Study the | Study the | Study the | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| occupational standard and professional qualification of professional groups who establish foreign occupational standard as role model in total no fewer than 3 countries with at least 1 AEC member country (if available) | information based on literature review to serve as role model in establishing the competency according to occupational standard | occupational standard and professional qualification of the professional groups who establish foreign occupational standard as role model in total no fewer than 3 countries and, for the studied countries, the study must be conducted in detail for each country consisting of the detailed determination of the levels of qualification, the detailed occupational standard consisting of Unit of Competence, Element of Competence, Performance Criteria, Range | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | | Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance, or details of other comparable standards | | | | |
| 2.2) Example of the process to request for certification of individual professional qualification in order to certify the professional qualification according to occupational standard from at least 1 country | Study the information based on literature review as role model in determining the competency according to occupational standard | Example of the process to request for certification of individual professional qualification in order to certify the professional qualification according to occupational standard from at least 1 country | | | | |
| 2.3) Determine and certify knowledge, ability, or individual competency relevant to the | To study the current situations of Thailand's certification | Certify knowledge, ability, or individual competency | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| professional groups who establish Thaiand international occupational standards currently used in Thailand | | | | | | |
| 2.4) Information relevant to occupational standard established in Thailand | To study the information relevant to occupational standard established in Thailand | Information in the industry, role of public and public sectors, relevant laws, and other information such as policies, action plans, national economic and social development plans, ministerial plans, etc. | | | | |
| 2.5) Present the information of past research | Present the information of past studies in the form of research | Information of past research | | | | |
| 3) Present the results of the study and analysis | Present the results of the study to the institute to consider the sufficiency of the information in | The study results consisting of framework, methods, action plans, roles and duties of various | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | order to establish the occupational standard]] | sectors, as well as advice or guideline recommendation, and feedback from the endorsement board, the working group, personnel and experts in professional groups such as associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others, and relevant government agencies and the private sector to participate in total no fewer than 50 persons | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | | (excluding the endorsement board, the working group, and the consultant team) | | | | |
| 4) Recommend the list of individuals and agencies deemed appropriate to the institute for selection and approval as the working group | To enable the institute to consider the qualifications, covering the stakeholders in the professions | Recommend the list of individuals and agencies deemed appropriate to the institute for selection and approval as the working group | | | | |
| **3rd Process: Establishment of occupational standards** | | | | | | |
| 1) Establish occupational standard by using the technique of Functional Analysis covering the work levels, from basic to advanced, with the following operation**:** | Conduct Functional Analysis according to principles | | | | | |
| 1.1) Organize | | Functional Map | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| workshop and provide advice to the working group | | consists of (1) Functional Map at the initial stage such as Key Purpose, Key Role, Key Function (2) Functional Map at the later stage such as Unit of Competence consisting of Element of Competence, Performance Criteria, Range Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance, identifying the codes and the names of the occupations according to the relevant international | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| | | standards (if available) | | | | |
| 1.2) Determine the levels of professional qualification of each occupation based on Thailand Professional Qualification Framework (TPQF) according to the occupational standard and professional qualification as determined by the institute | To determine the levels of professional qualification of each occupation in line with Thailand Professional Qualification Framework | Qualification levels that are correct according to the TPQF framework | | | | |
| 2) Present the results of the occupational standard and professional qualification establishment to the endorsement board for consensus approval | To receive recommendations from the endorsement board | Results of approval of occupational standards | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| 3) Organize public hearing to present the results of the occupational standard and receive feedback | To listen to opinions from the stakeholders in all sectors | Opinions from the stakeholders from all sectors in particular entrepreneurs, personnel and experts in the professional groups in total no fewer than 50 persons. If it is necessary to improve details following the results of the public healing, the improved version will be submitted to the endorsement board for approval once again. | | | | |
| 4) Recommend the list of at least 3 experts deemed appropriate for the selection and approval as assessors of the quality of | To assess the quality of the tools that are academically correct from appropriate experts | Appropriate experts and efficient assessment tools | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| assessment tools for competency assessment according to the occupational standard | | | | | | |
| **4th Process: Developing assessment tools and evaluating their quality** | | | | | | |
| 1) Conduct assessment, assessment tools, and test papers to test knowledge, consisting of the following: | Conduct assessment, assessment tools, and test papers to test knowledge from the sample, improved and rectified for correctness and appropriateness | Assessment tools that pass the try out and are improved and rectified for completeness | | | | |
| 1.1) Analyze the occupational standard to construct the assessment tools in each unit of competence classifying into the tools to measure knowledge, skills, and others | Select the assessment tools that are appropriate to competency assessment according to performance criteria | Assessment tools that are appropriate to the competency assessment | | | | |
| 1.2) Determine the assessment | Determine the assessment | Appropriate assessment tools | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| methods and construct the assessment tools according to the assessment guideline in all levels of all professional qualifications according to occupational standard by covering all performance criteria in the unit of competence according to the occupational standard, as well as the answers, in confidentiality | methods appropriate to competency assessment according to performance criteria | to assess competency | | | | |
| 2) Assess the quality of assessment tools and test papers by no fewer than 3 experts, in confidentiality | To assess the quality of tools that are academically correct from appropriate experts | Efficient assessment tools | | | | |
| **5th Process: Testing assessment tool** | | | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| 1) Conduct competency assessment test as prescribed in the professional qualification of the target professional groups with the constructed assessment tools, as follows: | Conduct competency assessment test as prescribed in the professional qualification of the target professional groups with the constructed assessment tools | Efficient assessment tools | | | | |
| 1.1) Determine the target group for assessment tool test with no fewer than 3 professional qualifications and no fewer than 10 persons per professional qualification without those sitting for the assessment to sit for the assessment in | Determine the target group for assessment tool test | Efficient assessment tools | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| the professional qualification undergoing the assessment test except the professional groups with the levels of professional qualification according to occupational standard with fewer than 3 professional qualifications | | | | | | |
| 1.2) Determine the examiners according to the examiners' qualifications certified by the institute | To acquire the examiners according to the examiners' qualifications in order to control assessment process according to the set standard | Assessment process according to set standard | | | | |
| 1.3) Conduct competency assessment test according to professional qualification | Conduct competency assessment test according to professional qualification | Results of assessment test | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| 1.4) Summary of assessment process, assessment results, and results of analysis of competency assessment test | Know the assessment process, assessment results, and results of analysis of competency assessment test | Assessment process, assessment results, and results of analysis of competency assessment test | | | | |
| 2) Present the summary of assessment process, assessment results, and results of analysis of competency assessment test to the endorsement board for consensus approval | Know the summary of assessment process, assessment results, and results of analysis of competency assessment test, and approval of the endorsement board | Truly applicable assessment process | | | | |
| 3) Recommend the name of at least 1 agency deemed able to serve as the certifying body of individual | Know the agency that will serve as the certifying body of competency assessment | Agency that will serve as the certifying body of competency assessment | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| competency according to occupational standard to the institute with approval by the endorsement board for consideration | | | | | | |
| 4) Summarize the results of the establishment of occupational standard and professional qualification | Know the results of the establishment of occupational standard and professional qualification in the entire process | Results of the establishment of occupational standard and professional qualification in the entire process | | | | |
| 5) Publicize to entrepreneurs, personnel in professional groups, relevant government agencies and private sector so that they know about the establishment of occupational standard and professional | To enable the stakeholders in the professions to know about the establishment of completed occupational standard ready for assessment and certification of individuals | Entrepreneurs, personnel in professional groups, relevant government agencies and private sector to know about the results of the establishment of occupational standard and professional qualification | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| qualification via various media channels in total no fewer than 5 work pieces such as newspaper (with the size not smaller than 6x5 column inches), magazine, journal, internet, public relation board, television, radio, press conference, etc. | | | | | | |
| 6) Produce the final report according to the process, scope, and operational guideline of the institute | Know about the final report according to the process, scope, and operational guideline of the institute | Final report according to the process, scope, and operational guideline of the institute | | | | |
| 7) Produce Occupational Standard and Professional Qualification Manual | To acquire Occupational Standard and Professional Qualification Manual | Occupational Standard and Professional Qualification Manual | | | | |
| 8) Produce occupational standard and | To acquire occupational standard and | Occupational standard and professional | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| professional qualification according to the format as determined by the institute | professional qualification according to the format as determined by the institute | qualification according to the format as determined by the institute | | | | |
| 9) Produce tools used for assessment classified by occupations and professional qualification | To acquire the tools used for assessment classified by occupations and professional qualification | Tools used for assessment, classified by occupations and professional qualification | | | | |
| 10) Produce manual for the examiners classified by occupations and professional qualification | To acquire manual for the examiners classified by occupations and professional qualification | Manual for the examiners classified by occupations and professional qualification | | | | |
| 11) Produce manual for those who undergo assessment | To acquire manual for those who undergo assessment | Manual for those who undergo assessment | | | | |
| 12) Produce hard copy of the written test papers to test knowledge and other test papers classified by | To acquire the written test papers to test knowledge and other test papers classified by occupations and | Written test papers to test knowledge and other test papers classified by occupations and professional | | | | |

| (1) Occupational standard process | (2) Objectives | (3) Goals | (4) Risk issues/ risk situations | (5) Risk factors/ causes | Risk assessment (6) | |
|---|---|---|---|---|---|---|
| | | | | | Likelihood of risks (1-5) | Impact (1-5) |
| occupations and professional qualification | professional qualification | qualification | | | | |
| 13) Enter the information of occupational standard and professional qualification into the database providing services of professional qualification of the institute | Enter the information of occupational standard and professional qualification into the database providing services of professional qualification of the institute | As database | | | | |
| 14) Enter the written test papers to test knowledge and other test papers according to the occupations and professional qualification classified by unit of competency and performance criteria | Enter the written test papers to test knowledge and other test papers according to the occupations and professional qualification classified by unit of competency and performance criteria | As database | | | | |

**Part 2 Risk management**

| Factors/causes of risk (4+5) | Risk control measures | Assessment results of risk control measures |
|---|---|---|
| | | |
| | | |

**Part 3 Guideline for management of remaining and newly found risks**

**Explanation,** please fill in the information that corresponds to the fact as much as possible

| Remaining risks/newly found risks | Risk level | Management guideline |
|---|---|---|
| | | |
| | | |

**Part 4** Recommendations on risk assessment and development of occupational standard and professional qualification process for environmental work

4.1 Recommendations on development of occupational standard and professional qualification process for environmental work (Take, Treat, Transfer, Terminate)

| **Process 1** |
|---|
| Formulate detailed action plans, delivery plan, and disbursement plan, as well as recommend the list of individuals and agencies deemed appropriate to the institute for selection and approval as the endorsement board |
| **Recommendation on risk management**<br>……..……<br>……<br>……..…… |

| **Process 2** |
| --- |
| (1) Publicizing to entrepreneurs, personnel in professional groups, relevant government agencies and the private sector to know about the results of occupational standard and professional qualification process via various media channels in total no less than 5 work pieces such as newspaper (the size not smaller than 6x5 column inches), magazine, journal, internet, public relation board, television, radio, press conference, etc., and present the information or evidence of the coordination with entrepreneurs, personnel in professions, relevant government agencies and the private sector, and the general public for invitation to participate in establishing the occupational standard and professional qualification<br>(2) Studying and analyze the information relevant to the target professional groups in order to establish the occupational standard and professional qualification by studying the occupational standard and professional qualification of the professional groups who produced the foreign occupational standard as role models from at least 3 countries and with at least 1 AEC country (if available). The countries under the study must have the details of each country consisting of the details of the determination of qualification levels, the details of occupational standard consisting of Unit of Competence, Element of Competence, Performance Criteria, Range Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance, or details of other comparable standards, and the example of the process of certification request for individual professional qualification to certify the professional qualification according to occupational standard of at least 1 country, designation and certification of knowledge, ability, and competency of individuals relevant to the professional groups that establish the Thai and international occupational standard currently used in Thailand. The information relevant to the occupational standard established in Thailand consists of information in the industry, roles of the government agencies and the private sector, relevant laws, and other information such as policies, action plans, national economic and social development plans, ministerial plans, and past research, etc.<br>(3) Present the results of the analysis from item (2) Framework, methods, action plans, and role and duty of various agencies, as well as counseling or |

recommendations of the guideline and public hearing from the endorsement board, the working group, entrepreneurs, personnel and experts in professional groups such as associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others, as well as relevant government agencies and the private sector for participation, with no fewer than 50 persons (excluding the endorsement board, the working group, and the consultant team)

( 4 ) Recommend the list of the individuals and agencies deemed appropriate to the institute for the selection and approval as the working group

**Recommendation on risk management**

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**Process 3**

(1) Establish occupational standard using the technique of Functional Analysis to cover all work levels from the basic to the advanced levels by organizing workshop, as well as providing advice to the working group to formulate the Functional Map consisting of the following:

(1.1) Functional Map such as Key Purpose, Key Role, Key Function

(1.2) Unit of Competence consists of Element of Competence, Performance Criteria,

Range Statement, required evidences of work and knowledge (Evidence Requirements), Assessment Guidance with identification of occupational codes and occupational names based on relevant international standards (if available), determination of the levels of professional qualification of each occupation in accordance with Thailand Professional Qualification Framework (TPQF) based on the format of occupational standard and professional qualification as determined by the institute

(2) Submit the results of occupational standard and professional qualification process to the endorsement board for consensus approval

(3) Organize public hearing to present the results of the establishment of occupational

standard and receive opinions from stakeholders from all sectors in particular entrepreneurs, personnel and experts in professional groups such as associations, federations, clubs, foundations, professional councils, federation of industries, chamber of commerce, and others, as well as relevant government agencies and the private sector for participation, with no fewer than 50 persons (excluding the endorsement board, the working group, and the consultant team). If it is necessary to improve details resulting from the public hearing, the improved results must be submitted to the endorsement board for approval again.

(4) Recommend the list of at least 3 appropriate experts for the selection and approval as assessors of the quality of the competency assessment tools according to the occupational standard

**Recommendation on risk management**

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**Process 4**

(1) Undertake assessment, assessment tools, and test papers to test knowledge consisting of analysis of occupational standard to construct the assessment tool in each unit of competence by dividing the tools to measure knowledge, skills, and others, and determine the assessment methods and construct the assessment tools according to the assessment guideline in all levels of all professional qualifications according to occupational standard covering all performance criteria in the unit of competence according the occupational standard, as well as answers, in confidentiality

(2) Conduct the assessment of the quality of the assessment tools and the test papers by at least 3 experts, in confidentiality

**Recommendation on risk management**

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| **Process 5** |
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| (1) Conduct the competency assessment test as determined in professional qualification of the target professional groups with the constructed assessment tools for no fewer than 3 professional qualifications, with no fewer than 10 persons per professional qualification, without those undergoing the assessment to sit for the assessment in the professional qualification undergoing the assessment test except the professional groups with the level of fewer than 3 professional qualifications according to occupational standard by the examiners certified by the institute, and make summary of the assessment process, assessment results, and analysis of the results of the competency assessment test<br>(2) Present the summary of assessment process, assessment results, analysis of competency assessment test to the endorsement board for consensus approval<br>(3) Recommend the name of no fewer than 1 agency deemed able to serve as the certifying body of individual competency according to occupational standard to the institute with the approval from the endorsement board for consideration<br>(4) Make summary of occupational standard and professional qualification process and publicize to entrepreneurs, personnel in professional groups, relevant government agencies and the private sector to know about the results of the occupational standard and professional qualification process via various media channels in total no fewer than 5 work pieces such as newspaper (the size not smaller than 6x5 column inches), magazine, journal, internet, public relation board, television, radio, press conference, etc.<br>(5) Produce final report according to the process, scope, and operational guideline of the institute, occupational standard and professional qualification manual, occupational standard and professional qualification based on the format determined by the institute, assessment tools classified by occupations and professional qualification, manual for examiners, manual for those who sit for assessment, test papers to test knowledge, and entry of the information on occupational standard and professional qualification into the institute’s database providing services for professional qualification |

**Recommendation on risk management**

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4.2 Additional recommendations

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**Thank you for your cooperation in answering the interview form**.

# BIOGRAPHY

| | |
|---|---|
| **Name-Surname** | Mali Chansunthorn |
| **Academic Background** | Master of Science in Environmental Science<br>Kasetsart University Year, 2002<br>Bachelor of Art in Community Development (Hons.)<br>Mahasarakham University Year, 1999 |
| **Experience** | Division Director, Division of Accreditations and Certifications at Thailand Professional Qualification Institute (Public Organization) Year, 2015-present<br>Expert for Business Foundation Development at Small and Medium Enterprises Development Year, 2013-2014<br>Consultant Level 3 at Management System Certification Institute (Thailand) (MASCI) Year, 2011-2013<br>Analyst Level 4 at National Science and Technology Development Agency (NSTDA) Year, 2007-2010<br>Environmental Scientist at Kasetsart University (Leampakpia Environmental Research and Development Royal Project) Year, 2000-2003 |