OCCUPATIONAL FRAMEWORK

SECTION E: WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES

DIVISION 37: SEWERAGE

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Occupational Framework
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ABSTRACT

Occupational Framework (OF) for Division E37 Sewerage was developed to address the analysis of the occupational areas in the Sewerage Industry. The main objectives of this OF are to provide an overall overview of the career path in the Sewerage Industry and related required skills. Based on National Water Services (SPAN) Commission Fact Book 2021, Sewage Treatment Plant (STP) has increased significantly from 6,871 STP in 2017 to 7,440 STP in 2021. Thus, proper career pathways and skills must be developed to cater to this expansion. The method applied in developing this OF is mainly Focus Group Discussion (FGD) and supported by a survey under three (3) major phases, including Information Gathering, Expert View and Expert Verification. FGD sessions were conducted using the Nominal Group Technique (NGT) approach to obtain qualitative consensus from 10 industry expert panels. The quantitative responses from 100 respondents of the validated survey questionnaire were analysed through Statistical Package for the Social Sciences (SPSS). The developed OF has also undergone usability verification by the stakeholders and industry players. Based on the FGD session, a total of five (5) occupational areas and 33 job titles have been determined. For skills in demand, the experts agreed that knowledge of sewerage operation is the most important aspect, followed by troubleshooting and IT literacy. Quantitatively, the demanded competency skills are strong technical aptitude (natural ability) / manual dexterity (hands-on) and a general attitude towards work (Commitment, resourcefulness, teamwork, etc.). The experts have also characterized 30 job titles identified as critical and 23 jobs classified as relevant to Industrial Revolution (IR). A total of twelve (12) established National Occupational Skills Standards (NOSS) were identified from the list of NOSS registered on 21 April 2022 and mapped onto the developed OS. The overall finding showed that the sewerage occupational framework had been successfully developed in accordance with the identified research objectives.

ABSTRAK

Kerangka pekerjaan (OF) bagi Bahagian E-37 Pembetungan dibangunkan untuk menganalisis bahagian pekerjaan bagi industri pembetungan. Objektif utama OF ini adalah untuk menyediakan gambaran keseluruhan tentang laluan kerjaya dalam Industri Pembetungan dan kemahiran yang diperlukan berkaitan. Berdasarkan Buku Fakta Suruhanjaya Perkhidmatan Air Negara (SPAN) 2021, Loji Rawatan Kumbahan (STP) telah meningkat dengan ketara daripada 6,871 STP pada 2017 kepada jumlah keseluruhan 7,440 STP pada 2021. Justeru, laluan dan kemahiran kerjaya yang betul mesti dibangunkan untuk menampung perkembangan ini. Kaedah utama yang digunakan dalam membangunkan OF ini adalah Perbincangan Kumpulan Berfokus (FGD) dan disokong oleh soal selidik di bawah 3 fasa utama termasuk Pengumpulan Maklumat, Pandangan Pakar dan Pengesahan Pakar. Sesi FGD telah dijalankan menggunakan pendekatan Teknik Kumpulan Nominal (NGT) bagi mendapatkan konsensus kualitatif daripada 10 panel pakar industri. Maklum balas kuantitatif daripada 100 orang responden tinjauan soal selidik yang disahkan telah dianalisis menggunakan *Statistical Package for the Social Sciences* (SPSS). OF yang dibangunkan juga melalui pengesahan kebolehgunaan oleh pihak berkepentingan dan pemain industri. Berdasarkan sesi FGD, sebanyak 5 bidang pekerjaan dengan 33 jawatan pekerjaan telah ditentukan. Bagi kemahiran yang diperlukan, pakar bersetuju bahawa pengetahuan dalam pengendalian pembetungan adalah aspek terpenting diikuti dengan penyelesaian masalah dan celik IT. Secara kuantitatif, kemahiran kompetensi yang diperlukan adalah berkaitan dengan kebolehan teknikal yang kukuh (kebolehan semula jadi) / kemahiran manual (*hands-on*) dan sikap umum terhadap kerja (Komitmen, kepintaran, kerja berpasukan, dan lain-lain.). Pakar juga telah mengenal pasti bahawa terdapat 30 jawatan yang dikenal pasti sebagai kritikal dan 23 pekerjaan diklasifikasikan sebagai relevan dengan Revolusi Perindustrian (IR). Sebanyak 12 Standard Kemahiran Pekerjaan Kebangsaan (NOSS) telah dikenal pasti daripada senarai NOSS yang didaftarkan pada 21 April 2022 dan dipetakan pada OS yang dibangunkan. Dapatan keseluruhan menunjukkan bahawa kerangka pekerjaan pembetungan telah berjaya dibangunkan selaras dengan objektif kajian yang ditentukan.

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ABBREVIATION

ASTRICE	Asian Sewerage Training Research and Innovation Centre of Excellence
BEM	Board of Engineers Malaysia
BRAINS	Billing, Records, and Information System
CAGR	Compound Annual Growth Rate
CIDB	Construction Industry Development Board
CST	Communal Septic Tanks
CSTF	Central Sludge Treatment Facilities
CU	Competency Unit
DOE	Department of Environment
DOSH	Department of Safety and Health
DOSM	Department of Statistics Malaysia
DSD	Department of Skills Development
DSM	Desludging Management System
EIMAS	Environment Institute of Malaysia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GTMP	Green Technology Master Plan
IETS	Industrial Effluent Treatment System
ILO	International Labour Organisation
IR	Industrial Revolution
IRRC	Integrated Resource Recovery Centre
ISIC	International Standard Industrial Classification
IST	Individual Septic Tanks
IWK	*Indah Water Konsortium*
JICA	Japan International Cooperation Agency
JSU	*Jadual Spesifikasi Ujian*
KKRS	Kementerian Kerja Raya Sabah
LFPR	Labour Force Participation Rate
MASCO	Malaysia Standard Classification of Occupations
MoF	Ministry of Finance
MOSQF	Malaysian Occupational Skills Qualification Framework

MSCS	Malaysia Skills Certification System
MSIC	Malaysian Standard Industrial Classification
NASCo	National Sewerage Company
NCS	National Competency Standard
NGT	Nominal Group Technique
NIOSH	National Institute of Occupational Safety and Health
NOSS	National Occupational Skills Standard
NRW	Non-Revenue Water
NSCP	National Sewerage Catchment Plan
OA	Occupational Analysis
OD	Occupational Descriptions
ODA	Official Cooperation Agency
OF	Occupational Framework
OR	Occupational Responsibilities
OS	Occupational Structure
REHDA	Real Estate and Housing Developer Association
SAP	System Applications and Products
SOCSO	Social Security Organisation
SPAN	*Suruhanjaya Perkhidmatan Air Negara*
SPKM	*Sistem Persijilan Kemahiran Malaysia*
SPSS	Statistical Package for the Social Sciences
SSD	Sewerage Services Department
SSM	*Suruhanjaya Syarikat Malaysia*
STP	Sewage Treatment Plant
WIM	Written Instructional Materials
WOPs	Multiple Water Operator Partnerships

GLOSSARY

Communal septic tank	A septic tank that treats sewage from two or more premises through a common internal sewerage piping.
Competent	Having the necessary ability, knowledge, or skill to do something successfully.
Industrial effluent	Liquid waste or wastewater produced by reason of or in the course of the production processes taking place at any industrial premises.
Pollutants	A substance or condition that contaminates air, water, or soil.
Sewage	Any liquid discharges containing human excreta, animal or vegetable matters in suspension or solution derived from domestic activities and being generated from household, commercial, institutional and industrial premises, including liquid discharges from water closets, basins, sinks, bathrooms and other sanitary appliances but excluding rainwater and prohibited effluent.
Sewer	Any pipe, with its appurtenances, is designed to convey sewage from two or more premises to sewage treatment works other than an individual internal sewerage piping or common internal sewerage piping.
Sewerage	A system of sewers.
Public sewerage system	A sewerage system which is connected to, or conveys sewage to, a public sewer
Private sewerage system	A sewerage system other than a public sewerage system
Sewerage system	A system incorporating sewers, disposal pipes, pumping stations or sewage treatment works, or any combination thereof and all other structures, equipment and appurtenances (other than individual internal sewerage piping, common internal sewerage piping or septic tanks) used or intended to be used for the collection, conveyance, pumping or treatment of sewage and sewage sludge or the disposal of treated sewage effluent or sewage sludge
Sewage treatment system	Any facility designed and constructed for the purpose of reducing the potential of sewage to cause pollution.
Sewerage services	The collection, conveyance, treatment and disposal of sewage or sewage sludge include the operation and maintenance of a sewerage system and the desludging of septic tanks

CHAPTER I

INTRODUCTION

1.1. Research Background

Sewerage Industry can be categorized as an essential industry that is imperative to Malaysia's sustainable, clean, safe, and healthy water ecosystem. The development of this industry is vital to ensure a well-managed and maintained sewerage network system. Initiatively, support from the government is needed, and it could be started with the development of a firm structure of occupation in this industry. This might increase the efficiency of sewerage services and avoid water pollution due to mismanagement that leads to discharging of non-complied untreated sewage.

According to the Department of Environment Malaysia, water pollution might be contributed by sewerage treatment plants, including public, private, Individual Septic Tanks (IST) and Communal Septic Tanks (CST), if maintenance is not properly carried out.[1] Water Services Industry Act 2006 (Act 655)[2] has outlined the provisions relating to the sewerage system and sewerage services, including sewerage construction-related matters, a connection of premises with the public sewerage system, proper drainage of sewage requirement, prohibition of noxious effluent discharge, private sewerage system matters, communal septic tanks matters, penalty enforcement, duty on operation and maintenance and licensing that must be abided by the sewerage industry player. Besides, Environmental Quality (Sewage)

[1] National Hydraulic Research Institute of Malaysia (NAHRIM), Ministry of Natural Resources and Environment (NRE). 2017. Current Situation and Issues of Industrial Wastewater Management in Malaysia. 13th WEPA Annual Meeting and WEPA International Workshop on Industrial Wastewater Management. http://wepa-db.net/3rd/en/meeting/20170926/pdf/26_3-06_Malaysia.pdf [16 October 2022].
[2] Malaysia. 2006. Water Services Industry Act 2006 (Act 655). - act

Regulations 2009[3] have also been outlined that specifically regulate sewage-related matters like sewage discharging, monitoring, sludge disposal, licensing and penalty. The need to control and monitor the pollutants from sewerage sources has enticed the development of more initiative frameworks towards planning economic activities driven by this pollution issue.

Government direction towards healthier economic expansion is attributed to the needs of industries. In sewerage industries, by referring to the related regulations and acts, Environmental Quality Act (EQA1974), the jobs and skills must be correctly identified and established to fulfil the outlined requirement to develop a proper sewerage management system. The Green Technology Master Plan 2017-2030 (GTMP 2017-2030)[4] has set long-term planning with the advancement in green-related industries, including sewerage industries. As an initiative to encourage the transition towards becoming a high-income nation, a demand-driven approach has been adopted to achieve 99% clean water accessibility. The government of Malaysia has also targeted to achieve 100% sludge to be recycled and 33% effluent to be treated and recycled by 2030 (GTMP 2017-2030).

The initiatives like National Sewerage Catchment Plan and Integrated Resource Recovery Centre stated in GTMP 2017-2030 encouraged the need to establish job titles based on the sewerage economic activities. Malaysian Standard Industrial Classification (MSIC) 2008 has provided clear classifications of economic activities according to sectors. As Malaysia is moving towards the improvement of conventional systems and industry advancement following the Industry Revolution, new economic activities would be drafted, and relevant job titles would be identified. Therefore, an Occupational Framework (OF) specifically for sewerage industries must be developed through the development of an Occupational Structure (OS) to further determine the relevant job titles according to sewerage area, skills in demand, jobs related to Industry Revolution, critical jobs and Occupational Description (OD) that can be used in the future.

[3] Malaysia. 2009. Environmental Quality (Sewage) Regulations 2009. - regulation
[4] Malaysia. 2017. The Green Technology Master Plan 2017 – 2030 (GTMP 2017 – 2030). – master plan

1.2. Problem Statement

The economic expansion plan introduced by the government of Malaysia has enticed sewerage industries to move together to achieve the aims outlined in GTMP 2017-2030. With initiatives such as National Sewerage Catchment Planning and Integrated Resource Recovery Centre, OS for the sewerage industry must be developed by referring to economic activities classified in MSIC 2008. However, the previously developed OF in 2016 (Water Services Industry OF 2016) was not specifically related to the Sewerage Industry. Moreover, Moreover, the identified job titles needed to follow the economic activities classified in MSIC 2008. Thus, the development of improved OF is proposed by constructing OS for Sewerage Industry by referring to economic activities under Division 37 in MSIC 2008.

Furthermore, there are also issues with regard to skills mismatching. International Labour Organisation (ILO) has come out with a study that the skills mismatching problem is a global issue, especially in low and middle-income countries. Furthermore, it is likely to happen in Malaysia too. This possibility should be refined through studies to help resolve this uncertainty. Failing to match relevant skills with a job causes unclear responsibility, leading to wrong tasks and increasing job burden.[5] This issue will further cause an increase in turnover and the unemployment rate. Therefore, to avoid such issues happening in Sewerage Industry, it is crucial to determine the needed relevant skills in the first place. This will help the employer to provide a proper job title to support economic expansion initiatives.

Industrial Revolution (IR) is an advancement plan to put Malaysian industries at par with international industries. According to Indah Water Konsortium (IWK)[6], the Sewerage Industry in Malaysia is also optimistic about this advancement plan and has come out with a green technology innovation plan. This could be achieved by innovating national wastewater management and preserving the environment through leveraging innovation and advanced technologies of the Industrial Revolution as well as digital transformation.[7] The initiative must be supported in achieving the transformation of the Sewerage Industry. Thus,

[5] Bergin A., Delaney J., Handel M., McGuiness S., Kupets O., Pauliakas K., and Redmond P. 2019. Skills and jobs mismatches in low- and middle-income countries. International Labour Organization.
[6] Indah Water Konsortium Sdn. Bhd. 2019. Shaping a sustainable tomorrow. Indah Water Konsortium Sustainability Report 2019/2020. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/INW%20SR%20report%202019-2020.pdf [16 October 2022].

by having a well-developed OS for the Sewerage Industry, suitable job titles related to the Industrial Revolution plan can be determined, and green technology innovation could be encouraged.

Moreover, in the Sewerage Industry, the critical jobs in an organisation have never been classified and provided with the occupational description. Identifying critical jobs is crucial to ensure that the productivity of a company that manages the sewerage treatment plant is high. However, the meaning of the critical job itself is not properly defined, causing confusion for the employer in determining the correct organisational structure. This might also cause irrelevant employment and redundancy in job titles. Therefore, this OF development for Division 37 could overcome this problem by determining the critical job and job description in Sewerage Industry.

1.3. Objective of Study

In general, the main objective of this study is to propose the OS, OD, skills in demand, and critical jobs of the Sewerage Industry. Specifically, the objectives of the study are as follows:

a) To develop an Occupational Structure (OS) in the Sewerage Industry based on MSIC 2008.
b) To determine the critical jobs in the Sewerage Industry.
c) To determine the job titles for the Sewerage Industry relevant to the Industrial Revolution (IR).
d) To determine the skills in demand in the Sewerage Industry.
e) To determine Occupational Descriptions (OD) of the Sewerage Industry for critical jobs based on developed OS.

1.4. Scope of Study

This study is based on an organisational level where only senior management personnel in the Sewerage Industry players all over Malaysia were chosen as the target respondent. Both qualitative and quantitative research methods were utilised in this study. Data were collected through document analysis, focus group discussion, and field survey methodology. The target respondents were identified based on Krejcie and Morgan sampling technique. DOSM reported that 69 establishments were identified for Division 37: Sewerage from Sewerage

Industry all over Malaysia. This division includes the operation of sewer systems or sewage treatment facilities that collect, treat, and dispose of sewage.

In the initial stage, this study was conducted by reviewing documents in trade journals, published government reports and relevant articles. This was followed by focus group interviewing and brainstorming with the pertinent senior industry representatives to gain insight into the industry and further develop the survey instrument items employed in the field study.

1.5. Justification for MSIC Section Selection

According to MSIC 2008 by the Department of Statistics Malaysia (DOSM), the Sewerage Industry is in tandem with a description of 2 digits MSIC 2008 Division 37: Sewerage, under 1-digit MSIC 2008 Section E: Water Supply; Sewerage, Waste Management and Remediation Activities. This division includes the operation of sewer systems or sewage treatment facilities that collect, treat, and dispose of sewage.

1.6. Structure of Chapters

This chapter concludes with a brief overview of the entire study, which includes:

a) Chapter 1

This chapter explains about research introduction, which consists of an introduction, problem statement, research objective, research scope and justification for MSIC 2008 Section selection;

b) Chapter 2

This chapter provides a literature review regarding the Sewerage industry in order to provide further understanding;

c) Chapter 3

This chapter explains the overall approach of the study and the method deployed to achieve the objective of the study;

d) Chapter 4

This chapter shows the results and findings of the research based on the approaches and methods deployed in this chapter; and

e) Chapter 5

This chapter explains the discussion, summary and conclusion of the research done. Additionally, recommendations from industry experts are also listed here.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter emphasises the explanation of the Sewerage industry, which focuses on the current scenario in Malaysia; industry stakeholders, relevant legislations, development plans, available training, relevant Malaysia Standards Industrial Classification (MSIC) 2008 sections, existing National Occupational Skills Standards (NOSS), and issues and challenges faced by the industry.

Findings in this chapter are obtained via document review, observation, interviews with industry practitioners and discussions under brainstorming sessions during workshops with Focus Group Discussion (FGD) panel members. This has been further discussed with FGD panel members to obtain insight into the matters at hand from the practitioner's perspective. It must be noted that this chapter is not a critical review of the available literature but is more of a presentation of facts that serves as a general introduction to the Sewerage industry for a wide range of readers for this report.

2.2 National Skills Development Act 2006 (Act 652)

National Skills Development Act 2006 (Act 652) came into effect on 1st September 2006 after it was officially gazette on 29th June 2006, with the mandate of promoting, through skills training, the development and improvement of a person's abilities, which are needed for vocation, and to provide for other matters connected therewith. Act 652 is significant because national legislation has been enacted solely and exclusively for skills training and development for the first time in the history of skills training in Malaysia. In addition, the

meaning and scope of skills training has been clarified and given a statutory interpretation that can distinguish it from other components of the country's national education and training system. Act 652 also provides for implementing a Malaysian Skills Certification System, leading to the award of five (5) levels of national skills qualification, namely Malaysian Skills Certificate Level 1, 2, and 3; Malaysian Skills Diploma; and Malaysian Skills Advanced Diploma.

2.3 Malaysian Occupational Skills Qualification Framework (MOSQF)

Malaysia Occupational Skills Qualification Framework (MOSQF) defines and categorises occupational skills into eight (8) competency levels. Department of Skills Development (DSD) governs the skills sector, in which there are eight (8) levels of skills qualification. The definition for each level of skills qualification is specified in the Malaysian Occupational Skills Qualification Framework (MOSQF)[8] and can be referred to in Annex 1.

2.4 Malaysia Skills Certification System (MSCS)

The Malaysia Skills Certification System is defined as policies, standards, mechanisms, and procedures involved in the awarding of a certificate by the Director of the Department of Skills Development.[9] Aside from that, it is also known in Malaysia as a skills and work-based certification system that is achieved through assessment and training. Candidates who meet the requirements of the National Occupational Skills Standards (NOSS) developed and regulated by the Department of Skills Development are eligible for the Malaysian Skills award (formerly known as the National Vocational Training Council).

MSCS, also known as the *Sistem Persijilan Kemahiran Malaysia (SPKM)*, was established in 1993 to replace the National Trade Certification System as part of a larger reform to streamline Malaysia's higher and further education systems. In 2007, the system was also mapped to the Malaysian Qualifications Framework, which provided a framework for credit equivalency and transfer between the vocational education and training and higher

[8] Department of Skills Development. 2014., Asia-Pacific Economic Cooperation (APEC) (2014). Enhancing the Quality and Relevance of Technical and Vocational Education and Training (TVET) for Current and Future Industry Needs. - report

[9] Department of Skills Development. 2020. Panduan Pembangunan Kerangka Pekerjaan Edisi 2020. - guidelines

education sectors. The details of the item in MSCS are explained in the next sub-chapter.

To achieve the MSCS goals and standards, six processes are required to develop competent and skilled labour. The process includes the development of the Occupational Framework (OF), National Occupational Skills Standards (NOSS), Written Instruction Material (WIM), Questions and Assessment, Implementation of the training institute and review of the Industrial need. Figure 2.1 shows a complete cycle for MSCS scope.

Figure 2.1: Malaysian Skills Certification System

2.4.1. Occupational Framework (OF)

Occupational Framework (OF) was previously known as Occupational Analysis (OA). The OF is an outcome of the occupational analysis and research on a particular industry sector. The contents of an OF shall include occupational structure, occupational definitions, job descriptions, manpower requirements and industry intelligence. The Occupational Structure (OS) is a matrix that shows the occupational areas and career paths for a particular

occupation. The information on manpower skills requirements, Occupational Descriptions (OD), and industry intelligence allows an overall understanding of the industry's occupational areas. Manpower requirement skills are to identify the skills gaps and shortages in the workforce. Industry Intelligence is based on actual qualitative and quantitative data from the industry to strengthen further and prove the reliability of the data. Therefore, a properly planned development and analysis would enable the OF to be precise and accurate, thus ensuring that it might be a reliable source of information for further analysis of the industry and the development of NOSS and training requirements.[10]

Heretofore, there was an OF developed in 2016 under the Water Services Industry in which one of the sub-sectors is the Sewerage Industry. The OF is one of the main references for occupational purposes. However, the OF can still be improved in order to ensure the framework is explicitly developed to focus on the Sewerage Industry. Besides, improvement can be made by developing OS, job description and skills directly referring to the classified sewerage activities listed in MSIC 2008. Moreover, the additional overview of critical and relevant job titles to the Industrial Revolution can also be reported. Then, the OS is supposed to be constructed according to section, division, group, and area classified in MSIC 2008. Some of the sewerage economic activities classified in MSIC 2008 can suggest being covered as an area or sub-area in the OS, for instance, collecting and transporting of human or industrial wastewater from one or several users, as well as rainwater by means of sewerage networks, collectors, tanks and other means of transport (sewage vehicles, etc.). The job titles like senior technical manager, senior manager, technical manager, manager, executive and supervisor can be suggested to be explicitly responsible only for one area or sub-area. Furthermore, the international occupation information specifically for the Sewerage Industry can also be added, not only reporting the comparative study with international occupational frameworks but is mostly towards manufacturing and utilities. Therefore, the present OF for Section E and Division 37 Sewerage has been developed for improvement.

[10] Department of Skills Development. 2022. National Occupational Skills Standards. https://www.dsd.gov.my/jpkv4/index.php/my/perkhidmatan/noss [7 October 2022].

2.4.2. National Occupational Skills Standards (NOSS) and National Competency Standard (NCS)

National Occupational Skills Standards (NOSS) is defined as a specification of the competencies expected of a skilled worker who is gainfully employed in Malaysia for an occupational area, level, and pathway to achieve the competencies and was gazetted in Part IV of the National Skills Development Act 652. Meanwhile, National Competency Standard (NCS) describes the knowledge, skills and attitudes needed to perform in a particular occupation but does not directly relate to any job classification. Standards are developed by industry experts based on the needs of the industry and are utilised as the main tool in the implementation of the Malaysian Skills Certification System, in which the performance of existing industry workers and trainees is assessed based on Standards for awarding of Malaysian Skills Certificate.[11]

The DSD has developed 12 NOSS related to MSIC 2008 Division 37 as of October 2022. The summary of the NOSS titles, according to NOSS Registry 21 April 2022, is provided in Table 2.1 below.

Table 2.1: Summary of NOSS developed under Group 370
(Source: NOSS Registry 21 April 2022)

MSIC Group	Corresponding NOSS/ Level	
370: Sewerage	1. CM-031-2:2014	Sewage Treatment Maintenance
	2. E382-001-2:2017	Sewage Sludge Desludging and Discharge Operation
	3. E370-003-2:2022	Sewer Network Operation and Maintenance Services
	4. CM-031-3:2014	Sewage Treatment Supervision
	5. E382-001-3:2017	Sewage Sludge Desludging and Discharge Supervision
	6. E370-003-3:2022	Sewer Network Operation and Maintenance Supervision

[11] Department of Skills Development. 2022. Malaysian Skills Certificate. https://www.dsd.gov.my/index.php/perkhidmatan/sijil-kemahiran-malaysia-skm [7 October 2022].

MSIC Group	Corresponding NOSS/ Level
	7. E370-001-4:2016 Sewage Treatment Plant Operation Control 8. E382-001-4:2017 Sewage Sludge Desludging and Discharge Administration 9. E370-003-4:2022 Sewer Network Operation and Maintenance Technical Administration 10. E370-001-5:2016 Sewage Treatment Plant Operation Management 11. E382-001-5:2017 Sewage Sludge Desludging and Discharge Management 12. E370-003-5:2022 Sewer Network Operation and Maintenance Management

Based on 12 NOSS established related to this study, three (3) NOSS are Level 2, 3 NOSS are Level 3, three (3) standards are Level 4, and another three (3) standards are Level 5.

2.4.3. Written Instructional Materials (WIM)

WIM is a document prepared by the instructor for the use of instructors and trainees to assist the teaching and learning process.[12] The purpose of WIM is to:

a) Become the main learning material in the teaching and learning process;
b) Ensure that the Learning Outcome in the designated Competency Unit (CU) is achieved; and
c) Help the instructor build self-confidence and prepare for the teaching session.

[12] Department of Skills Development. 2020. Panduan Pembangunan Bahan Pengajaran Bertulis Edisi 2020. - guidelines

2.4.4. Evaluation Question

Evaluation in the context of the Malaysian Skills Certification System (MSCS) is a process of assessing the level of knowledge and skills as well as safety/environmental attitudes/practices of a candidate who follows a skills training program held at an accredited centre. Assessment is done by using various suitable methods to assess a candidate's skills as required.[13]

In order to ensure the validity of the questions developed, the following points need to be paid attention to, namely:

a) Question concept;
b) Type of assessment, whether Knowledge or Performance Assessment;
c) *Jadual Spesifikasi Ujian* (JSU) for Final Evaluation.

2.5 Malaysia Standard Industrial Classification 2008 (MSIC 2008)

The MSIC 2008 is intended to be a standard classification of productive economic activities. Its main purpose is to provide a set of activity categories that can be utilised for collecting and presenting statistics according to such activities. Therefore, MSIC aims to present this set of activity categories so that entities can be classified according to the economic activity they carry out. For international comparability purposes, the MSIC 2008 Version 1.0 conforms closely to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4, published by the United Nations Statistics Division, with some modifications to suit national requirements.

The objective of an industrial classification system is to classify data regarding the economy according to categories of activities. The MSIC is a classification of all types of economic activities and is not a classification of goods and services, nor is it a classification of occupations.[14]

[13] Department of Skills Development. 2020. Panduan Pembangunan Soalan Edisi 2020. - guidelines
[14] Department of Statistics Malaysia. 2008. Malaysia Standard Industrial Classification (MSIC). - standards

2.6 Key Stakeholders

A stakeholder is a person, group or organisation with an interest or concern in an organisation. The key stakeholders for the Sewerage Industry in Malaysia comprised government agencies, regulatory bodies, industry associations, professional bodies, and established training centres. The organisation's actions, objectives and policies affect the stakeholder.

2.7 Scope of Occupational Framework Based on MSIC 2008

The MSIC 2008 is a standard framework for classifying establishments and other statistical units in the given industry in all official statistics. It also serves as a standard reference to users of official statistics on the type of economic activities included under the various categories of industries. This section defines the MSIC 2008 based on the Department of Statistics Malaysia (DOSM) and the criteria for this study's title selection.

In order to review that the scope of the specialized sewerage activities is comprehensively covered in this Occupational Framework research, the definition of sewerage has to be spelt out clearly. Under MSIC, the area being researched falls under the Section and Division listed in Table 2.2 below.

Table 2.2: MSIC 2008 by Section, Division and Group

Section	**E**	Water Supply; Sewerage, Waste Management and Remediation Activities
Division	**37**	Sewerage
Group	**370**	Sewerage

The following Table 2.3 provides the structure for this Occupational Framework based on MSIC 2008 for the different groups and items.

Table 2.3: MSIC 2008 by Section, Division, Group, Item and Class

Section	**E**	Water Supply; Sewerage, Waste Management and Remediation Activities
Division	**37**	Sewerage
Group	**370**	Sewerage
Class	**3700**	Sewerage
Item	**37000**	Sewerage and similar activities (1)
(1) **Includes**:		(a) Operation of sewer systems or sewer treatment facilities, maintenance of sewers. (b) Collecting and transporting of human or industrial wastewater from one or several users, as well as rainwater by means of sewerage networks, collectors, tanks and other means of transport (sewage vehicles, etc.). (c) Emptying and cleaning of cesspools and septic tanks, sinks and pits from sewage, servicing of chemical toilets. (d) Treatment of wastewater (including human and industrial wastewater, water from swimming pools, etc.) by means of physical, chemical and biological processes like dilution, screening, filtering, sedimentation, etc. (e) Maintenance and cleaning of sewers and drains, including sewer rodding.

2.7.1 Government Agencies and Regulatory Bodies

Government agencies are permanent or semi-permanent organisations that are responsible for the oversight and administration of specific functions. While regulatory bodies are the public authority responsible for exercising autonomous authority over some area of human activity in a regulatory or supervisory capacity. In Malaysia, there are many government agencies and regulatory bodies related to the sewerage industry. For this study, 19 bodies have been identified as relevant in this industry. The list can be referred to in Table 2.4.

Table 2.4: List of Government Agencies/Regulatory Agencies for the Sewerage Industry

No.	Ministry	Government agencies/ regulatory bodies	Roles, functions and responsibilities
1.	Ministry of Natural Resources, Environment and Climate Change	Department of Environment[15]	The roles and functions of the Department of Environment to the Sewerage Industry: 1) Enforcement of EQA 1974 (Environmental Quality (Sewage) Regulation 2009). 2) Enforcement of EQA 1974 (Environmental Quality (Clean Air) Regulation 2014).
2.	Ministry of Natural Resources, Environment and Climate Change	Department of Irrigation & Drainage.[16]	The roles and functions of the Department of Irrigation & Drainage in the Sewerage Industry are: 1) Collaboration of drainage system. 2) Monitoring of drainage system.
3.		Department of Sewerage Services (SSD).[17]	The role and function of the Department of Sewerage Services are to implement the sewerage system project.
4.		Department of Director General of Lands & Mines.[18]	The Director General of Land & Mines is a regulator of land and mines related to sewerage activities.
5.		Energy Commission.[19]	Energy Commission is a regulator for energy supply and consumption (Act Energy Commission 2001) to the Sewerage Industry.

[15] Malaysia. 1974. Environmental Quality Act 1974. – act
[16] Department of Irrigation and Drainage. 2022. http://www.water.gov.my/about-us-mainmenu-243/profile/our-background-mainmenu-508?lang=en [7 October 2022].
[17] Department of Sewerage Services. 2022. http://www.jpp.gov.my/index.php/en/jpp/perihal-jpp/profile [8 October 2022]
[18] Department of Director General of Lands & Mines. 2022. https://www.jkptg.gov.my/en/korporat/fungsi-jabatan [7 October 2022].
[19] Energy Commission. 2001. Act Energy Commission 2001. – act

No.	Ministry	Government agencies/ regulatory bodies	Roles, functions and responsibilities
6.		National Water Service Commission (*Suruhanjaya Perkhidmatan Air Negara*, SPAN).[20]	The roles and functions of the National Water Service Commission to the Sewerage Industry: 1) To implement and enforce the water supply and sewerage services laws (Water Services Industry Act 2006) in Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan 2) To consider and recommend reforms to the water supply and sewerage services laws. 3) To ensure the productivity of the water supply and sewerage services industry and monitor operator's compliance with stipulated standards, contractual obligations and relevant laws and guidelines. Licensing/Permit holder Regulator. 4) To advise the Minister on all matters in relation to the national policy objectives of water supply and sewerage services laws and to implement and promote the national policy objectives.
7.	Ministry of Finance	Ministry of Finance (MoF).[21]	The roles and functions of the Ministry of Finance to the Sewerage Industry: 1) To monitor all companies incorporated with the Minister of Finance. 2) To formulate and administer policies related to the management of government procurement.

[20] National Water Service Commission. 2022. https://www.span.gov.my/article/view/functions [8 October 2022].
[21] Ministry of Finance. 2022. http://www.treasury.gov.my/?lang=en [8 October 2022].

No.	Ministry	Government agencies/ regulatory bodies	Roles, functions and responsibilities
8.	Ministry of Human Resources	Department of Occupational Safety and Health (DOSH).[22]	Department of Occupational Safety and Health is a regulator of occupational safety and health in the sewerage industry.
9.	Kementerian Kerja Raya Sabah (KKRS)	Sewerage Services Department (Sabah)[23]	The roles and functions of the Sewerage Services Department (Sabah) in the Sewerage Industry: 1) To implement the sewerage system project. 2) To provide the sewerage operation maintenance. 3) To enforce the Sabah Sewerage Services Enactment 2017.
10.		Public Work Department Sabah[24]	The roles and functions of the Public Work Department in the Sewerage Industry are: 1) Maintenance Works. 2) Issuance of permit (Way leave).
11.		Public Work Department Sarawak[25]	The roles and functions of the Public Work Department in the Sewerage Industry are: 1) Maintenance Works. 2) Issuance of permit (Way leave).
12.	Sarawak Government	Sewerage Services Department Sarawak.[26]	The roles and functions of the Sewerage Services Department (Sarawak) in the Sewerage Industry: 1) To implement the sewerage system project. 2) To provide the sewerage operation maintenance.

[22] Department of Occupational Safety and Health. 2022. http://www.dosh.gov.my/index.php/about-us/dosh-profile [7 October 2022].
[23] Sewerage Services Department (Sabah). 2017. Sabah Sewerage Services Enactment 2017. – enactment
[24] Public Work Department Sabah. 2022. https://jkr.sabah.gov.my/en/home-en/ [7 October 2022].
[25] Public Work Department Sarawak. 2022. https://jkr.sarawak.gov.my/ [7 October 2022].
[26] Sarawak Services Department. 2005. Sewerage Systems and Services Ordinance 2005. - ordinance

No.	Ministry	Government agencies/ regulatory bodies	Roles, functions and responsibilities
			3) To enforce the Sewerage Systems and Services Ordinance 2005 (Sarawak).
13.	Sabah Government	Sabah Lands & Survey Department[27]	Sabah Lands & Survey Department is a regulator of land and mines and enforcement of the relevant sections of the Land Ordinance related to sewerage activities.
14.	Ministry of Housing and Local Government	Minister of Housing and Local Government.[28]	The roles and functions of the Minister of Housing and Local Government to the Sewerage Industry: 1) To provide a working permit for maintenance work. 2) Planning and development authority under its jurisdiction. 3) To provide policy and advisory services to the Federal Government, state governments and local authorities pertaining to land planning, management, development and conservation which is in line with the National Physical Plan.
15.	Ministry of Tourism, Culture and Environment Sabah Malaysia	Environment Protection Department (Sabah).[29]	Environment Protection Department (Sabah) is responsible for the monitoring of compliance with environmental condition orders and regulations. Protect sensitive areas for the maintenance of environmental quality and stability.
16.	Ministry of	Public Work	The roles and functions of the Public Work

[27] Sabah Lands & Survey Department. 2022. https://jtu.sabah.gov.my/homepage/index.cfm?section=About&action=function&lang=Eng [7 October 2022].
[28] Ministry of Housing and Local Government. 2022. https://www.kpkt.gov.my/index.php/pages/view/312?mid=466 [7 October 2022].
[29] Ministry of Tourism, Culture and Environment Sabah Malaysia. Environment Protection Department. 2022. https://epd.sabah.gov.my/v2/index.php/about-us/corporate-profile/objectives-and-strategies [7 October 2022].

No.	Ministry	Government agencies/ regulatory bodies	Roles, functions and responsibilities
	Works	Department.[30]	Department in the Sewerage Industry are: 1) Maintenance Works. 2) Issuance of permit (Way leave).
17.		Construction Industry Development Board (CIDB).[31]	Construction Industry Development Board is responsible to regulate, control & monitor construction works (Section 25 Act 520:2011) in the Sewerage Industry.
18.	Ministry of Health	Department of Health.[32]	Department of Health is responsible in regulating public health related to the Sewerage Industry.
19.	Prime Minister's Department	Economic Planning Unit.[33]	The Economic Planning Unit is responsible for the planning of future developments in the sewerage industry. It includes implementation, coordination and monitoring of the national programmes, initiatives, and development projects' progress.
20.	Public Sewerage Operator	Indah Water Konsortium Sdn. Bhd.[34]	Indah Water Konsortium Sdn. Bhd. (IWK) owned by the Ministry of Finance is an operator for sewerage services. To develop and maintain a modern and efficient sewerage system for all Malaysians.

[30] Public Work Department of Malaysia. 2022. https://www.jkr.gov.my/en/page/misi-visi-fungsi-objektif-1) [7 October 2022].
[31] Construction Industry Development Berhad (CIDB). 2022. http://www.cidb.gov.my/index.php/en/corporate-info/functions [7 October 2022].
[32] Ministry of Health Malaysia. 2022. https://www.moh.gov.my/index.php/pages/view/137?mid=14 [7 October 2022].
[33] Prime Minister's Department. Economic Planning Unit. 2022. https://www.epu.gov.my/en/department-profile/profile/functions [7 October 2022].
[34] Indah Water Konsortium Sdn. Bhd. 2022. https://www.iwk.com.my/home) [7 October 2022].

2.7.2 Industry Associations and Professional Bodies

Industry association is an association that supports and protects the rights of a particular industry and the workers in the industry. In Malaysia, some industry associations and professional bodies are related to the Sewerage Industry. For this study, three (3) industry associations were selected due to their acts as the main association in this industry. The list can be referred to in Table 2.5.

Table 2.5: List of Industry Associations and Professional Bodies for Sewerage Industry

No.	Industry Associations / Professional Bodies	Roles, Function and Responsibilities
1.	Malaysian Water Association.[35]	The roles and functions of the Malaysian Water Association in the Sewerage Industry: 1) The national association regarding networking and technological advancement for water professionals involved in the complete water cycle. 2) Membership comprises professionals from policymakers, water operators, consultants, contractors and suppliers.
2.	Board of Engineers Malaysia (BEM).[36]	BEM is responsible for the registration of engineers in Malaysia. Since engineering is one of the required occupations in the Sewerage Industry, hence, BEM is also related to this industry. The functions of BEM are: 1) To regulate the conduct and ethics of the engineering profession, 2) To disputes on professional conduct and ethics. 3) To promote continued learning and education.

[35] Malaysian Water Association. 2022. www.mwa.org.my [8 October 2022].
[36] Board of Engineers Malaysia. 2022. http://bem.org.my/web/guest/functions [8 October 2022].

No.	Industry Associations / Professional Bodies	Roles, Function and Responsibilities
3.	Real Estate and Housing Developer Association (REHDA).[37]	REHDA is responsible for the establishment of a Facility Licensee to own, construct, refurbish, and improve/upgrade sewerage systems which comprises a sewage treatment plant and sewer reticulation, which shortens the related approval processes.

2.7.3 Training Centres

Human Capital Development is vital in the efforts to enhance the viability of the sewerage industry. In this regard, manpower needs for the Sewerage Industry are provided by several agencies, which include, among others, specialised training institutions. A training centre is a centre that offers the service that allows companies to build custom training material that documents its best practices and procedures. In Malaysia, many established training centres are related to the information service activities industry. However, three (3) training centres were identified as main training providers in this industry. The list of training centres can be referred to in Table 2.6 below.

Table 2.6: List of Training Centres for Sewerage Industry

No.	Training Centre	Roles, Function and Responsibilities
1.	Asian Sewerage Training Research and Innovation Centre of Excellence (ASTRICE), Indah Water Konsortium.[38]	Indah Water Konsortium (IWK) Sdn. Bhd. advocates the need to enhance the knowledge and skill of its staff and other workers and practitioners in the sewage sector to be effective and efficient in planning, operations and maintenance of its sewerage assets. ASTRICE was established by IWK for technical training on the theory and practicals of sewerage systems. Besides, its training and development program also focuses on capacity building in the areas of customer relations, health and safety, fundamentals of sewerage systems of new technology, processes and skills.

[37] Real Estate and Housing Developer Association. 2022. https://rehdainstitute.com/property-development-lab-initiatives/ [7 October 2022].
[38] Indah Water Konsortium ASTRICE. 2022. https://www.iwk.com.my/astrice [7 October 2022].

No.	Training Centre	Roles, Function and Responsibilities
2.	Environment Institute of Malaysia (EIMAS) – Department of Environment (DOE).[39]	EiMAS by DOE was established with the objectives of manpower enhancement and intensification through environmental management and protection development programs. Besides, it also promotes the application of cleaner production technologies and best industrial environmental management practices.
3.	National Institute of Occupational Safety and Health (NIOSH).[40]	The Institute is responsible for providing occupational safety and health training, professional consultation and certifications that might relate to the Sewerage Industry needs.

2.8 Legislations, Policies and Initiatives

It is imperative that this research must refer to legislation, by-laws and policies that are directly related to the Sewerage Industry.

2.8.1 Government Legislations

In Malaysia, the Sewerage Industry is referring and abides by some legislations related to sewerage operation and services. There are thirteen (13) legislations identified as relevant in this industry. The following Table 2.7 indicates the relevant legislation in the Sewerage Industry.

Table 2.7: Relevant legislations for the Sewerage Industry

No.	Legislation	Description
1)	Environmental Quality Act 1974.[41]	The legislation that is related to the prevention, abatement, control of pollution and enhancement of the environment in Malaysia is the Environmental Quality Act of 1974. The Act restricts the discharge of wastes into the environment in contravention of acceptable

[39] Environment Institute of Malaysia (EIMAS), Department of Environment. 2022. http://www.eimas.doe.gov.my/ [7 October 2022].
[40] National Institute of Occupational Safety and Health. 2022. http://www.niosh.com.my/ [7 October 2022].
[41] Malaysia. 1974. Environmental Quality Act 1974 – act

No.	Legislation	Description
		conditions.
2)	Water Services Industry Act 2006 (Act 655). [42]	This act sets out the rules for the planning, design and construction of sewerage systems and septic tanks in the water services industry. These rules shall also apply to any submission made for sewerage works or septic tank works that have commenced before these rules come into force.
3)	Environmental Quality (Sewage) Regulations 2009.[43]	The Environmental Quality (Sewage) Regulations 2009 regulates sewage-related matters like sewage discharging, monitoring, sludge disposal, licensing and penalty. The regulations shall apply to any premises that discharge sewage onto or into any soil, inland, or Malaysian waters.
4)	Environmental Quality (Industrial Effluent) Act 2009. [44]	The Environmental Quality (Industrial Effluent) Act 2009 regulates the effluent treatment system design, monitoring, operational skills and competencies, management practices, effluent parameters, licensing, and inspection.
5)	Malaysia Sewerage Industry Guideline. [45]	National Water Service Commission has set out the sewerage management guideline that are arranged in several volumes, including: Volume 2 - The procedures for sewerage works. Volume 3 – Sewer networks and pump stations Volume 4 – Sewage treatment plants Volume 5 – Septic tanks Source: Malaysia Sewerage Industry Guideline.

[42] Malaysia. 2006. Water Services Industry Act 2006 (Act 655). – act
[43] Malaysia. 2009. Environmental Quality (Sewage) Regulations 2009. – regulations
[44] Malaysia. 2009. Environmental Quality (Industrial Effluent) Act 2009. – act
[45] Malaysia. 2013 - Malaysia Sewerage Industry Guideline. – guideline

No.	Legislation	Description
6)	Sabah Sewerage Services Enactment 2017. [46]	This enactment may be cited as the Sewerage Services Enactment 2017. The enactment was arranged in twelve (12) sections, including responsibility for sewerage systems and sewerage services, director of sewerage services, licensing, approval of plans and specifications of sewerage systems or septic tanks, public sewerage systems, private sewerage systems and septic tanks, charges, general offences and penalties, powers of entry and enforcement.
7)	Sewerage Systems and Services Ordinance 2005. [47]	This ordinance may be cited as the Sewerage Systems and Services Ordinance, 2005. The ordinance was arranged in five (5) sections, including responsibility for sewerage systems and services, design and specifications for sewerage systems and septic tanks, powers of entry, investigations, arrest and penalties. Source: Sewerage Systems and Services Ordinance 2005.
8)	Water Services Industry (Sewerage Services Charges) Regulations 2022.[48]	The Water Services Industry (Sewerage Services Charges) Regulations 2022 regulates the sewerage services charges (domestic premises, commercial premises, government premises and industrial premises), determination of water consumed, minimum charges of connected services, repeated or additional desludging services charges, and cancellation charges of desludging services.
9)	Water Service Industry (Planning, Design and Construction of Sewerage System and Septic Tank) Rules	The Water Service Industry (Planning, Design and Construction of Sewerage System and Septic Tank) Rules 2013 highlights the rules on sewerage planning, design, construction of sewerage works and septic tank works, inspection, and letter of confirmation for sewerage and septic tanks works, handing over of sewerage system, competent person and fees.

[46] Sewerage Services Department (Sabah). 2017. Sabah Sewerage Services Enactment 2017. – enactment
[47] Sarawak Services Department. 2005. Sewerage Systems and Services Ordinance 2005. - ordinance
[48] Malaysia. 2022. Water Services Industry (Sewerage Services Charges) Regulations 2022. – regulations

No.	Legislation	Description
	2013.[49]	
10)	Water Services Industry (Desludging Services) Regulations 2021.[50]	The regulation regulates the desludging services, including scheduled desludging of septic tanks, direction by the commission to desludge, discharge of prohibited effluent, desludging services charge, exemption and transitional provision.
11)	Energy Commission Act 2001.[51]	An Act to provide for the establishment of the Energy Commission with powers to regulate the energy supply activities in Malaysia, to enforce the energy supply laws, and for matters connected therewith.
12)	Construction Industry Development Board Section 25 Act 520. [52]	An Act to establish the Malaysia Construction Industry Development Board and to provide for its function relating to the construction industry and for matters connected therewith. This act shall apply throughout Malaysia; however, the Minister may, by order, suspend the operation of the whole or any provisions of this act in any part of Malaysia.
13)	Act 514 Occupational Safety and Health Act 1994.[53]	An act to make further provisions for securing the safety, health and welfare of persons at work, for protecting others against risks to safety or health in connection with the activities of persons at work, to establish the National Council for Occupational Safety and Health, and for matters connected therewith.

[49] Malaysia. 2013. Water Service Industry (Planning, Design and Construction of Sewerage System and Septic Tank) Rules 2013. - rules
[50] Malaysia. 2021. Water Services Industry (Desludging Services) Regulations 2021. – regulations
[51] Energy Commission. 2001. Act Energy Commission 2001. – act
[52] Malaysia. 2015. Construction Industry Development Board Section 25 Act 520. – act
[53] Malaysia. 1994. Act 514 Occupational Safety and Health Act 1994. – act

2.8.2 Government Policies and Initiatives

Government policies and initiatives are plans of action adopted or pursued by the government in order to increase the growth of the sector.

a) Green Technology Master Plan 2017-2030

The Green Technology Master Plan 2017-2030 has outlined strategies for emphasising wastewater treatment technology by targeting 100% sludge, and 33 % treated effluent to be recycled by 2030. This strategy includes providing quality and efficient water and sewerage services, which is essential in ensuring a high quality of life and facilitating economic development. With the initiatives of enhancement of wastewater treatments sector, National Sewerage Master Plan, National Sewerage Catchment Plan and Integrated Resource Recovery Centre (IRRC).[54]

b) National Sewerage Catchment Plan (NSCP)

The NCSP has been strategically discussed and outlined in The Green Technology Master Plan 2017-2030. SPAN is formulating the plan in accordance with the provisions in *Suruhanjaya Perkhidmatan Air Negara* Act 2006 (Act 654). This document encompasses sewerage planning policy and strategies that cover the nation's planning needs. This document has been used as a guide to preparing a sewerage development plan that is appropriate for the needs of the area, to determine the investment required for sewerage infrastructure that would consider the whole life cycle cost, to encourage resource recovery from point source up to by-products of sewage treatment and to facilitate inter-agency coordination. The NSCP also includes strategic plans for the identification of catchment areas and the rationalisation of treatment plants. Last but not least, it is also to be used as a guide to promoting participation amongst stakeholders in order to create awareness within the sewerage sector.[55]

[54] Malaysia. 2017. The Green Technology Master Plan 2017 – 2030 (GTMP 2017 – 2030). – master plan
[55] Green Technology Master Plan 2017-2030. ISBN 978-967-5893-09-4.

c) Integrated Resource Recovery Centre (IRRC)

The Green Technology Master Plan 2017-2030 has also outlined the strategy for improving the water sector by enhancing the Sewerage Industry. It has been discussed that all organic water, in terms of liquids and solids, has been treated in the IRRC to leverage the facilities for the wastewater treatment plant and the digester. This might help to promote the production of reclaimed water and the generation of more gases for electricity or biomethane as fuel. Several locations have been identified as potential sites for the future development of IRRC.[56]

d) Operation and Maintenance (O&M) Improvements

The Sewerage Services Department of the Ministry of Energy, Green Technology and Water has come out with an overview of Malaysia's sewerage management. Some strategies have been outlined for improvement, including O&M. The planning focused on varying the expertise for sewerage systems to achieve efficient desludging services and septage management. With a high quality of effluent compliances would consequently contribute to improved water quality.[57]

e) Sustainable Sewerage Planning & Development for Infrastructure Improvements

From the overview of Malaysia's sewerage management by the Sewerage Services Department of the Ministry of Energy, Green Technology and Water, the guidelines and standards for sustainable sewerage planning & development for infrastructure improvements would be developed. This could be achieved with the strategy of integrated financing for sewerage development and nationwide catchments strategy.[58]

f) Customer Service & Awareness Program for Sustainable Services

Besides, the Sewerage Services Department has also strategized the customer service & awareness program for sustainable services. The targeted improvements include efficiently addressing operational complaints, improved level of service for customers, communications

[56] Malaysia. 2017. The Green Technology Master Plan 2017 – 2030 (GTMP 2017 – 2030). – master plan
[57] Ministry of Energy, Green Technology and Water. 2011. Overview of the Water Services Industry in Malaysia. http://www.wepa-db.net/pdf/1203forum/20.pdf [8 October 2022].
[58] Ministry of Energy, Green Technology and Water. 2011. Overview of the Water Services Industry in Malaysia. http://www.wepa-db.net/pdf/1203forum/20.pdf [8 October 2022].

and public outreach and education and comprehensive billing and collection system.[59]

g) Creating Value for The Sewerage Industry

To ensure that the Sewerage Industry is viable, Research and Development (R&D) for operational improvements & sustainable services must be taken into account in bringing significant value in the Sewerage Industry. This initiative has also been strategized in the Green Technology Master Plan 2017-2030, in which R&D should be enhanced simultaneously with Training & Accreditation services to develop a skilled and knowledgeable workforce.[60]

h) Eleventh Malaysia Plan, 2016-2020

The main aim for the Sewerage Industry in Eleventh Malaysia Plan, 2016-2020, is to focus on improving the quality and efficiency of the water services industry. These served as a strong foundation for achieving targets of 99% clean and treated water while reducing Non-Revenue Water (NRW) to 25%. The Government also aims to increase coverage of sewerage-connected services by up to 80% for main urban cities. To achieve these targets, four initiatives have been identified as follows[61]:

- Raising the financial sustainability of the water services industry.
- Expanding network and treatment plant capacity through infrastructure investment and the use of efficient technology.
- Increasing efficiency and productivity of water and sewerage services.
- Strengthening the regulatory framework of the water services industry.

[59] Ministry of Energy, Green Technology and Water. 2011. Overview of the Water Services Industry in Malaysia. http://www.wepa-db.net/pdf/1203forum/20.pdf [8 October 2022].
[60] Ministry of Energy, Green Technology and Water. 2011. Overview of the Water Services Industry in Malaysia. http://www.wepa-db.net/pdf/1203forum/20.pdf [8 October 2022].
[61] Economic Planning Unit, Prime Minister's Department. 2021. Ensuring Quality and Efficient Water and Sewerage Services. https://www.epu.gov.my/sites/default/files/2021-05/Strategy%20Paper%2016.pdf [9 October 2022].

i) Twelfth Malaysia Plan, 2021-2025

In Twelfth Malaysia Plan, it was reported that sewerage connectivity in main cities was improved by upgrading and constructing seven regional and centralised sewage treatment plants with 195 km length of sewer network during the Eleventh Plan. In the Twelfth plan, the strategy on extending the provision of infrastructure and improving the basic infrastructure provision strategy has also included the Sewerage Industry. Besides that, the Sewerage Industry has also been involved in the reduction of the Rural-Urban development gap strategy.[62]

2.9 Industry and Market Intelligence

Industry and market intelligence are the information or data analysis derived from various sources to be utilised by an organisation to make business decisions, manpower developments and training requirements. Market intelligence is critical to understand market segmentation, personal development opportunity and existing market matrices. This section provides information regarding the value chain of sewerage services, and the Sewerage Industry based on the water supply industry growth and employment statistics.

2.9.1 Value Chain of Sewerage Industry

Water supply, sewerage, waste management and remediation activity sector are characterized into four sections, namely, resource function (water resource), production function, delivery or collection function and consumption function. Figure 2.2 illustrate the value chain model of the water and Sewerage Industry. The model interprets the correlation between the water supply and sewerage chain cycle. The water supply chain is categorised under MSIC 2008 Division 36: Water Collection, Treatment and Supply. Referring to Figure 2.2, the flow process for water supply or Division 36 starts from raw water production, followed by raw water transmission, treatment and water distribution. However, in this Occupational Framework, the development focuses on sewerage services, categorised under MSIC 2008 Division 37: Sewerage. Based on the figure, the sewerage service falls under the production and collection function. For production function, the service includes the

[62] Economic Planning Unit, Prime Minister's Department. 2021. Twelfth Malaysia Plan, 2021-2025. https://rmke12.epu.gov.my/en [9 October 2022].

treatment process, treated wastewater transmission process and final discharge. As for the collection function, the sewerage service started with the collection of wastewater from the consumer.

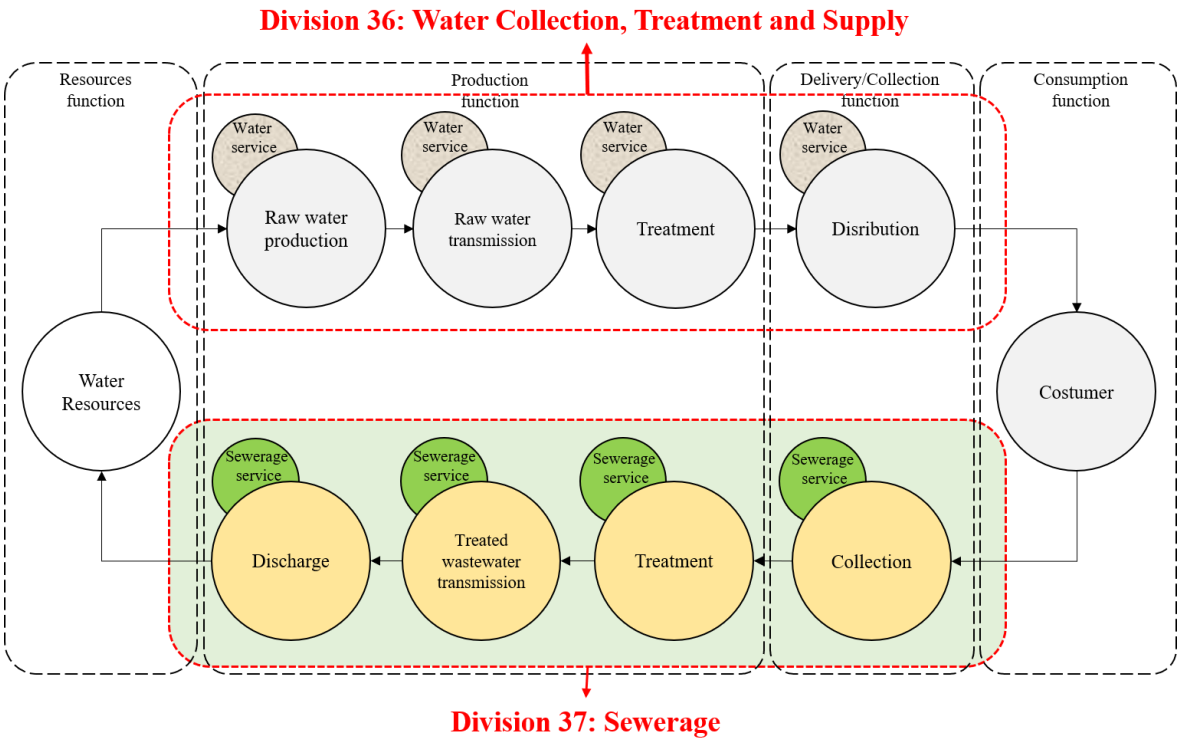

Figure 2.2: Value Chain Model of the Water and the Sewerage Industry (Adapt from Marc Spiller[63])

2.9.2 Growth of the Sewerage Industry

The Sewerage Industry is a sub-sector of Malaysia's water supply, sewerage, waste management and remediation activity industry. According to Economic Census (2016), a total of 784 facilities were established in 2015 with a Compound Annual Growth Rate (CAGR) of 5.5 per cent. From the 784 establishments, 69 establishments were established for the sewerage system. Next, the total gross value growth at 8.8 per cent from RM 7.847 million (2010) to RM 11,550.8 million (2015). The sewerage sector has contributed 9.4 per cent (RM 1,088.2 million) from the total gross value. As for value-added, the sewerage sector

[63] Spiller, Marc & Mcintosh, B.S. & Seaton, R. (2009). *The influence of supply and sewerage area characteristics on water and sewerage companies' responses to the Water Framework Directive*. Water science and technology: International Journal of Association on Water Pollution Research. 60. 1811-9.

has also increased from 209 million in 2010 to 446 million in 2015, respectively.

Another comparison study was reported by the Annual Economic Statistic 2018, as shown in Figure 2.3 below. The Malaysian water supply, sewerage, waste management and remediation activity industry gained at least RM 10.1 billion in revenue in 2017. Furthermore, the total employment rate in this sector itself has reached more than 60 per cent of the industrial workforce (~ 40,000 staff). Thus, this has set the highest employment rate record compared to the other sector (25,000 people).[64]

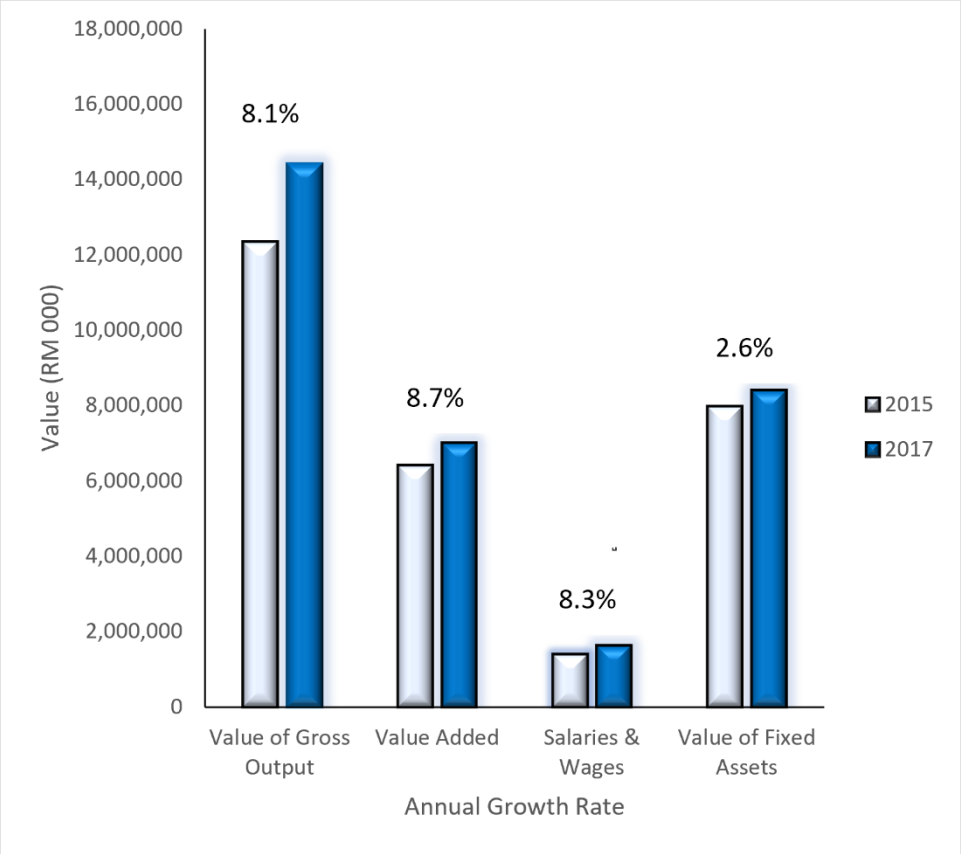

Figure 2.3: Annual Growth Rate for the water supply; sewerage, waste management and remediation industry for 2015 and 2017 (Annual Economic Statistic 2018)

Based on the figure above, the CAGR increased from 2015 to 2017 to 8.1 per cent for gross output, from 12,329.4 million to 14,417.2 million. From the total gross value, sewerage

[64] Malaysian Water Association. 2021. Malaysia Water Industry Status & Outlook Report 2020/21. - report

contributed 7.6 per cent (RM 1,101.8 million) growth in 2017. Meanwhile, the added value has reported an increase of 8.7 per cent per annum with RM 7,002.7 million in revenue. A total of 458.1 million were contributed from the sewerage facilities, which showed an increase of RM 11,372 million for the last three (3) years. On the other hand, the value of the fixed asset also increased by 2.6 per cent in 2017, contributing to RM 8.39 million compared to 2015 at RM 7.97 million. A detail on the sewerage annual growth rate trend is illustrated in Figure 2.4 below.

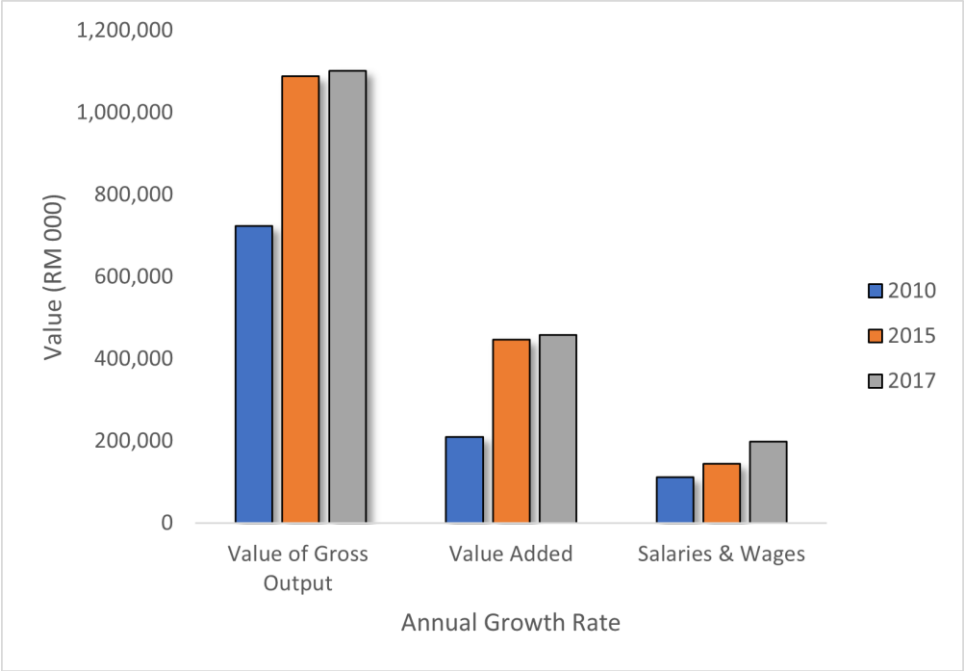

Figure 2.4: Sewerage Annual Growth Rate Trend from 2010 to 2017

Referring to Figure 2.4, the trend shows a significant growth in the sewerage system facilities for the last seven (7) years. The growth of this sector is due to the investment in the sewerage system, where the number of established sewerage facility increase from time to time and sewerage development is estimated to continue to increase gradually in 2022.

2.9.3 Employment Statistics

The water supply industry is a developing sector that requires more competent and expert workers to maintain the supply and demand as well as to sustain and improve the quality of the water management system. According to Sustainable Development Goal 6 (SDG6), one of the aims is to achieve universal and equitable access by improving the water quality by

reducing pollution, eliminating dumping, minimising the release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally in 2030.

Previous data established by DOSM (2018) recorded that the number of workers in the water supply industries showed a capital growth of 3.4 per cent in the number of persons engaged (52,518 workers). Statistically, the number of employments by sub-sector group is listed in Figure 2.5. According to the report, 17,936 persons, or 34.2 per cent of workers, are from the water collection, treatment, and supply group, followed by waste collection 17,798 workers. 5,966 were from the material recovery group. As for waste treatment and disposal, sewerage and remediation activities and other waste management service recorded at 5,490 workers, 5,227 workers, and 100 workers, respectively.

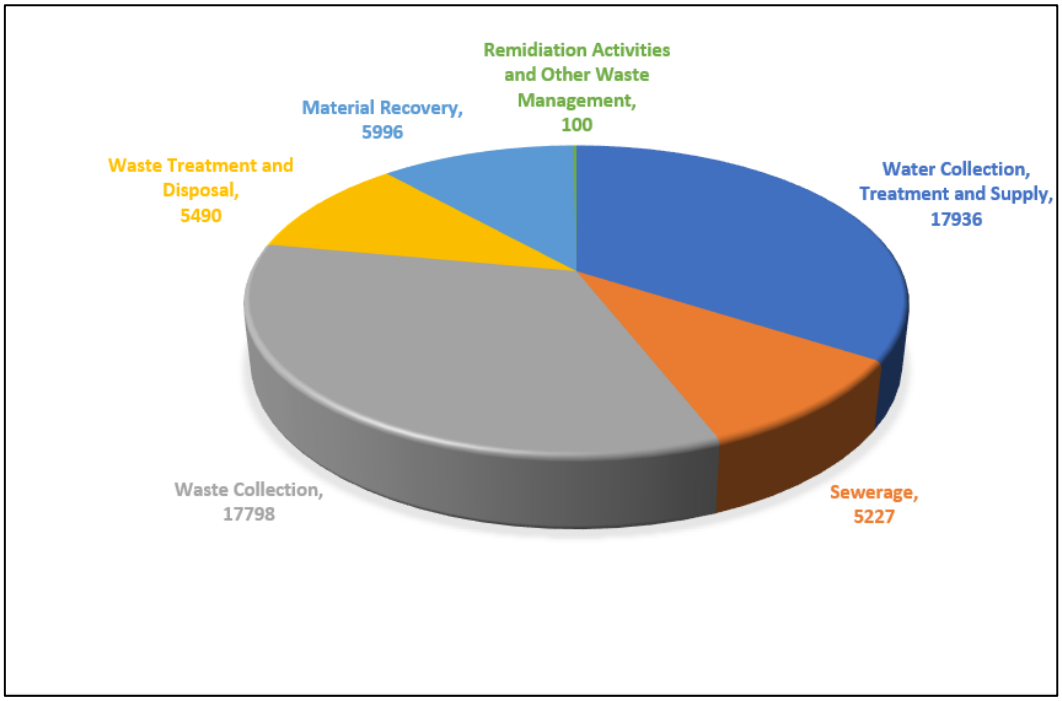

Figure 2.5: Number of Employment by Sub-Sector Group

Table 2.8 indicates the worker's category statistics in 2015 and 2017 for the water supply, sewerage, waste management and remediation activity sector. Under this scope of discussion, the workers are categorized into several levels, namely Managerial level, Technician and Associate Professional level, Clerical level, Plant & Machine Operators and Assembler level and Elementary Occupation level. Based on the data, the trend shows an increase in workers for all levels.

Table 2.8: Category of Workers of Water Supply; Sewerage, Waste Management and Remediation for years 2015 and 2017

Category of Workers	Number of Person Engaged (workers)	
	2015	2017
Manager, Professional and Researcher	3,707	4,944
Technician and Associate Professionals	3,957	4,924
Clerical and Related Occupations	12,198	12,420
Plant and Machine Operator and Assemblers	14,026	15,832
Elementary Occupation	12,161	13,822

If narrowed to the category of a skilled worker (see Table 2.9), the trend also showed an increase of 12.5 per cent of employed skilled workers. For semi-skilled and low-skilled, the trend shows an increase of 3.7 per cent and 6.4 per cent, respectively.

Table 2.9: Category of Skilled Worker of Water Supply; Sewerage, Waste Management and Remediation Industry for the years 2015 and 2017

Category of Skilled	Number of Person Engaged		Salaries and wages paid (RM million)	
	2015	2017	2015	2017
Skilled	7,664	9,868	478,638	639,050
Semi-Skilled	26,224	28,251	632,658	741,184
Low-Skilled	12,161	13,822	194,252	856,843

For sewerage services, the total number of workers reported by DOSM (2018) partially increased by the rate of 0.3 per cent from 5,193 workers in 2015 to 5,227 workers in 2017. On average, a sewerage worker's monthly salary is estimated at RM 3,151. The detail is shown in Table 2.10. Meanwhile, according to *Suruhanjaya Perkhidmatan Air Negara* (SPAN), in 2021, the water and sewerage fact book reported that the latest number of registered sewerage workers was 3,414. However, the data only cover the peninsular and Labuan Federal Territory area. From the data obtained, the trend showed a slight increase in workers starting from 2018 until 2021.

Table 2.10: Principal Statistics of the Sewerage Industry

Reference	Year	Total Number of Persons Engaged	Salaries & Wages Paid (RM'000)
SPAN Fact Book 2021 (*Exclude Sabah and Sarawak)	2021	3,414	N/A
	2020	3,432	N/A
	2019	3,412	N/A
	2018	3,376	N/A
AES 2018 (DOSM)	2017	5,227	197,660
	2015	5,193	144,289

N/A – Not Available

2.10 Occupational Comparison Between Malaysia and Selected Countries

The sewerage industry is an important industry for a country. Even in developed countries, the sewerage industry is a critical industry that acts as one of the main contributors to the economy and provides employment to millions of people. Two countries were selected as an overview for the sewerage industry, namely Japan[65] and Indonesia. Japan is among the top 25 countries in the world in wastewater management.[66] In comparison, Indonesia is a regional country with many similarities with Malaysia, including its sewage management. These two countries were chosen due to the cooperation established with Malaysia in several programs and initiatives in wastewater management.

From November 2000 until January 2009, the largest project to improve water quality and public sanitation conditions in 13 urban cities in Malaysia was conducted by the SSD of the Ministry of Energy, Water and Communication. This project was executed under Official Development Assistance (ODA) Loans from Japan International Cooperation Agency (JICA). From the Ex-Post Evaluation Report[67], the project focused on the development of large-scale Sewage Treatment Plants (STP) and Central Sludge Treatment Facilities (CSTF) in the selected areas, including Bunus, Pantai, Bandar Tun Razak, Puchong, Sungai Nyior,

[65] Berita Harian. 2017. IWK jalin kerjasama dengan TGS Jepun. https://www.bharian.com.my/taxonomy/term/5/2017/01/235530/iwk-jalin-kerjasama-dengan-tgs-jepun [20 October 2022].
[66] NationMaster. 2022. Top Countries in Total Waste Water Treatment. https://www.nationmaster.com/nmx/ranking/total-waste-water-treatment [20 October 2022].
[67] Japan International Cooperation Agency (JICA). 2013. Ex-Post Evaluation of Japanese ODA Loan Project Report. Sewerage Treatment Plant Project. https://www2.jica.go.jp/en/evaluation/pdf/2013_MXVIII-2_4_f.pdf [28 October 2022].

Juru, Kangar, Damansara, Sunggala, Kuala Sawah, Klang, Sungai Udang and Kota Setar. This STP and CSTF project is consistent with Seventh Malaysia Development Plan (1996-2000) and aligned with the Japanese assistance policy to Malaysia. The project has given a tremendous outcome where the outflow at target plants was drastically improved, and the population served has also achieved the targeted percentage. The project has also opened further cooperation with JICA, including Technical Cooperation Project on Water Management and Sewerage[68], Sewerage & Drainage System Development Study[69], a Visit by Japan Sanitation Board[70] and Collaboration Visit & Project by Japanese Companies[71].

Meanwhile, Malaysia also cooperates well with Indonesia in the Sewerage Industry in most of the joint ventures of IWK with Environmental Cooperation-Asia (Eco-Asia). On 5 December 2008, a Memorandum of Understanding on the twinning partnership program was signed between IWK and *Perusahaan Daerah Air Minum* Tirtanadi of Medan[72]. This initiative was conducted with the objective of improving the sanitation services in Medan by increasing the demand and connection of sewerage. The role of IWK as a mentor partner is to review the Medan Masterplan and provide training & sharing of expertise in sewerage development planning and controls[73]. Besides, IWK has also been appointed as an Eco-Asia training partner for capacity-building programmes in Asian countries, including Indonesia. Four capacity building programs were completed out of 22 International capacity buildings, including Multiple Water Operator Partnerships (WOPs) for sewerage management improvements in Indonesia.[74] Based on the programmes that have been conducted

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[68] Japan International Cooperation Agency. 2022. Past Activities. https://www.jica.go.jp/malaysia/english/activities/past01.html [28 October 2022].

[69] Japan International Cooperation Agency. 2022. Past Activities. https://www.jica.go.jp/malaysia/english/activities/past01.html [28 October 2022].

[70] Indah Water Konsortium. 2011. Sustainability Report 2011. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/SustainabilityReport2011.pdf [28 October 2022].

[71] Indah Water Konsortium. 2010. Sustainability Report 2010. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/SustainabilityReport2010.pdf [28 October 2022].

[72] Indah Water Konsortium. 2009. Sustainability Report 2008-2009. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/SustainabilityReport2008-2009.pdf [28 October 2022].

[73] Indah Water Konsortium. 2009. Sustainability Report 2008-2009. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/SustainabilityReport2008-2009.pdf [28 October 2022].

[74] Indah Water Konsortium. 2011. Sustainability Report 2011. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/SustainabilityReport2011.pdf [28 October 2022].

previously, this shows the credibility of Malaysia's Sewerage Industry as a country with developed sewerage systems to help the countries in Southeast Asia with wastewater and sewerage management.

2.11 Relation of Industrial Revolution with Occupation

As Malaysia is going forward with the fusion of technology towards industry transformation, the Sewerage Industry is also optimistic by uplifting its readiness to embrace changes to adapt to Industrial Revolution 4.0. IWK with Business Plan 2019-2023 is strategizing the initiative, including the plan to innovate national wastewater management with digital transformation, and looking forward to steering IWK towards the expansion of wastewater management efficiency.[75] The business plan is also aligned with the strategic direction set by the Ministry of Environment and Water (KASA) for 2020-2030, in which some of the strategic planning supported the initiative by IWK towards green technology advancement together with sewerage operational expenditure recovery and water reclamation.[76]

The skills according to the level of competencies needed by the workforce in the Water and Sewerage Services Industry related to the Industrial Revolution have also been identified. Some of the identified soft skills like analysing, evaluating data, operating SMART devices to input data, work assigned and preparing the report, required training on IR 4.0 for Desludging Management System (DMS), System Applications and Products (SAP) and Facility Management (Maintenance Scheduling, Analysis, Manpower), and Billing, Records and Information System (BRAINS).[77] All the required training falls under the Big Data Analytics and Internet of Things pillars of technology advancement. The listed Industrial Revolution-related skills needed show that the Sewerage Industry has already uplifted the readiness to adopt digital transformation.

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[75] Indah Water Konsortium. 2020. Shaping a sustainable tomorrow Indah Water Konsortium Sustainability Report 2019/2020. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/INW%20SR%20report%202019-2020.pdf [16 October 2022].

[76] Kementerian Sumber Asli, Alam Sekitar Dan Perubahan Iklim. 2020. Environmental Sustainability in Malaysia, KASA 2020-2030. https://www.kasa.gov.my/resources/rujukan/Roadmap_KASA_2020-2030-en.pdf [19 October 2022].

[77] Pembangunan Sumber Manusia Berhad. 2020. Industrial Skills Framework for Water & Sewerage Services Industry 2020. https://hrdcorp.gov.my/wp-content/uploads/2021/03/HRDF_IndSF_WaterSewerage.pdf [19 October 2022].

Besides, IWK has also streamlined the strategic initiatives towards technological advancement in the Sewerage Industry by enhancing Research and Development (R&D). Some R&D opportunities have been planned, and related projects like Identifying Sensors as Smart Materials to Track Sewer Line Performance, Mathematical Modelling & Computer Simulation and Automated/Independent Individual Sewerage Treatment Plant (STP) could be categorized as Industry Revolution projects.[78] This might help to achieve the targeted 100 % sludge (bio-solid) to be reused and 33 % effluent to be treated and recycled set in GTMP by 2030. The transformation in the sewerage management system could entice the needs of relevant occupations in this industry to cater to all the technological advancement initiatives of the Industry Revolution.

2.12 Conclusion

The Sewerage Industry is an important and strategic part of the Malaysian development plan. The overall Sewerage industry employment increased from 84,653 persons in 2015 to 95,737 persons in 2017. There are 12 NOSS related to this division that has been developed over the years. Some of the NOSS titles in this group have yet to be revised and require immediate action to update the standard in line with the industry's growth.

The findings on the Sewerage Industry landscape, the MSIC 2008 definition of the job area, and the NOSS that have been developed give an insight into the overall picture of the industry. These inputs pave the way and guide the next course of action in restructuring the occupational structure, identifying skills in demand and critical job titles. The requirements of the Industrial Revolution would also impact the future of manpower in this area. All information from the literature review was used to construct a survey questionnaire and interview protocol items to obtain important findings for the development of this OF.

As to materialise the above, certain research methodologies are employed. The description of research strategies and approaches is discussed in the next chapter.

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[78] Indah Water Konsortium. 2020. Shaping a sustainable tomorrow Indah Water Konsortium Sustainability Report 2019/2020. https://www.iwk.com.my/cms/upload_files/resource/sustainabilityreport/INW%20SR%20report%202019-2020.pdf [16 October 2022].

CHAPTER III

METHODOLOGY

3.1 Introduction

This chapter describes the overall methodology for developing Occupational Framework (OF) Section E and Division 37 Sewerage (E37). The research framework highlighted all the development phases, involving all methods and approaches to achieve objectives. Research approach addressed all the approaches used for the selected methods, which reflect the outcome of this research. The methods suggested mainly included document analysis, Focus Group Discussion (FGD) and survey. The qualitative approach utilised data collection and analysis through document analysis and semi-quantitative FGD. Meanwhile, the quantitative approach utilised a survey instrument, which is the questionnaire that was developed by using the output from the qualitative findings. The detailed descriptions of overall methods have been explained in the next section.

3.2 Research Design

This present research was designed according to the approach of semi-quantitative and qualitative with FGD as the main research methodology. Throughout this methodology, the selection of industry panel experts was based on a purposive sampling of Patton, 2002[79] in which the respondents were experts from the Sewerage Industry. In order to achieve the objectives and scope of this present research, the design was based on the multi-approach of systematic literature highlights, focus group brainstorming and in-depth interview on related questions of the Sewerage Industry. Table 3.1 highlights the mapping summary of the methodology with research scopes and objectives.

[79] Patton. M. Q. 2002. Qualitative research and evaluation methods (3rd ed.). Thousand Oaks, CA: Sage Publications

Table 3.1: The Mapping of Methodology with Research Scopes and Objectives

Objective	Information Data	Method	Source/ Criteria	Analysis
a) To develop an Occupational Structure (OS) in the Sewerage Industry based on MSIC 2008	Primary	• Focus Group Discussion;(FGD 1 and 2) • Nominal Group Technique (NGT) • Specific Interview Protocol • Industrial Engagement	• Malaysian Standard Industrial Classification (MSIC) 2008 • Malaysian Occupational Skills Qualification Framework (MOSQF) • Sewerage Industry Experts in Malaysia • Verification from the Department of Skills Development (DSD) • Technical Category & Human Resources from Industry • Department of Statistics Malaysia (DOSM), National Water Service Commission (*Suruhanjaya Perkhidmatan Air Negara*, SPAN), Social Security Organisation (SOCSO) and Malaysia Standard Classification of Occupations (MASCO)	• Content Analysis (Consensus by Experts)
b) To determine the critical jobs in the Sewerage Industry	Primary	• Focus Group Discussion (FGD 1 and 2) • Nominal Group Technique (NGT) • Specific Interview Protocol • Industrial Engagement • Survey Questionnaires	• Malaysian Standard Industrial Classification (MSIC) 2008 • Malaysian Occupational Skills Qualification Framework (MOSQF) • Sewerage Industry Experts in Malaysia • Verification from DSD • Technical Category & Human Resources from Industry • DOSM, SPAN, SOCSO and MASCO • Survey Respondents from Sewerage Industry in Malaysia	• Content Analysis (Consensus by Experts) • Analysis from Statistical Package for the Social Sciences (SPSS)

Objective	Information Data	Method	Source/ Criteria	Analysis
c) To determine the jobs titles for the Sewerage Industry that is relevant to Industrial Revolution (IR)	Primary	• Focus Group Discussion (FGD 1 and 2) • Nominal Group Technique (NGT) • Specific Interview Protocol • Industry and Stakeholder Engagement • Survey Questionnaires	• Malaysian Standard Industrial Classification (MSIC) 2008 • Malaysian Occupational Skills Qualification Framework (MOSQF) • Sewerage Industry Experts in Malaysia • Verification from DSD • Technical Category & Human Resources from Industry • DOSM, SPAN, SOCSO and MASCO • Survey Respondents from Sewerage Industry in Malaysia	• Content Analysis (Consensus by Experts) • Analysis from Statistical Package for the Social Sciences (SPSS)
d) To determine the skills in demand of the Sewerage Industry	Primary	• Focus Group Discussion (FGD 2) • Nominal Group Technique (NGT) • Specific Interview Protocol • Survey Questionnaires	• Malaysian Standard Industrial Classification (MSIC) 2008 • Malaysian Occupational Skills Qualification Framework (MOSQF) • Sewerage Industry Experts in Malaysia • Verification from DSD • Technical Category & Human Resources from Industry • DOSM, SPAN, SOCSO and MASCO • Survey Respondents from Sewerage Industry in Malaysia	• Content Analysis (Consensus by Experts) • Analysis from Statistical Package for the Social Sciences (SPSS)
e) To determine Occupational Descriptions (OD) of the Sewerage Industry for critical jobs based on developed OS	Primary	• Focus Group Discussion (FGD 2) • Nominal Group Technique (NGT) • Specific Interview Protocol	• Malaysian Standard Industrial Classification (MSIC) 2008 • Malaysian Occupational Skills Qualification Framework (MOSQF) • Sewerage Industry Experts in Malaysia • Verification from DSD • Technical Category, Human Resources from Industry • DOSM, SPAN, SOCSO and MASCO	• Content Analysis (Consensus by Experts)

The overall process to develop OF for E37 Sewerage was conducted in three (3) sequential phases. Qualitative and quantitative analysis were used to conduct every phase to achieve all objectives. A brief explanation of each phase is as follows,

Phase 1 – **Information Gathering**, highlighting the qualitative data collection from document analysis activities, including data for literature review and obtaining information during Industrial Engagement. The findings were used to construct semi-structured questions for interview protocol items and predefined survey questionnaires.

Phase 2 – **Expert View**, the qualitative point of view and consensus from industry experts were recorded through the FGD method to achieve research objectives. The Sewerage Industry Experts from all over Malaysia were gathered to obtain the latest information from industries facilitated by the researcher and assistant researcher.

Phase 3 – **Expert Verification for Usability**, verification and usability stage of the developed OF through an Industry & Stakeholder Engagement session by means of verifying and considering the usability of developed OF for E37 Sewerage as a reference to the future resembling development activities like NOSS and the others.

The research framework in Figure 3.1 on the following page illustrates all the methods and approaches involved in each phase. The information on the implementation of every phase is highlighted in the next section

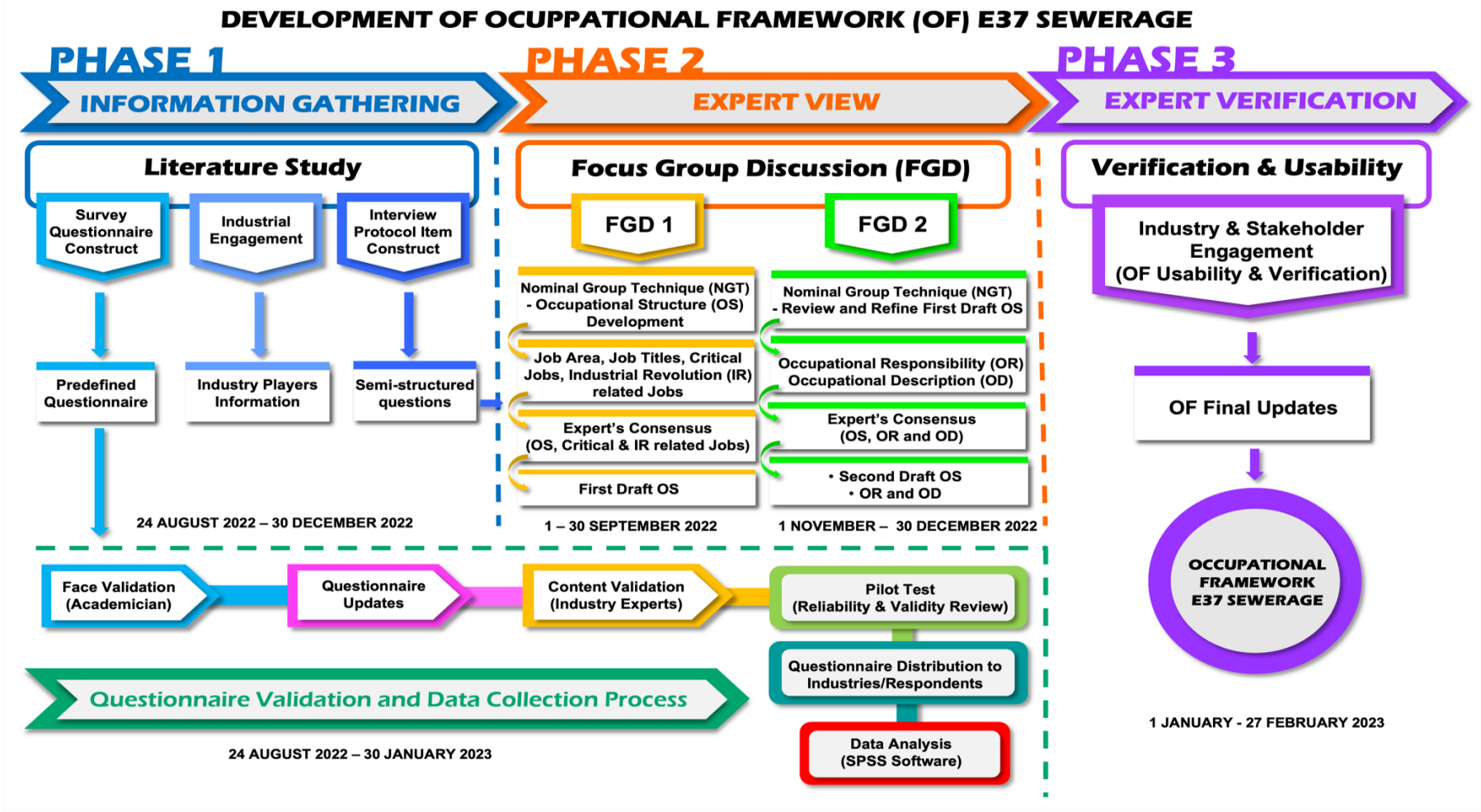


Figure 3.1: Research Framework for Development of Occupational Framework for Division 37 Sewerage

3.3 Implementation of Phase 1 - Information Gathering

Phase 1 focuses on the data collection on the research problem with regards to occupational in sewerage industries and the identification of objectives. It also involves gathering information for literature study by reviewing and digital benchmarking through adaptation of current sources like articles, written reports, journals, websites and guidelines. All the information was used to construct a predefined survey questionnaire and semi-structured questions for the interview protocol. The semi-structured questions prepared in line with the objectives were discussed with Sewerage Industry experts during FGD, and the questionnaire has undergone face validation by selected academicians. Specific interviews and reviews from the appointed experts during the FGD session also helped to validate the reliability of the constructed survey items. Representatives from DOSM and SOCSO were also invited, and the latest related information and statistics were collected from the brainstorming session during FGD.

Data from selected documents were analysed in developing a survey questionnaire and semi-structured questions for the interview protocol. The document analysis strategy for this present research is to systematically review the Sewerage Industry-related Policies, Plans, Acts, and Guidelines. Besides, it also involves information or data extraction from economics and other relevant agencies' databases. The main database references of the Sewerage Industry are highlighted in Table 3.2.

Table 3.2: The Main Database References of the Sewerage Industry

Database	Referred Documents	Remarks
Policies, Plans, Acts and Guidelines	Panduan Pembangunan OF	Guidelines for the development of OF document
	Malaysia Standard Industrial Classification (MSIC) 2008. Department of Statistics Malaysia (DOSM)	Reference of the Sewerage Industry economic activities classification
	Malaysia Occupational Skills Qualification Framework (MOSQF). Department of Skills Development (DSD)	Reference of eight (8) skills level of MOSQF

Database	Referred Documents	Remarks
	The Green Technology Master Plan 2017-2030	Reference of planning and initiatives related to the Sewerage Industry
	Environmental Quality Act 1974	Reference of Acts related to the Sewerage Industry
	Water Services Industry Act 2006	Reference of Acts related to the Sewerage Industry
	Sewerage Services Act 1993 (Act 508)	Reference of Acts related to the Sewerage Industry
	Malaysia Sewerage Industry Guideline	Reference of Guidelines related to the Sewerage Industry
	Eleventh Malaysia Plan, 2016-2020	Reference of planning and initiatives related to the Sewerage Industry
	Twelfth Malaysia Plan, 2021-2025	Reference of planning and initiatives related to the Sewerage Industry
	Environmental Sustainability in Malaysia, KASA 2020-2030	Reference of planning related to the Sewerage Industry
Economic Database	Annual Economic Statistics 2018 Water Supply; Sewerage, Waste Management and Remediation Activities (DOSM, 2018). Department of Statistics Malaysia (DOSM)	Reference for statistical data (growth of Sewerage Industry – Gross Output) for the Sewerage Industry
	Malaysia Water Industry Status & Outlook Report 2020/21. The Malaysian Water Association	Reference for market size of Malaysia Water Industry
	Malaysia Water Industry Status & Outlook Report 2020/21. The Malaysian Water Association	Reference for market size of Malaysia Water Industry (Compound Annual Growth Rate (CAGR))
	Industrial Skills Framework for Water & Sewerage Services Industry 2020, *Pembangunan Sumber Manusia Berhad*	Reference of Sewerage Services industrial skills framework related to Industry Revolution and Principal Statistics of the Sewerage Industry.
Database from other relevant agencies	Current Situation and Issues of Industrial Wastewater Management in Malaysia. 13th WEPA Annual Meeting and WEPA International Workshop on Industrial Wastewater Management	Reference of statistical data on wastewater management in Malaysia that related to the Sewerage Industry

Database	Referred Documents	Remarks
	Performance Monitoring and Evaluation Tips: Conducting focus group interviews. USAID.	Reference of implementation of Focus Group Discussion
	Gaining Consensus Among Stakeholders Through the Nominal Group Technique, U.S. Department of Health and Human Services, Centre for Disease Control and Prevention	Reference of Nominal Group Technique.
	National Water Service Commission. Water and Sewerage Fact Book 2021	Reference of employment statistics in the Water and Sewerage Industry
	Skills and jobs mismatch in low- and middle-income countries. International Labour Organization	Reference of global issues related to skills mismatching
	Indah Water Konsortium Sustainability Report 2007-2020	Reference of Sewerage Operator activities, planning and reports
	Occupational Framework 2016 (Water Services Industry)	Comparison with the present developed OF

Based on the referred databases, the analysis was done towards information gathered prior to developing a predefined survey questionnaire and interview protocol semi-structured questions before moving to the next phases of FGD implementation. The economic activities classification in MSIC 2008 was the most imperative information or reference supported by the policies, legislations, acts and guidelines of Sewerage Industry stakeholders. Besides, the statistical analysis of the Sewerage Industry in Malaysia Water Industry is important to establish the economic performances, national and international sewerage industry outlook and profile of current and future workforce and initiatives. Moreover, the Industry Revolution relevancy perspective view in the Sewerage Industry is of important information in achieving the development objective of OF E37 Sewerage.

3.4 Implementation of Phase 2 - Experts View

Phase 2 is the implementation of the main method of the research, which is FGD. In this research, two (2) stages of FGD (FGD 1 and 2) were conducted in which the research objectives differentiated each stage. The sewerage industry experts have been brought to engage in NGT sessions in both FGD stages. This phase is crucial in order to gather and record all the information obtained during the interview protocol by discussing the semi-structured questions. From the interview, the proliferation of ideas and open-ended discussion happened during the NGT approach in order to achieve saturation discussion from industry experts before the finalised idea is confirmed with consensus from all through voting. This exercise continued until all framework areas were finalised and concluded. Besides, findings from the discussion of semi-structured questions have been cross-checked with the gathered information and data from document analysis.

For OF E37 Sewerage development, an in-depth FGD session with an industry expert panel was conducted according to the following procedural steps illustrated in Figure 3.2.

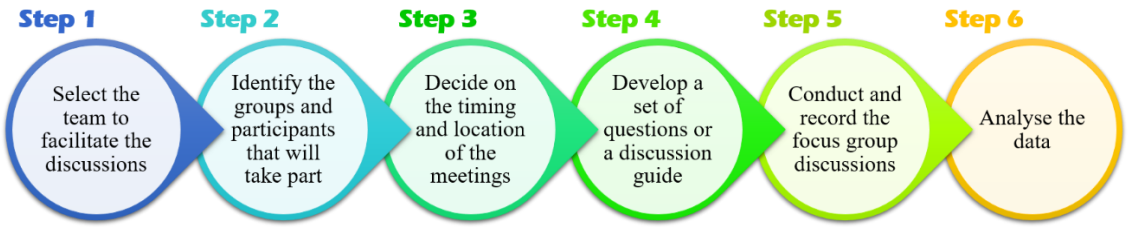


Figure 3.2: Focus Group Discussion Procedures (Source: Adapt from United States Agency International Development)[80]

Initially, the expert panels were selected from managerial-level personnel with experience of 7 years and above in the Sewerage Industry. In this phase, a moderator was appointed to control the dynamic of the group. The NGT approach was used during a brainstorming session in order to obtain consensus from the industry expert panel to achieve

[80] USAID. 2011. Performance Monitoring and Evaluation Tips: Conducting focus group interviews. Number 10. http://pdf.usaid.gov/pdf_docs/pnadw110.pdf [20 October 2022].

the aims of each FGD session. The NGT was chosen with the purpose of obtaining a democratic consensus by prioritizing the ideas based on votes. With these techniques, the individual influences have been balanced, and more ideas could be generated throughout the session[81]. The NGT conducted during the FGD session was adapted from the procedural steps illustrated in Figure 3.3.

Figure 3.3: Nominal Group Technique Procedures[82]

The interview protocol is a qualitative research instrument involving the collection of specific data from FGD. The construct of interview protocol items also emphasises the need for skill areas in the Sewerage Industry in Malaysia. The NGT and interview approach was adapted by considering the input of the following aspects.

i) The Sewerage Industry skill area group that refers to MSIC 2008;
ii) Job title statement by area group that refers to MOSQF;
iii) Reconciliation by cross-checking with components in MSIC 2008, *Include Item & Exclude Item*;
iv) Other inputs include trends, current, and future technologies related to the Sewerage industry.

The selection criteria of expert panels and the actual respondents from FGD 1 and 2 sessions are summarised in Table 3.3.

[81] U.S. Department of Health and Human Services, Centre for Disease Control and Prevention. 2018. Gaining Consensus Among Stakeholders Through the Nominal Group Technique. https://www.cdc.gov/healthyyouth/evaluation/pdf/brief7.pdf [20 October 2022].
[82] U.S. Department of Health and Human Services, Centre for Disease Control and Prevention. 2018. Gaining Consensus Among Stakeholders Through the Nominal Group Technique. https://www.cdc.gov/healthyyouth/evaluation/pdf/brief7.pdf [20 October 2022].

Table 3.3: Method, Criteria and Actual Respondents of FGD Session

No	Method	Criteria	Actual Respondents
1	**Focus Group Discussion 1** Location: Bangi Resort Hotel Date: 17 & 18 September 2022	**Respondent background:** Sewerage Operator in Peninsular Malaysia, Sarawak and Sabah (IWK and SSD), Regulatory Body (SPAN), Related Bodies (DOSM & SOCSO) **Sampling method:** Sampling was based on collective findings from various backgrounds according to critical areas classified in MSIC 2008 Division 37 Sewerage and related bodies. Panels were selected based on the listed criteria: • Expert Panel with at least five (5) years of experience in the relevant field of expertise in the professional/technical field according to the MSIC 2008 section/section/group under Division 37 Sewerage (proven through a nomination form or CV supported by the employer). • Possess the written release letter from the representing organisation. • Holding the minimum position of senior management officer and experienced in human resource management, projects and operations in the Sewerage Industry and representing stakeholders. • Authorities, statutory bodies (GLCs), multinational companies (MNCs) or other organisations related to the Sewerage Industry.	**FGD 1:** 6 Panels, 2 Facilitators
2	**Focus Group Discussion 2** Location: Hilton Garden Inn Hotel Date: 3 & 4 December 2022		**FGD 2:** 8 Panels, 3 Facilitators

3.4.1 Focus Group Discussion 1

The main aim of FGD 1 was to develop the Sewerage Industry Occupational Structure (OS) by referring to classified economic activities in MSIC 2008. The discussion focused on the development of OS, which was recommended by industry expert panels, as listed in Table 3.4.

Table 3.4: List of Industry Expert Panel during FGD 1

No.	Panel	Position	Organisation/Company
1	Ruhaidah Md Hassan	Manager	Indah Water Konsortium Sdn. Bhd.
2	Wee Soon Guan	Executive Desludging	Indah Water Konsortium Sdn. Bhd (Melaka)
3	Mohd Johan Bakri	Executive	Indah Water Konsortium Sdn. Bhd. (Negeri Sembilan)
4	Majid Saith Mohamed	Manager	Indah Water Konsortium Sdn. Bhd (Shah Alam)
5	Ir. Alvin Garry Rasion	Deputy Director	Sewerage Services Department (SSD) Sabah
6	Ir. Ts. Mohamad Fahrurrazi Kamaludin	Data Scientist	Social Security Organisation (SOCSO)
7	Dr Mohd Razealy Anuar	Facilitator/Researcher	PFH Resources (M) Sdn. Bhd.
8	Mr. Ahmad Ramdan M. Yusof	Facilitator/Assistant Researcher	PFH Resources (M) Sdn. Bhd.

A series of ideas were obtained through the NGT brainstorming session which the consensus on the prioritized ideas was achieved based on indirect voting according to mutual consent by all panels. Besides, semi-structured questions constructed during document analysis have been discussed, and findings from panels on the critical job and jobs relevant to the Industry Revolution have been recorded. The FGD 1 focused on developing the first draft of OS and findings from semi-structured questions during interview protocol. The NGT discussion during FGD 1 is shown in Figure 3.4.

Figure 3.4: NGT Discussion During FGD 1

The samples of the semi-structured questions for FGD 1 were set as follows:

- What will be the Sewerage Industry occupational structure (OS) looks like?
- How to determine the relevant sewerage job titles that are in line with the Industrial Revolution?
- How to determine the critical jobs for the Sewerage Industry?
- Who are the key stakeholders in the Sewerage Industry?
- What are the legislations, policies, and initiatives for the Sewerage Industry?
- What is the current development of the Sewerage Industry in Malaysia?
- What are the current employment statistics for this industry?

- Which countries can be referred to as an example of this industry based on their current development?
- What are the issues and challenges faced by the industry?

3.4.2 Focus Group Discussion 2

In FGD 2 session, expert panels from FGD 1 and additional panels from the Sewerage Industry, SPAN and DOSM, as listed in Table 3.5, were re-invited to re-engage for discussion on the subsequent review and revision of the obtained OS, critical jobs, and jobs relevant for Industry Revolution from FGD 1. Then, further discussions on skills in demand, occupational responsibility (OR), job descriptions and semi-structured questions were also conducted. The consensus and updates were obtained from the discussions and ended with mutual consent from all panels through voting. The outcomes for FGD 2 were to construct a second draft of OS, finalise critical jobs and jobs relevant to the Industry Revolution and determine the OR and job descriptions. The NGT discussion during FGD 1 is shown in Figure 3.5.

Table 3.5: List of Industry Expert Panel during FGD 2

No.	Panel	Position	Organisation/Company
1	Ruhaidah Md Hassan	Manager	Indah Water Konsortium Sdn. Bhd.
2	Wee Soon Guan	Desludging Executive	Indah Water Konsortium Sdn. Bhd. (Melaka)
3	Mohd Johan Bakri	Executive	Indah Water Konsortium Sdn. Bhd. (Negeri Sembilan)
4	Mohd Fadil Mohamed Noor	Manager	Indah Water Konsortium Sdn. Bhd. (Cyberjaya)
5	Siti Rabiah Abu Bakar	Engineer	Sewerage Services Department (SSD) Sarawak
6	Ir. Ts. Mohamad Fahrurrazi Kamaludin	Data Scientist	Social Security Organisation (SOCSO)

No.	Panel	Position	Organisation/Company
7	Mr. Mohammad Nasir Mahmood	Director	Suruhanjaya Perkhidmatan Air Negara (SPAN) Cyberjaya
8	Ms. Nazira Abdullah	Assistant Director	Department of Statistics Malaysia (DOSM)
9	Dr. Mohd Razealy Anuar	Facilitator/Researcher	PFH Resources (M) Sdn. Bhd.
10	Mr. Ahmad Hayaton Jamely Salehuddin	Facilitator/ Assistant Researcher	PFH Resources (M) Sdn. Bhd.
11	Mr. Ahmad Ramdan M. Yusof	Facilitator/ Assistant Researcher	Precious Galaxy Sdn. Bhd.

Figure 3.5: NGT Discussion During FGD 2

The samples of the semi-structured questions for FGD 2 are set as follows:

- What will be the job descriptions for critical jobs in Sewerage Industry?
- What will be the responsibility of each job titles identified in OS?
- What are the job scopes of each of these job titles?
- What is the occupational demand by various skill categories, including TVET on related occupations?
- What are the entry-level job titles and career progressions until the highest level of competency in the occupational structure?

At the end of both FGD 1 and FGD 2 sessions, the finalized OS with identified job titles has been obtained with the agreement and consensus from all expert panels from the Sewerage Industry, regulatory and related bodies. Job titles categorised as critical and related to IR have been deduced from the obtained OS. Descriptions and scopes of the identified job titles were also specified through OR and OD. Key stakeholders, legislation, demanding skills, and key issues were also discussed. Besides, content validity for the survey questionnaire was also conducted during the FGD session. All the information from FGD sessions was used as findings for OF development.

3.4.3 Survey

This study employed a self-explanatory survey to achieve five key objectives related to the critical job's classification, occupational qualification, skills in demand, emerging skills and related issues. Both face-to-face and online forms were used as a platform for the survey. The survey was specifically distributed to the industrial players and stakeholders of the Sewerage Industry all over Malaysia.

a) Sampling Method

According to Majid Konting (2004), a sample is defined as a group of people, institutions, locations or situations that can be a resource for the information needed by the researcher. At the same time, the population is a bigger group that obtained benefits from the research findings. This study uses a random sampling method to acquire the research sample. The main targeted respondent group focuses on the industrial sewerage player. The number of respondents was segregated according to the latest number of establishments obtained from DOSM; 69 establishments have been identified. Thus, according to Krejcie and Morgan (Table 3.6), 50 establishments were selected, and each establishment targeted at least two (2) persons to complete the survey. Thus, the total survey aimed estimated at 100 respondents. Details are presented in Table 3.7.

Table 3.6: Sample determination Table (Source: Krejcie and Morgan (1970)[83])

Population (N)	**Sample (n)**	**Population (N)**	**Sample (n)**	**Population (N)**	**Sample (n)**
10	10	55	48	100	80
15	14	60	52	110	86
20	19	65	56	120	92
25	24	70	59	130	97
30	28	75	63	140	103
35	32	80	66	150	108
40	36	85	70	160	113
45	40	90	73	170	118
50	44	95	76	180	123

Table 3.7: Sewerage Sampling size

SECTION	**DIVISION**	**GROUP**	**NUMBER OF ESTABLISHMENT**	**NUMBER OF SAMPLES**	**NUMBER OF TARGETED RESPONDENTS**	**NUMBER OF ACTUAL RESPONDENTS**
E	**37**	370	**69**	**50**	**100**	**100**

[83] Krejcie, R. & Morgan, D. 1970. Determining sample size for research activities. Educational and Psychological Measurement, *30*, 607-610.

b) Questionnaire Design and Validation

Survey questionnaire items were constructed by considering adaptation and modification according to the requirements from the previous OF (DSD, 2016)[84]. The survey was designed and divided into five (5) sections according to the set key objectives, and the description of each section is tabulated in Table 3.8.

Table 3.8: The Description of Section in Survey Questionnaire

Section	Description	Literature Source
Section 1: Critical Job Classification	This section explores the critical jobs that can be classified in the Sewerage Industry.	(MSIC, 2008) Section E Division 37 Sewerage
Section 2: Occupational Qualification	This section aims to identify the occupational academic and technical & vocational qualifications in the Sewerage Industry.	(DSD, 2014) Enhancing the Quality & Relevance of TVET for Current & Future Industry Needs – Phase 1
Section 3: Skills in Demand	This section aims to determine which category of skills is in demand and the skills gap in the Sewerage Industry.	(DSD, 2016) Occupational Framework 2016 Water Services Industry.
Section 4: Emerging Skills	This section determines the impact of the Industry Revolution on the economic activities in the Sewerage industry and the relevant skills to be equipped by the workforce for the Industry Revolution.	(EPU, 2012) National Fourth Industrial Revolution (4IR) Policy.
Section 5: Related Issues	This section explores the key issues related to the Sewerage Industry.	(MoHR, 2008) Handbook on Social Skills & Social Values in TVET.

The key objectives of the survey questionnaire were set according to the document analysis in phase 1. The items in the questionnaire were constructed from the adaptation of some literature sources, as listed in Table 3.2. Critical job classification item was constructed by referring to all the listed economic activities in MSIC 2008. In addition, the adaptation of

[84] Department of Skills Development. 2016. Occupational Framework 2016 Water Services Industry.

the Level of Descriptor items from MOSQF (DSD, 2014)[85] helped clarify the reference level of employment ability. The construct items for emerging skills that are related to the Industry Revolution (IR) refer to the elements of the National Fourth Industrial Revolution (4IR) Policy (EPU, 2012)[86]. Meanwhile, the related issues construct items were adapted according to elements required on social skills and social values from the Ministry of Human Resources (MoHR, 2008)[87].

The constructed pre-defined question was then validated through the face and content validation processes. Face validity has been conducted by two academicians from Universiti Pendidikan Sultan Idris (UPSI) and one from Universiti Tun Hussein Onn Malaysia (UTHM). Then the face-validated questionnaire was then gone through content validation by experts appointed during FGD 1 and FGD 2. The list of face and content validators of the questionnaire are listed in Table 3.9.

Table 3.9: The List of Face and Content Validators of Survey Questionnaire

No.	Name	Expertise/Position	University/ Colleges/Organisations
1	Ts. Dr. Mohd Ridhuan Mohd Jamil	Methodology (Focus Group Discussion (FGD) & Fuzzy Delphi Method (FDM))	Jabatan Pengajian Pendidikan Fakulti Pembangunan Manusia Universiti Pendidikan Sultan Idris (UPSI),
2	Assoc. Prof. Dr. Mohamed Nor Azhari Azman	Examiner (Vocational Education & Curriculum Development; STEM Education)	Fakulti Teknikal & Vokasional (FTV) Universiti Pendidikan Sultan Idris (UPSI)

[85] Department of Skills Development. 2014., Asia-Pacific Economic Cooperation (APEC) (2014). Enhancing the Quality and Relevance of Technical and Vocational Education and Training (TVET) for Current and Future Industry Needs. - report

[86] Prime Minister's Department. Economic Planning Unit. 2012. National Fourth Industrial Revolution (4IR) Policy,.

[87] Ministry of Human Resources (MoHR). 2008. Handbook on Social Skills & Social Values in TVET, Jointly Published MoHR & UPM, Putrajaya.

No.	Name	Expertise/Position	University/ Colleges/Organisations
3	Assoc. Prof. Dr. Mimi Mohaffyza Mohamad	Field Specialization & MBOT Auditor (Technical & Vocational Curriculum Development)	Fakulti Pendidikan Teknikal & Vokasional (FPTV), Jabatan Pendidikan Profesional & Pengajian Pasca Siswazah Universiti Tun Hussein Onn Malaysia (UTHM)
4	Ruhaidah Md Hassan	Manager	Indah Water Konsortium Sdn. Bhd.
5	Wee Soon Guan	Desludging Executive	Indah Water Konsortium Sdn. Bhd. (Melaka)
6	Mohd Johan Bakri	Executive	Indah Water Konsortium Sdn. Bhd. (Negeri Sembilan)
7	Majid Saith Mohamed	Manager	Indah Water Konsortium Sdn. Bhd. (Shah Alam)
8	Mohd Fadil Mohamed Noor	Manager	Indah Water Konsortium Sdn. Bhd. (Cyberjaya)
9	Siti Rabiah Abu Bakar	Engineer	Sewerage Services Department (SSD) Sarawak
10	Ir. Alvin Garry Rasion	Deputy Director	Sewerage Services Department (SSD) Sabah
11	Mohammad Nasir Mahmood	Director	Suruhanjaya Perkhidmatan Air Negara (SPAN) Cyberjaya
12	Ir. Ts. Mohamad Fahrurrazi Kamaludin	Data Scientist	Social Security Organisation (SOCSO)

FGD also provides preliminary information from the results of brainstorming and necessary interviews. The feedback from the panel helped the content to be validated before going through the pilot study session. The expert panel reviewed, examined and revised the predefined questionnaire during the FGD session. From the face-to-face session, direct information on the recommendations and suitability of the questionnaire was recorded. Qualitatively, this method of review and verification by the expert industry panels is

beneficial before the data from the questionnaire can be measured (Noraini Idris, 2010)[88].

The predefined questionnaires constructed during the document analysis stage are re-designed after undergoing face validation by a selected academician and content validation by the industry expert panel during FGD 1. All suggestions and comments on instrument improvements, such as spelling errors, grammar, terminology, and item appropriateness, have been taken. At the same time, items that are less clear, confusing and dichotomous were removed and modified to meet the research needs. Next, the pre-determined questionnaire was undergone a pilot test by industrial players that tested the reliability and validity review before being distributed to the targeted respondents from the industry. Pilot studies allow the researchers to overcome any possible risks in the next phase.

c) Data Collection Strategy

Bias in the survey procedure could be lessened by employing the extrapolation method reported by Armstrong and Overton (1977)[89]. For this present research, data collection was conducted face-to-face and online. To encourage reasonable response rates from the respondents, a token of appreciation will be given to respondents for each completed questionnaire.

d) Data Analysis

The survey questionnaire data were analysed by using Statistical Package for the Social Sciences (SPSS) software. The internal consistency value with Alpha-Cronbach's coefficient was measured to prove that the instrument is measured quantitatively and can genuinely represent the research.

The reliability and revision of the constructed instrument can also be obtained by analytical testing. This value not only contributes to the level of reliability but also helps to give the researcher confidence in the instrument provided in the research.

[88] Noraini Idris. 2010. Penyelidikan dalam Pendidikan. Mc Graw Hill Education (Malaysia) Sdn. Bhd., Kuala Lumpur

[89] Armstrong, J. S., & Overton, T. S. 1977. Estimating nonresponse bias in mail surveys. Journal of Marketing Research, 14(3), 396–402.

According to Creswell (2012)[90], the Alpha-Cronbach coefficient level is acceptable at 0.6, the coefficient at 0.72 is a fair value, and the coefficient at 0.93 can be considered high. The conducted research could be concluded as good research if all three parts of the instrument construct reached a high level of reliability.

3.4.4 Pilot Study and Findings

The pilot study was conducted to obtain the validation and reliability of the instrument items in the survey. The pilot study was conducted on a small scale before the actual study was conducted. According to Johanson & Brooks (2010)[91], the appropriate sample size for the pilot study is 30 respondents from the total population. In this study, the total number of respondents has been determined to be 100 people. Thus, 30 respondents were chosen to conduct the pilot study. The survey was distributed using Google Forms to the selected sewerage industrial player. This method is applied due to time and place limitations. The google form closed once 30 respondents were obtained.

The finding of reliability statistics is depicted in Table 3.10 below. The Cronbach's Alpha analysis was applied using SPSS to measure the reliability of the data. The Cronbach analysis was only applied to skill in demand and related issues since this is the only scaler parameter in the survey. Based on the table below, the result shows that the reliability value was recorded at 0.973 for skill in demand and 0.990 for related issues, respectively. This showed that the survey recorded a high consistency value. Hence, this showed that the survey is suitable to represent the actual study.

Table 3.10: Cronbach's Alpha Analysis

Parameter	**Cronbach's Alpha**	**N of Items**
Skills in Demand	0.973	54
Related Issue	0.990	120

[90] Creswell, J. W. 2012. Educational research: Planning, conducting, and evaluating quantitative and qualitative research (4th ed.). Boston, MA: Pearson.
[91] Johanson, G.A. and Brooks, G.P. 2010. Initial scale development: sample size for pilot studies. Educational and psychological measurement, 70(3), 394-400

3.5 Implementation of Phase 3 – Expert Verification

The final phase of OF development focuses on the verification and usability of the developed OF to the stakeholders. An engagement session with the invited sewerage industry experts and stakeholders was conducted with the aim of verifying all the findings obtained and testing the usability of the document. The inputs and recommendations of experts and stakeholders have been recorded. The OF documents were then amended with final updates and editing before the official documents were disseminated to the prospective users.

The Industrial Engagement was conducted on 17 January 2023 at Bangi Resort Hotel. The invited panels and stakeholders are listed in Table 3.11, and the engagement activities are depicted in Figure 3.6.

Table 3.11: List of Industry Expert Panels during Industrial Engagement.

No.	Panel	Position	Organisation/Company
1	Ms. Ruhaidah Md Hassan	Manager	Indah Water Konsortium Sdn. Bhd.
2	Mr. Wee Soon Guan	Desludging Executive	Indah Water Konsortium Sdn. Bhd. (Melaka)
3	Mr. Majid Saith Mohamed	Manager	Indah Water Konsortium Sdn. Bhd (Shah Alam)
4	Mr. Mohammad Nasir Mahmood	Director	Suruhanjaya Perkhidmatan Air Negara (SPAN) Cyberjaya
5	Mr. Iwan Nazri Mohd Nordin	Deputy Director	Suruhanjaya Perkhidmatan Air Negara (SPAN) Cyberjaya
6	Mr. Abidul Qader Othman	Senior Executive	Suruhanjaya Perkhidmatan Air Negara (SPAN) Selatan
7	Ts. Norhafiz Zamri	Deputy Director	Suruhanjaya Perkhidmatan Air Negara (SPAN) Pahang
8	Dr. Mohd Razealy Anuar	Facilitator/Researcher	PFH Resources (M) Sdn. Bhd.

Figure 3.6: Industrial Engagement for E37 Sewerage

3.6 Conclusion

In summary, the development of OF for E37 Sewerage was conducted according to the research framework comprising three (3) major phases, including information gathering, expert view and expert verification. From this research framework, three (3) major methods have been identified to be employed throughout this research, which are document analysis, Focus Group Discussion (FGD) and survey. Document analysis focuses on data and information gathering for constructing the questionnaire for the survey and semi-structured questions for the interview protocol. The predefined questionnaire has undergone face validity, content validity, and a pilot test for reliability and review before being distributed to industry players. The FGD session was divided into two (2) separate sessions in which the aim for each session was differentiated according to the objectives through the NGT approach. FGD 1 aimed to come out with the first draft of OS, and FGD 2 aimed for the second draft of OS and job descriptions. In line with that, skills in demand, critical job titles, and jobs relevant to the Industry Revolution will also be discussed. The survey was designed to achieve five (5) key objectives, namely, critical jobs classification, occupational qualification, skills in demand, emerging skills and related issues. The survey was conducted through face-to-face and online platforms. The data from respondents were analysed and discussed in Chapter 4, together with all findings from the FGD session. The final phase of OF development focuses on the verification and usability of the developed OF to the stakeholders. An engagement session with the invited sewerage industry experts and stakeholders was conducted to verify all the findings obtained and to test the usability of the document. The inputs and recommendations of experts and stakeholders were recorded, and the OF documents underwent final updates and editing before the official documents were disseminated to prospective users.

CHAPTER IV

FINDINGS

4.1 Introduction

This chapter elaborates on the findings from the research works on 2 digits Malaysia Standards Industrial Classification (MSIC) 2008 Division 37: Sewerage. The findings were compiled according to the research objectives, including the development of Occupational Structure (OS), critical jobs and job titles related to the Industrial Revolution (IR), and Occupational Descriptions (OD) from data gathering and discussion during Focus Group Discussion (FGD). Meanwhile, skills in demand in the Sewerage Industry were determined from FGD and supported by responses from the survey.

4.2 Occupational Structure

Occupational Structure (OS) has been developed from the brainstorming discussion with the expert panels from the Sewerage Industry during FGD 1 and further reviewed and refined in FGD2. The determined and agreed job titles were arranged according to the job area associated with economic activities of 'Includes' item 37000 Sewerage and similar activities classified from group 370 Sewerage in MSIC 2008. Besides, the job titles were also mapped to eight (8) occupational skills qualification levels specified in the Malaysian Occupational Skills Qualification Framework (MOSQF).

During the brainstorming session through the Nominal Group Technique (NGT) of FGD 1 and 2, the expert panels unanimously agreed that five (5) job areas had been identified to be associated with economic activities classified in MSIC 2008. Since the sewerage economic activities in MSIC 2008 are classified into one (1) class and item, the job areas

were identified according to the ‘Include” item of 37000 Sewerage and similar activities. The identified job areas associated with the ‘Includes’ item of Sewerage from MSIC 2008 are mapped in Table 4.1.

Table 4.1: Description of Job Area

Job Area from OS	Description
Operation and maintenance of sewerage system (Mechanical & Electrical)	The job area was classified as ‘Includes’ Item (a) which involved the operation of sewer systems or sewer treatment facilities, maintenance of sewers as stated in MSIC 2008.
Operation and maintenance of sewerage system (Sewage Treatment Plant)	The job area was classified as ‘Includes’ Item (a) which involved the operation of sewer systems or sewer treatment facilities, maintenance of sewers as stated in MSIC 2008.
Treatment of wastewater (Industrial Effluent Treatment System)	The job area was classified as ‘Includes’ Item (d) which involved the treatment of wastewater (including human and industrial wastewater, water from swimming pools, etc.) by means of physical, chemical and biological processes like dilution, screening, filtering, sedimentation, etc as stated ion MSIC 2008.
Collecting and transporting of septage (Desludging)	The job area was classified as ‘Includes’ Item (b) which involved the collecting and transporting of human or industrial wastewater from one or several users, as well as rainwater by means of sewerage networks, collectors, tanks and other means of transport (sewage vehicles, etc.) and Item (c) emptying and cleaning of cesspools and septic tanks, sinks and pits from sewage, servicing of chemical toilets as stated in MSIC 2008.
Operation and Maintenance of Sewer Network	The job area was classified as ‘Includes’ Item (e) which involved the maintenance and cleaning of sewers and drains, including sewer rodding as stated in MSIC 2008.

The OS for the Sewerage Industry and the summary of job titles are tabulated in Table 4.2 and Table 4.3, respectively. For all five (5) job areas, the highest level for a job title is level 7, described as the ability to reformulate and address problematic situations using relevant understanding, methodologies and approaches. The responsibility also includes planning and developing courses that could initiate substantial development, exercising broad autonomy and judgment that affect the sub-area of study or work. Meanwhile, all job areas require general workers except for collecting and transporting septage (Desludging) and operation and maintenance of the sewer network.

There are 33 job titles identified involving general worker, operator, technician, supervisor, executive, technical manager and senior technical manager, according to each job area. All job titles related to sewerage's technical and operation were specifically identified. About 30 job titles, except general workers, were determined as critical jobs. The critical job is defined as a job in demand but hard to fill and always short of supply due to the nature of the jobs, which require a certain set of skills and are sought-after by employers. Sought-after means that demand for a job title exceeds the supply of appropriately qualified workers despite efforts on the part of employers to satisfy their demand and for reasons not easily addressed through changes in employer hiring practices. It is also considered the strategic occupation of the industry that is critical to the business's success. There are twenty-three (23) job titles identified to relate to IR, which are classified from technician level to senior technical manager for each job area except technician in operation and maintenance of sewerage system (Sewage Treatment Plant) and treatment of wastewater (Industrial Effluent Treatment System).

Table 4.2: Occupational Structure for Division 37 Sewerage

Section	**(E) Water Supply; Sewerage, Waste Management and Remediation Activities**				
Division	**(37) Sewerage**				
Group	**(370) Sewerage**				
Area	**Operation and maintenance of sewerage system (Mechanical & Electrical)**	**Operation and maintenance of sewerage system (Sewage Treatment Plant)**	**Treatment of wastewater (Industrial Effluent Treatment System)**	**Collecting and transporting of septage (Desludging)**	**Operation and Maintenance of Sewer Network**
8	No Job Title	No Job Title	No Job Title	No Job Title	No Job Title
7	Senior Mechanical & Electrical Technical Manager***	Senior Treatment Technical Manager***	Senior Treatment Technical Manager (Environmental Officer) ***	Senior Desludging Technical Manager***	Senior Network Technical manager***
6	Mechanical & Electrical Technical Manager***	Treatment Technical Manager***	Treatment Technical Engineer***	Desludging Technical Manager***	Network Technical Manager***
5	Mechanical & Electrical Executive***	Treatment Executive***	Treatment Executive***	Desludging Executive***	Network Executive***
4	Mechanical & Electrical Supervisor***	Treatment Supervisor***	Treatment Supervisor***	Desludging Senior Supervisor***	Network Supervisor***
3	Mechanical & Electrical Technician***	Treatment Technician*	Treatment Technician*	Desludging Field Supervisor***	Network Technician***
2	Mechanical & Electrical Operator*	Treatment Operator*	Treatment Operator*	Desludging Operator*	Network Operator*
1	General Worker	General Worker	General Worker	No Job Title	No Job Title

*Critical Job Title
** Job title relevant to IR
***Critical and job titles relevant to IR

Table 4.3: Summary of Job Title for Division 37 Sewerage

No	Job Area	Level								Total Identified Job Titles	Total Critical Job Titles	Total Job Titles Relevant to IR	Total Critical Job Titles and Relevant to IR
		1	2	3	4	5	6	7	8				
370 - Sewerage													
1	Operation and maintenance of sewerage system (Mechanical & Electrical)	1	1	1	1	1	1	1	NJT	7	7	5	5
2	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	1	1	1	1	1	1	1	NJT	7	7	4	4
3	Treatment of wastewater[1] (Industrial Effluent Treatment System)	1	1	1	1	1	1	1	NJT	7	7	4	4
4	Collecting and transporting of septage (Desludging)	NJT	1	1	1	1	1	1	NJT	6	6	5	5
5	Operation and Maintenance of Sewer Network	NJT	1	1	1	1	1	1	NJT	6	6	5	5

NJT – No Job Title

4.3 **Occupational Responsibilities**

Occupational Responsibilities (OR) is imperative in identifying the related duties, tasks and responsibilities of a position or job title, which is eventually useful in determining the needed competency skills. The list of occupational responsibilities for group 370 Sewerage is listed in Table 4.4.

DIVISION: 37 SEWERAGE

GROUP: 370 SEWERAGE

Table 4.4: List of Occupational Responsibilities for Group 370 Sewerage (1 of 2)

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
8	No Job Title	No Job Title	No Job Title
7	**Senior Mechanical & Electrical Technical Manager** 1. Set M&E organisation objectives, strategies, and policies. 2. Set M&E organisation KPI. 3. Set M&E organisation related operations. 4. Plan M&E organisation maintenance program. 5. Plan M&E organisation budget and expenditure. 6. Monitor M&E organisation operation management. 7. Monitor M&E organisation operation efficiency and productivity. 8. Monitor M&E organisation safety and health implementation. 9. Advise M&E organisation technical matters.	**Senior Treatment Technical Manager** 1. Set STP objectives, strategies, and policies. 2. Set STP organisation KPI. 3. Set STP organisation related operation. 4. Plan STP organisation maintenance program. 5. Plan STP organisation budget and expenditure. 6. Monitor STP organisation operation management. 7. Monitor STP organisation operation efficiency and productivity. 8. Monitor STP organisation safety and health implementation. 9. Advise STP organisation technical matters. 10. Interpret STP organisation operation and maintenance strategy. 11. Conduct STP organisation staff	**Senior Treatment Technical Manager (Environmental Officer)** 1. Set IETS organisation objectives, strategies, and policies. 2. Set IETS organisation related operation. 3. Plan IETS organisation KPI 4. Plan IETS organisation maintenance program. 5. Plan IETS organisation budget and expenditure. 6. Monitor IETS organisation operation management. 7. Monitor IETS organisation operation efficiency and productivity. 8. Monitor IETS organisation safety and health implementation. 9. Advise IETS organisation technical matters.

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
	10. Interpret M&E organisation operation and maintenance strategy. 11. Conduct M&E organisation staff competency and knowledge assessment. 12. Perform M&E organisation facilities auditing and reporting. 13. Report M&E organisation operation performance. 14. Liaise with the relevant authorities.	competency and knowledge assessment. 12. Perform STP organisation facilities auditing and reporting. 13. Report STP organisation operation performance. 14. Liaise with the relevant authorities.	10. Interpret IETS organisation operation and maintenance strategy. 11. Conduct IETS organisation staff competency and knowledge assessment. 12. Perform IETS organisation facilities internal auditing and reporting. 13. Report IETS organisation operation performance. 14. Liaise with the relevant authorities.
6	**Mechanical & Electrical Technical Manager** 1. Implement the M&E section objectives, strategies, and policies. 2. Lead M&E section-related operations. 3. Manage M&E section operation and maintenance budget. 4. Manage M&E section operations and results. 5. Manage M&E section subordinate competency and training.	**Treatment Technical Manager** 1. Implement the STP section objectives, strategies, and policies. 2. Lead STP section related operations. 3. Manage STP section operation and maintenance budget. 4. Manage STP section operations and results. 5. Manage STP section subordinate competency and training. 6. Manage STP section subordinate's KPI. 7. Manage STP section resources (3M)	**Treatment Engineer** 1. Implement the IETS objectives, strategies, and policies. 2. Lead IETS section related operations. 3. Manage IETS operation and maintenance budget. 4. Manage IETS section operations and results. 5. Manage IETS subordinate competency and training. 6. Manage IETS section subordinate's KPI.

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
	6. Manage M&E section subordinate's KPI. 7. Manage M&E section resources (3M). 8. Oversee M&E section performance improvement. 9. Interpret M&E section process control data. 10. Monitor M&E section regulatory compliance. 11. Perform M&E section facilities auditing and reporting. 12. Report M&E section efficiency and productivity. 13. Ensure M&E section safety policy compliance.	8. Oversee STP section performance improvement. 9. Interpret STP section process control data. 10. Monitor STP section regulatory compliance. 11. Perform STP section facilities auditing and reporting. 12. Report STP section efficiency and productivity. 13. Determine the STP section programs. 14. Ensure company safety policy compliance.	7. Manage IETS resources (3M). 8. Oversee IETS section performance improvement. 9. Interpret IETS section process control data. 10. Monitor IETS section regulatory compliance. 11. Perform IETS facilities auditing and reporting. 12. Report IETS section efficiency and productivity 13. Ensure company safety policy compliance.

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
5	**Mechanical & Electrical Executive** 1. Organise M&E related operational works. 2. Establish M&E administrative procedure of sewerage system. 3. Lead M&E operation and maintenance works. 4. Prepare M&E risk assessment report. 5. Monitor M&E responsive works. 6. Monitor M&E operation performance. 7. Monitor M&E subordinate training and performance. 8. Prepare M&E operation report. 9. Ensure M&E safety practice and compliance.	**Treatment Executive** 1. Organise STP related operational works. 2. Execute STP administrative works. 3. Lead STP operation and maintenance works. 4. Prepare STP risk assessment report. 5. Monitor STP responsive works. 6. Monitor STP sampling works. 7. Monitor STP operation performance 8. Monitor STP staff training and performance. 9. Prepare STP operation report. 10. Ensure STP safety practice and compliance.	**Treatment Executive** 1. Organise IETS related operational works. 2. Execute IETS administrative works. 3. Lead IETS operation and maintenance works. 4. Prepare IETS risk assessment report. 5. Monitor IETS responsive works. 6. Monitor IETS sampling works. 7. Monitor IETS operation performance 8. Monitor IETS staff training and performance. 9. Prepare IETS operation report. 10. Ensure IETS safety practice and compliance.

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
4	**Mechanical & Electrical Supervisor** 1. Supervise M&E daily operation. 2. Prepare M&E work order. 3. Supervise M&E maintenance works. 4. Supervise M&E responsive works. 5. Implement M&E work safety compliance. 6. Support M&E asset management system implementation. 7. Coordinate M&E technician schedule.	**Treatment Supervisor** 1. Supervise STP daily operation. 2. Prepare STP work order. 3. Supervise STP maintenance works. 4. Supervise STP responsive works. 5. Implement STP work safety compliance. 6. Support STP asset management system implementation. 7. Coordinate STP technician schedule.	**Treatment Supervisor** 1. Supervise IETS daily operation. 2. Prepare IETS work order. 3. Supervise IETS maintenance works. 4. Supervise STP responsive works. 5. Implement IETS work safety compliance. 6. Support IETS asset management system implementation. 7. Coordinate IETS technician schedule.
3	**Mechanical & Electrical Technician** 1. Perform M&E related operational works. 2. Execute M&E work order. 3. Conduct M&E maintenance works. 4. Conduct M&E responsive works. 5. Implement M&E work safety requirements.	**Treatment Technician** 1. Perform STP related operational works. 2. Execute STP work order. 3. Conduct STP maintenance works. 4. Conduct STP responsive works. 5. Implement STP work safety requirements. 6. Carry out STP process monitoring. 7. Comply with STP work safety requirements.	**Treatment Technician** 1. Perform IETS related operational works. 2. Execute IETS work order. 3. Conduct IETS maintenance works. 4. Conduct IETS responsive works. 5. Submit IETS daily monitoring report. 6. Implement IETS work safety requirements.

Area/ Level	Operation and maintenance of sewerage system (Mechanical & Electrical, M&E)	Operation and maintenance of sewerage system (Sewage Treatment Plant, STP)	Treatment of wastewater (Industrial Effluent Treatment System, IETS)
2	**Mechanical & Electrical Operator** 1. Assist M&E maintenance works. 2. Carry out M&E responsive works. 3. Carry out housekeeping. 4. Implement M&E work safety and health regulation.	**Treatment Operator** 1. Assist STP related operational works. 2. Assist STP maintenance works. 3. Carry out STP responsive works. 4. Carry out housekeeping. 5. Implement STP work safety and health regulation.	**Treatment Operator** 1. Assist IETS related operational works. 2. Assist IETS maintenance works. 3. Carry out IETS responsive works. 4. Carry out housekeeping. 5. Implement IETS work safety and health regulation.
1	**General Worker** 1. Maintain workstation cleanliness. 2. Assist site/plant works according to instructions. 3. Assist in materials loading and unloading activities. 4. Perform housekeeping. 5. Comply with safety, health, and environment regulation.	**General Worker** 1. Maintain workstation cleanliness. 2. Assist site/plant works according to instructions. 3. Assist in materials loading and unloading activities. 4. Perform housekeeping. 5. Comply with safety, health, and environment regulation.	No Job Title

Table 4.4: List of Occupational Responsibilities for Group 370 Sewerage (2 of 2)

Area/ Level	Collecting and transporting of septage (Desludging)	Maintenance and operation of sewer network
8	No Job Title	No Job Title
7	**Senior Desludging Technical Manager** 1. Set desludging organisation operation objectives, strategies, and policies. 2. Set desludging organisation fundamental plan. 3. Plan desludging organisation KPI. 4. Plan desludging operation organisation maintenance program. 5. Plan desludging operation organisation budget and expenditure. 6. Monitor desludging operation organisation management. 7. Monitor desludging operation organisation efficiency and productivity. 8. Monitor desludging operation organisation safety and health implementation. 9. Advise desludging operation organisation technical matters. 10. Conduct desludging organisation staff competency and knowledge assessment.	**Senior Network Technical Manager** 1. Plan sewer network organisation related operation. 2. Plan public sewer network operation program. 3. Plan sewer network inspection program. 4. Manage sewer network budget and expenditure. 5. Manage public sewer network maintenance program. 6. Manage all sewer network contracts and compliance. 7. Manage sewer network preventive maintenance. 8. Liaise with all relevant parties (internal and external). 9. Report sewer network operation performance. 10. Ensure employee relevant training are equipped. 11. Ensure compliance with company health & safety policy.

Area/ Level	Collecting and transporting of septage (Desludging)	Maintenance and operation of sewer network
	11. Perform desludging organisation facilities internal auditing and reporting. 12. Report desludging operation organisation performance. 13. Liaise with the relevant authorities.	
6	**<u>Desludging Technical Manager</u>** 1. Implement the desludging operation section objectives, strategies, and policies. 2. Lead desludging section related operation. 3. Manage desludging section operation and maintenance budget. 4. Manage desludging section operations and results. 5. Manage desludging section subordinate competency and training. 6. Manage desludging section subordinate's KPI. 7. Manage desludging section resources (3M). 8. Oversee desludging section performance improvement. 9. Monitor desludging section regulatory compliance. 10. Perform desludging section facilities auditing and reporting. 11. Report desludging section efficiency and productivity. 12. Ensure section safety policy compliance.	**<u>Network Technical Manager</u>** 1. Manage sewer network inspection program. 2. Manage sewer network preventive maintenance. 3. Manage public sewer network maintenance program. 4. Manage all sewer network contracts and compliance. 5. Manage sewer network operation KPI. 6. Manage sewer network budget and expenditure. 7. Implement sewer network objectives, strategies, and policies. 8. Monitor sewer network operation performance. 9. Manage sewer network subordinates training and performance. 10. Coordinate with relevant authorities and parties. 11. Ensure sewer network compliance with safety and health standard.

Area/ Level	Collecting and transporting of septage (Desludging)	Maintenance and operation of sewer network
5	**Desludging Executive** 1. Organise desludging related operational work. 2. Execute desludging administrative work. 3. Prepare desludging risk assessment report. 4. Monitor desludging operation performance 5. Monitor desludging subordinate training and performance. 6. Prepare desludging operation report. 7. Ensure desludging safety practice and compliance. 8. Liaise with relevant authorities.	**Network Executive** 1. Execute sewer network operation plan. 2. Execute sewer network administrative work. 3. Execute sewer network subordinate KPI. 4. Prepare sewer network daily report. 5. Prepare sewer network performance report. 6. Implement sewer network maintenance work. 7. Supervise sewer network predictive maintenance work. 8. Supervise the sewer network contract and compliance. 9. Ensure compliance with safe working procedure 10. Maintain sewer network safety and performance. 11. Liaise with the relevant authorities.
4	**Senior Desludging Supervisor** 1. Supervise desludging daily operations. 2. Prepare desludging work order. 3. Supervise desludging team KPI. 4. Implement desludging work safety compliance. 5. Coach desludging team daily activity. 6. Coordinate desludging technician work schedule.	**Network Supervisor** 1. Coordinate sewer network daily work schedule. 2. Prepare sewer network daily work order. 3. Supervise sewer network maintenance work. 4. Supervise sewer network team KPI. 5. Coach sewer network team operational activity. 6. Prepare sewer network maintenance and performance report. 7. Implement sewer network safety and health practice.

Area/ Level	Collecting and transporting of septage (Desludging)	Maintenance and operation of sewer network
3	**Field Supervisor** 1. Coordinate desludging daily work schedule. 2. Prepare desludging team daily work order. 3. Supervise desludging activity. 4. Supervise desludging team KPI. 5. Coach desludging team daily activity. 6. Implement desludging work safety compliance.	**Network Technician** 1. Execute sewer network daily work order. 2. Carry out sewer network operational work. 3. Carry out sewer network maintenance work. 4. Carry out sewer network responsive work. 5. Implement sewer network work safety practices.
2	**Desludging Operator** 1. Identify desludging activity tools, equipment and safety apparatus. 2. Perform desludging activities. 3. Check septic tank defect. 4. Obtain public premises consent and signature. 5. Assist desludging tanker cleaning. 6. Provide tanker driver necessary information and feedback. 7. Implement Desludging work safety and health regulation.	**Network Operator/Jetter Driver** 1. Drive sewer cleaning vehicle (SCV). 2. Perform sewer network cleaning activity. 3. Operate rodding equipment. 4. Identify sewer network tools and equipment. 5. Implement sewer network safety and health compliance. 6. Provide sewer network necessary information and feedback. 7. Monitor SCV routine maintenance.
1	No Job Title	No Job Title

4.4 Findings Analysis

The obtained findings were interpreted through the qualitative data of information gathering from literature and discussion with the expert panels. Then, the collected information from the discussion was supported and validated with quantitative findings from the survey questionnaire.

Skills are imperative to ensure the occupational improvement and career development of the employees in the Sewerage Industry. The right skills must be determined to overcome the skills mismatching. The required skills are different according to the job level, and the factors contributing to the demand must be first identified. These factors could help further identify the relevant competency skills demanded in the Sewerage Industry. From that, the skills could be related to the IR-related skills according to the job area. This could also help identify new skills required by Sewerage Industry so that upskilling training or curriculum towards emerging technology could be adopted. Besides, the related issues that might limit the employees' career expansion are also needed to help develop a good curriculum for skills enhancement in Sewerage Industry. Therefore, in determining the skills required by Sewerage Industry, this section is presented according to the following arrangement:

- Jobs in demand
- Competency skills in demand
- IR-related skills for the Sewerage Industry
- Related issues in the Sewerage Industry

4.4.1 Jobs in Demand

Factors contributing to job demand and specific requirements and skills according to job level were identified as listed in Table 4.5. According to management, technical and general levels, various factors have been identified, and most are related to specific knowledge, technical and non-technical skills. For each factor, the expert panels from the Sewerage Industry have suggested the specific requirements and skills needed in fulfilling the identified job demand.

Table 4.5: Factors Contributed to Job Demand in the Sewerage Industry

No.	Job titles	Factor(s) contributing to the demand	Specific requirements and skills
1	**Management Level:** Senior Technical Managers, Technical Managers and Executive	• Mismatch of required and suitable qualification. • Mismatch of specific knowledge and skills in specific sewerage job areas. • Limited experienced personnel in each job area of sewerage. • Limited skilled and highly trained operation staff.	• Qualification (academic and skills) relevant to the job function, for example, Sijil Kemahiran Malaysia (E 382-001-5:2017 Desludging and Discharge Management Level 5). • Knowledge required to perform the job function according to job area, for example, the knowledge possessed by managerial level on STP, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, etc. • Operation or technical skills like STP, NPS, STF, public network system, desludging and M&E related skills • Management and soft skills like management measures, asset management, leadership, motivation and self-empowerment skills • Knowledge of current or latest technology like Desludging Management System (DMS), System Application and Products (SAP), etc. • Analytical skills like Characteristics of Top Employees, Quality of High Performers, etc.
2	**Technical Level:** Supervisor, Technician and Operator.	• Mismatch of required and suitable qualification • Mismatch of specific knowledge and skills in specific sewerage job area	• Qualification which is relevant to the job function, for example, Sijil Kemahiran Malaysia (E 382-001-2:2017 Desludging and Discharge Operation Level 2 and E 382-001-3:2017 Desludging and Discharge Supervision Level 3).

No.	Job titles	Factor(s) contributing to the demand	Specific requirements and skills
		• Limited experienced personnel in each job area of sewerage. • Limited skilled and highly trained operation staff	• Technical knowledge (operation and maintenance) required to perform the job function according to job area, for example, knowledge of STP, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, etc. • Operation or technical (operation and maintenance) skills like STP equipment, NPS, confined space, Sludge Dewatering & Disposal, Accident Reporting & Investigation, Troubleshooting, etc. • Soft skills like communication, documentation, ethics, teamwork, integrity, etc.
3	**General/Helper** General Worker	• Difficult to recruit local workers • Lack of social skills.	• Able to adapt to work pressure. • Able to interpret simple instructions (Communication skills).

A survey has been done, and collective responses of 100 sewerage industry players according to job area were collected. Figure 4.1 depicts the job scope classification of respondents who participated in the survey. This shows that industry players from all sewerage job areas comprehensively participated in the survey as classified in MSIC 2008. The respondent's positions and organisation lists were also collected and tabulated in Table 4.6.

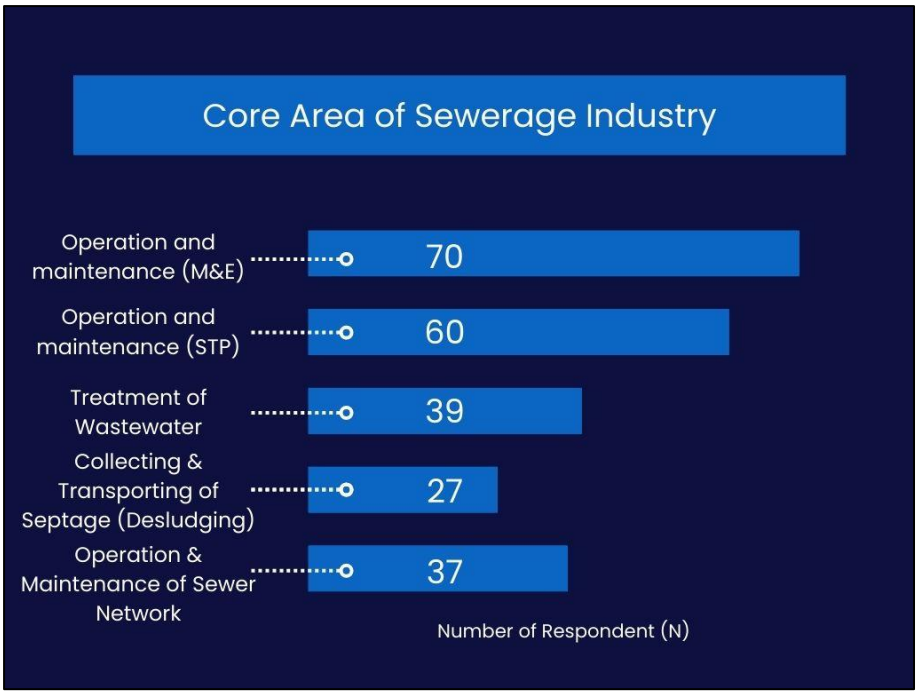


Figure 4.1: Core sewerage Job Area

Table 4.6: Survey Respondent's Position and Organisation

Position	• Plant Manager • Assistant Engineer • Senior Director • *Pegawai Kerja Perkhidmatan Daerah* • Sewerage Engineer • Head of Section Mechanical and Electrical (M&E) • Project Manager • Director • Quantity Surveyor • M&E Manager • Account Executive • Application Engineer • Assistant Project Manager • Assistant General Manager • HR and Account Executive • Ketua Penolong Pengarah • Manager • Managing Director • Service Engineer • Senior Director • Senior Sales and Project Engineer • Senior Service Coordinator • Senior Technician

	• Service Manager • Supervisor
Organisation	• Indah Water Konsortium Sdn. Bhd. • Sewerage Services Department of Sabah • Sewerage Services Department of Sabah (Kudat) • Sewerage Services Department of Sabah (Kota Kinabalu) • Sewerage Services Department of Sabah (Keningau) • Sewerage Services Department of Sabah (Beaufort) • Sewerage Services Department of Sabah (Semporna) • Suruhanjaya Perkhidmatan Air Negara (SPAN) • Fostec Engineering Sdn. Bhd. • H2O Engineering and Solutions Sdn. Bhd. • Sar-Alam Indah S/B • Kejuruteraan Prinsip Menarik Sdn. Bhd. • Tsurumi Pump (M) Sdn. Bhd. • P-Tech Engineering Sdn. Bhd. • Ebara Pumps Malaysia Sdn. Bhd. • Promosys Technology (M) Sdn. Bhd • Penasal Enterprise Sdn. Bhd. • Xylem Water Solutions Sdn. Bhd. • Sabakini Sdn Bhd. • Environ Holdings Sdn. Bhd. • Sub Pump Engineering Sdn. Bhd. • Delta Gemilang Sdn. Bhd. • Envirocare Maintenance Sdn. Bhd. • Sulzer Pumps Wastewater Malaysia Sdn. Bhd. • Mectech Engineering • Techno Alam Indah Sdn. Bhd. • Advance Grow Sdn. Bhd. • Bfl Electrical Works • Winston Eng Corp Sdn. Bhd. • Tyce Engineering Sdn. Bhd. • Invercity Sdn. Bhd. • Zr Enterprise • Hovk Seng Lee Berhad • Advance System Integrators Sdn. Bhd. • Lintasan Korporat Sdn. Bhd. • Aks Construction • Nishimatsu Construction • Ap-Col Geotechnics Sdn. Bhd. • Aksit Business Solutions Sdn. Bhd. • Tomher Environmental Sdn. Bhd. • Grundfos Pumps Sdn. Bhd. • Joh Teknologi Enterprise • Rigi Development • Hock Seng Lee Berhad

Based on the survey data illustrated in Figure 4.2, 23% have agreed that the set of skills for Technician and Technical Manager is hard to fill in Sewerage Industry. This result somewhat agreed with the factors contributing to the demand the expert panels identified during FGD sessions in Table 4.5.

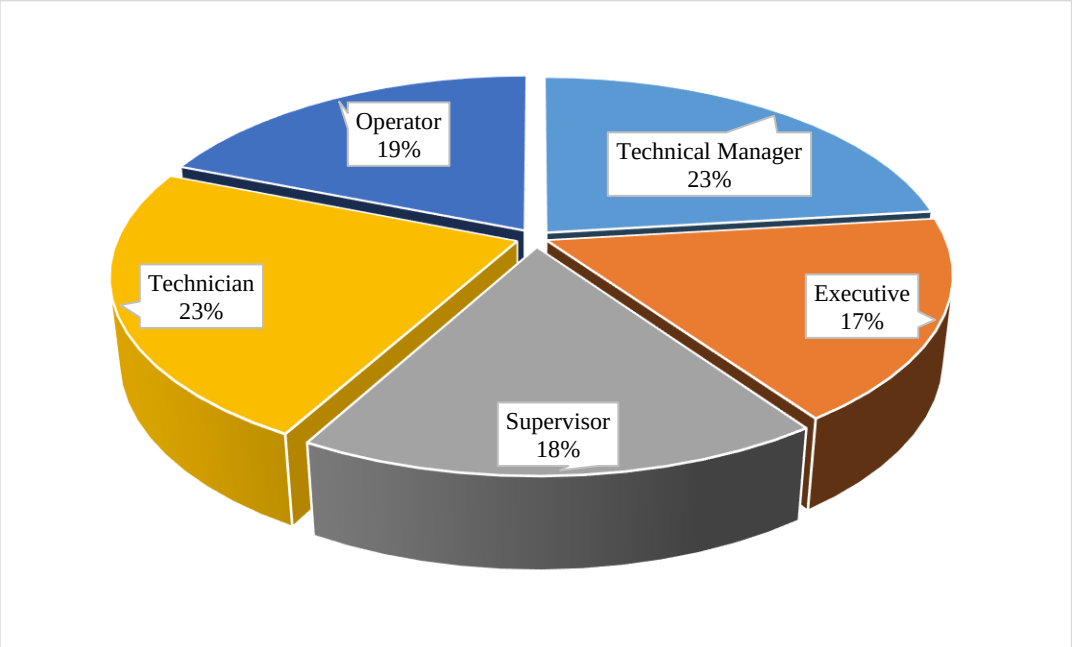


Figure 4.2: Set of Skills that Hard to Fill in the Sewerage Industry

Besides, about 31.3% of respondents voted technician, and 24.2% voted technical managers as jobs selected to ensure the smooth operation in the Sewerage Industry, as depicted in Figure 4.3. Moreover, it was also found that technician was selected as a job that is highly provided with opportunities for improvement, as shown in Figure 4.4.

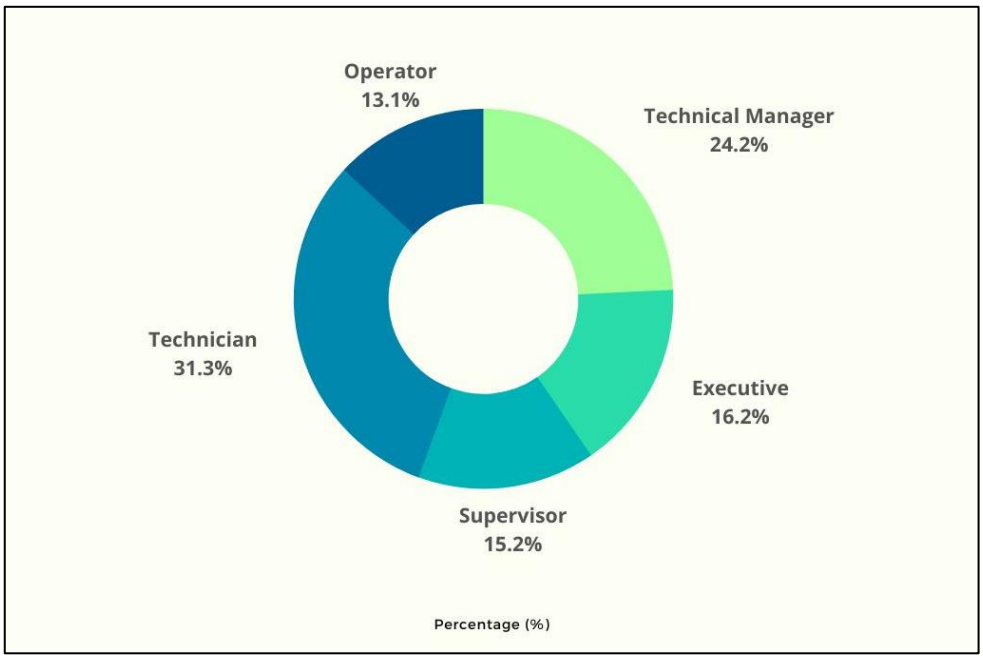


Figure 4.3: Position Required for Smooth Operation

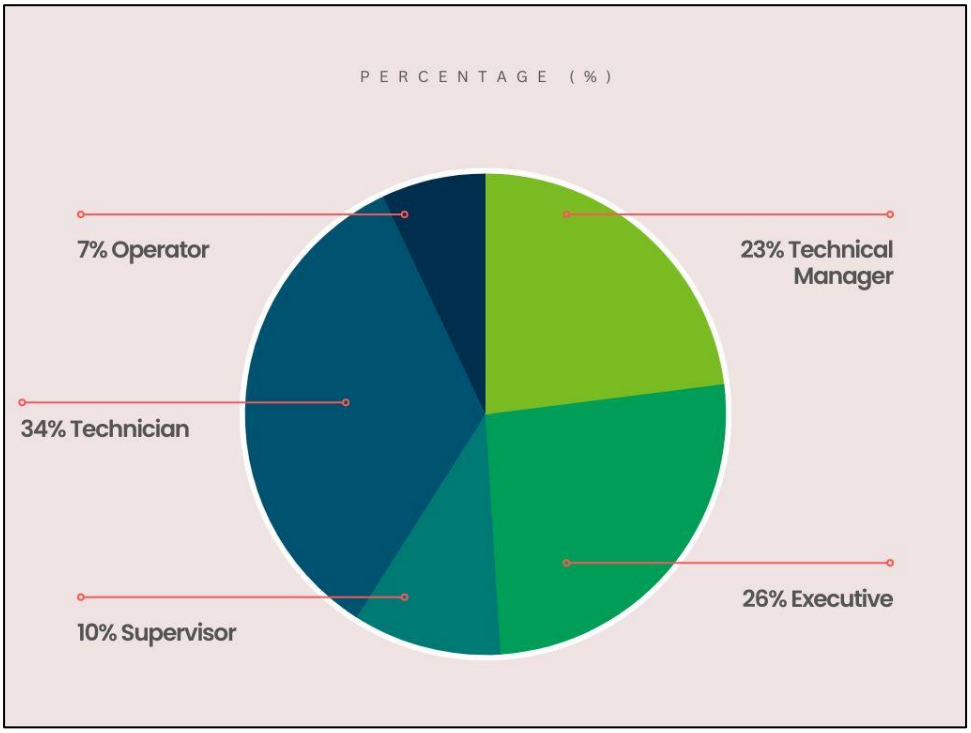


Figure 4.4: Job Title Pursued by The Employee

Since technician requires a set of skills that is hard to fill and are opened with high opportunities for improvement, then these job titles can be considered highly demanded in any sewerage organisation. This is proven by the 34 respondents from the Sewerage Industry

players who picked the technician that has the highest turnover rate in the Sewerage Industry, as depicted in Figure 4.5. Due to the worker's various skills in this position, the skilful worker will be offered better benefits and salary schemes by another sewerage organisation. Thus, this justifies the turnover rate findings from the survey.

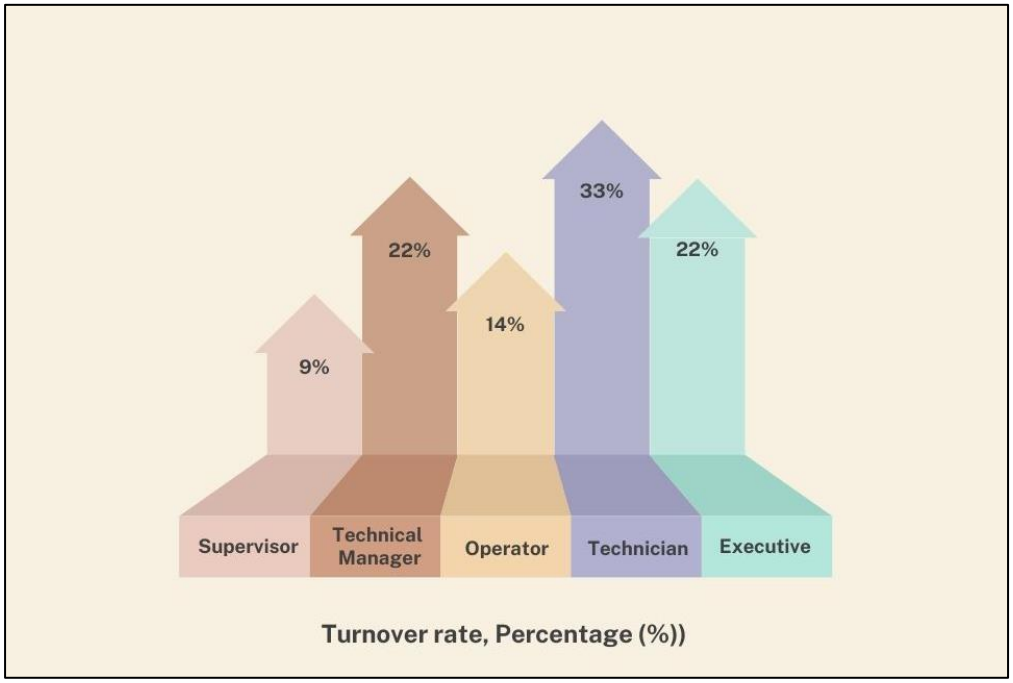


Figure 4.5: Job Position with High Turnover Rate

In conclusion, FGD and collective survey responses have found that technicians and technical managers are demanding jobs in Sewerage Industry. The industry experts discussed and agreed upon this result during the FGD session, where several factors were identified that led to the demand. This is also supported by respondents' data from a survey among the Sewerage Industry players in Malaysia.

4.4.2 **Competencies in Demand**

The in-demand skills according to competencies for the Sewerage Industry are listed in Table 4.7. There are 18 competency skills that have been identified by industry experts, including technical and non-technical skills. The factors that contributed to the demand have also been identified, and the listed factors are the one that is happening in the current Sewerage Industry. Most of the factors are related to the problem with regards to knowledge and skills of sewerage operation and process. Expert panels have also suggested the specific

requirements and skills like training, upskilling and knowledge exchange that could facilitate fulfilling the demand for the skills.

Table 4.7: Skills in Demand in Sewerage Industry

Competency Skills	Factor(s) contributing to the demand	Specific requirements and skills
• Sewerage system knowledge	• No programme to transfer knowledge and skills to a new successor. • Lack of exposure to process and operation. • The Sewerage Industry is rarely adopting/open to new technologies easily. • Lack of youth involvement due to Dirty, Dangerous, Difficult industry (3D).	• Training on related sewerage areas, for example, Sewer Network Maintenance, STP equipment, M&E Sewerage System, Sludge Dewatering, Fault Finding & Troubleshooting, Confined Space, Environmental Impact Assessment, Pump & Pumping System, Sewer Rehabilitation, Construction of STP, Construction of Sewers, etc. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills for workers. • Promote the exchange of knowledge and skills among industry players.
• Operation costing	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added non-technical aspects related to IR, for example, budget management and facilities management, integrated management system training, etc. • Continuous improvement of skills for workers.
• Raw material & procurement	• Insufficient training to focus on non-technical aspects. • Lack of exposure to process and operation.	• Training programmes should be enhanced/added with non-technical aspects related to IR, like Asset Risk Management Framework. • Training on related sewerage areas • Continuous improvement of skills.
• Operation & Maintenance	• No programme to transfer knowledge and skills to a new successor. • Lack of exposure to process and operation. • The Sewerage Industry is rarely adopting/open to new technologies easily. • Lack of youth involvement due to Dirty, Dangerous,	• Training on operation and maintenance according to job area, for example, Treatment Module 1 and 2: Introduction to Sewage Treatment O&M Requirements and Process Monitoring and Control, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, etc. • Revise the training syllabus

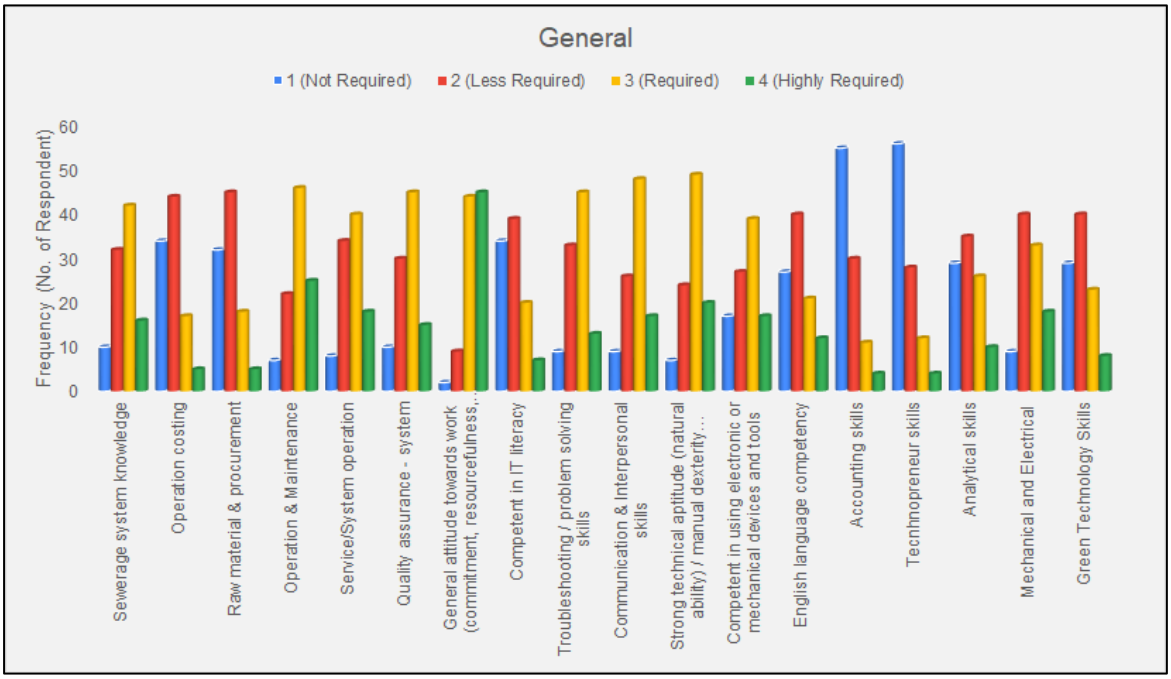
Competency Skills	Factor(s) contributing to the demand	Specific requirements and skills
	Difficult industry (3D).	• Review the training mode of delivery. • Continuous improvement of skills. • Promote the exchange of knowledge and skills among industry players.
• Service/System operation	• No programme to transfer knowledge and skills to a new successor. • Lack of exposure to process and operation. • Lack of hands-on experience towards the operation. • The sewerage industry is rarely adopting/open to new technologies easily. • Lack of youth involvement due to Dirty, Dangerous, Difficult industry (3D).	• Training on operation according to job area, for example, STP, Network Pumping Station (NPS), Sludge Treatment Facilities (STF), desludging, etc. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills. • Promote the exchange of knowledge and skills among industry players.
• Quality assurance - system	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added, like Quality Assurance, Integrated Management System, Sampling for Sludge Disposal Site, Testing & Commission of Sewerage System training, etc. • Continuous improvement of skills.
• General attitude towards work (Commitment, resourcefulness, teamwork, etc.)	• Insufficient training to focus on non-technical aspects. • Lack of youth involvement due to Dirty, Dangerous, Difficult industry (3D).	• Training programmes should be enhanced/added with non-technical aspects, for example, motivation and self-empowerment skills, Safety Passport Programme, Renewable Energy & Energy Efficiency, Managing Disciplinary, Effective Time Management, SCV/Jetter Works, etc. • Continuous improvement of skills.
• Competent in IT literacy	• Insufficient training to focus on non-technical aspects,	• Training programmes should be enhanced/added with non-technical aspects related to IR like Integrated Management System (IMS), Desludging Management System (DMS), Billing, Records and Informations System (BRAINS), System Application and Products (SAP) and etc. • Continuous improvement of skills,

Competency Skills	Factor(s) contributing to the demand	Specific requirements and skills
• Troubleshooting / problem solving skills	• No programme to transfer knowledge and skills to a new successor. • The Sewerage Industry is rarely adopting/open to new technologies easily. • Lack of hands-on experience towards the operation.	• Training on maintenance and troubleshooting, for example, Fault Finding and Troubleshooting training on STP, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, Hazard Identification Risk Assessment & Risk Control & Workplace Inspection (HIRARC-WI), etc. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills. • Promote the exchange of knowledge and skills among industry players.
• Communication & Interpersonal skills	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added with non-technical aspects like Effective Communication, Motivation and Self-Empowerment, Critical Thinking, etc. • Continuous improvement of skills.
• Strong technical aptitude (Natural ability) / manual dexterity (hands-on)	• No programme to transfer knowledge and skills to a new successor. • Lack of exposure to process and operation. • Lack of hands-on experience towards the operation. • The Sewerage Industry is rarely adopting/open to new technologies easily. • Lack of youth involvement due to Dirty, Dangerous, Difficult industry (3D).	• Training on Critical Thinking, Strategic Problem Solving, STP Operation and Management, Effective Scientific, Technical Writing, Communication, etc. • Revise the training syllabus • Review the training mode of delivery. • Continuous improvement of skills • Promote the exchange of knowledge and skills among industry players.
• Competent in using electronic or mechanical devices and tools	• Lack of exposure to process and operation. • The sewerage industry is rarely adopting/open to new technologies easily.	• Training on related sewerage areas. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills.
• English language competency	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added like Critical Thinking, Strategic Problem Solving, Effective Scientific, Technical Writing, Communication, etc.

Competency Skills	Factor(s) contributing to the demand	Specific requirements and skills
• Accounting skills	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added like Basic and Advanced Accounting, Sewerage Construction Management, Cost Effective, etc. • Continuous improvement of skills
• Technopreneur skills	• Insufficient training to focus on non-technical aspects.	• Training programmes should be enhanced/added with non-technical aspects like Technopreneur and Entrepreneur, Business Management and etc. • Continuous improvement of skills.
• Analytical skills	• Lack of exposure to process and operation. • Lack of hands-on experience towards the operation. • Lack of exposure to process and operation.	• Training on analytical related sewerage areas like Sludge Disposal Sampling, Accident Reporting and Investigation, Fault Finding, Strategic Problem Solving, Analytical Troubleshooting and etc. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills.
• Mechanical & Electrical skills	• Lack of exposure to process and operation. • Lack of hands-on experience towards the operation. • Lack of exposure to process and operation.	• Training related to M&E in sewerage areas like CIDB: Sewerage Construction Manager: Module C: Mechanical & Electrical, Introduction to Mechanical and Electrical of Sewerage System, etc. • Revise the training syllabus. • Review the training mode of delivery. • Continuous improvement of skills.
• Green technology skills	• Lack of exposure to process and operation. • Lack of hands-on experience towards the operation. • Insufficient training to focus on non-technical aspects. • The Sewerage Industry is rarely adopting/open to new technologies easily.	• Training on green technology skills like Renewable Energy and Energy Efficiencies, Introduction to Environmental Obligation and Climate Change, Green Technology and Sustainability Practices. • Revise the training syllabus. • Review the training mode of delivery. • Introduce programmes for managing asset life cycles in green/circular technology. • Continuous improvement of skills for workers.

All the identified competency skills were then included in the survey questionnaire to obtain the quantitative findings from the Sewerage Industry players. Figure 4.6 shows that the findings from the survey on skills required by management, technical and general levels support the findings from FGD. Management level includes senior technical manager, technical manager and executive. The technical level includes supervisor, technician and operator. While the general level consists of the general workers.

For the general group, it was found that 69 respondents selected competencies that related to strong technical aptitude (natural ability) / manual dexterity (hands-on), and 89 respondents selected general attitude towards work (Commitment, resourcefulness, teamwork, etc.) as highly required and required in the Sewerage Industry. Besides, the competencies related to sewerage system operation and maintenance, capable to troubleshoot, problem-solving, hands-on, communication and interpersonal skills are also required in the Sewerage Industry. However, 55 respondents agreed that skills related to accounting and technopreneur are not required for workers at this level.



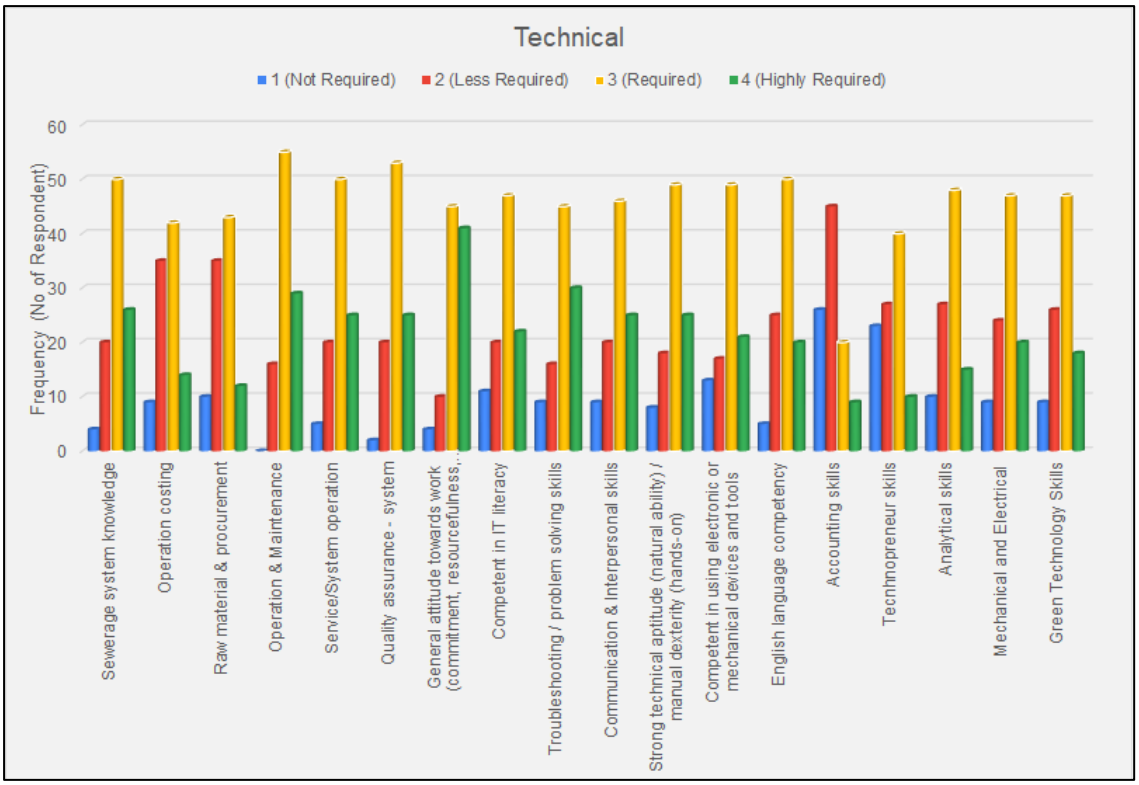


Figure 4.6: Skills Required According to General, Technical and Management Level

For the technical level, 41 respondents agreed that skills related to a general attitude towards work (Commitment, resourcefulness, teamwork, etc.) are highly required to be at the technical level. Besides, skills like operation and maintenance, troubleshooting/problem-solving and service/system operation are also required for career improvement and new recruitment. Most respondents agreed that all competency skills suggested by expert panels during the FGD session are required except for accounting skills. This is somewhat similar to the findings from the previous section (section 4.4.1) that technician requires a set of skills that are hardly filled in the Sewerage Industry, which eventually causes this job to encounter with high turnover rate. For the management level, all competency skills are required by this level.

Responses from the survey illustrated in Figure 4.7 shows that 24 respondents agreed that the competencies needed the most in the Sewerage Industry is competency involve capabilities to reformulate and use relevant skills to address problematic situations. It includes taking responsibility for planning and developing courses of action and exercising broad autonomy and judgment. It also reflects the understanding of theoretical and relevant methodological perspectives. This competency falls under level 7 of the MOSQF level descriptor.

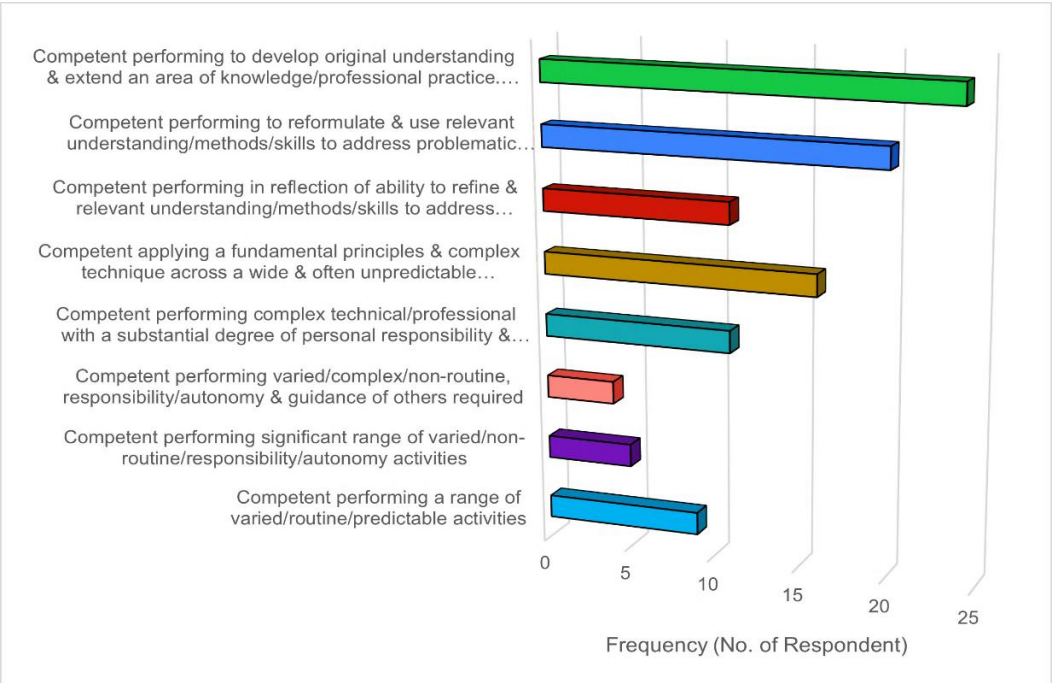


Figure 4.7: Occupational Competency Qualification Needed in the Sewerage Industry

80 % of respondents from the Sewerage Industry players in Figure 4.8 agreed that current sewerage workers in Malaysia still possess the skills needed to operate and manage sewerage operations. However, more upskilling programmes are needed to move towards the Industrial Revolution.

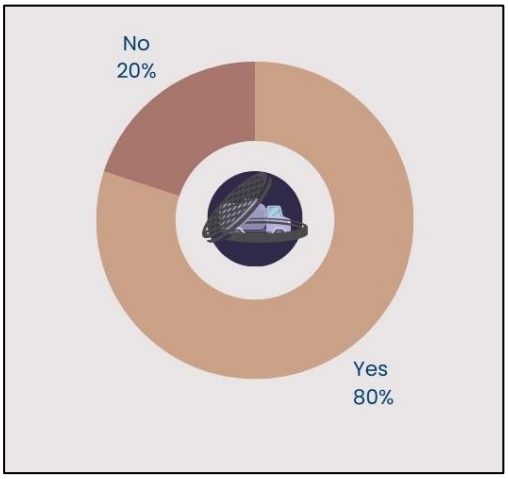


Figure 4.8: Required Skill Possessed by the Sewerage Worker (Observation)

A survey on the skill gap among sewerage workers was conducted. The result from the survey, as depicted in Figure 4.9, has exposed that education and training mismatch and lack of knowledge were selected by 60 respondents as the factor contributing to such a problem. This result directly shows that proper training is imperative to avoid a skill gap among employees. Besides, insufficient salary is another issue leading to skill gap problems. The stagnant salary scheme might cause insufficient salary due to a lack of skills.

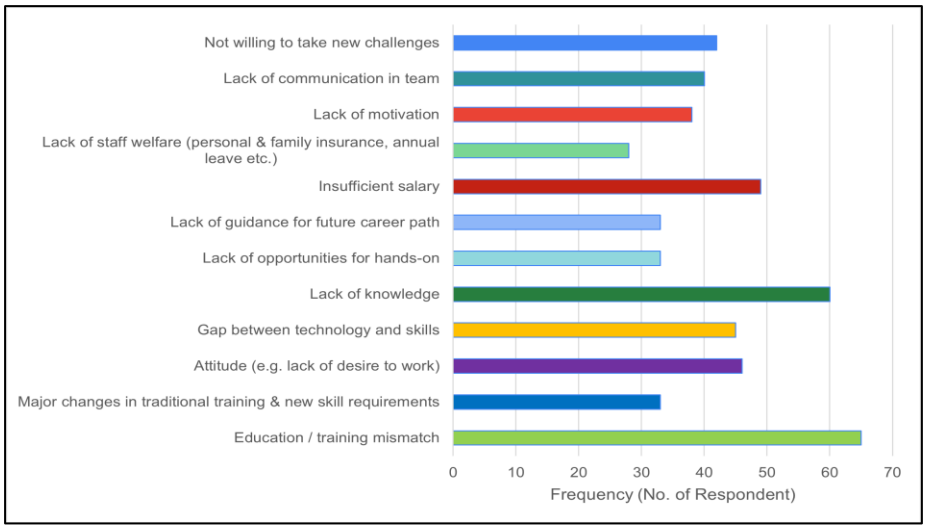


Figure 4.9: Skill Gap Among the Workers

Moreover, a survey was also conducted on the solution for the skill gap among sewerage workers. From the survey result in Figure 4.10, respondents agreed that the best solution to overcome the skill gap issue is providing training, retraining, on-job training, upskilling and re-skilling programme. The importance of workers having sufficient and proper training, then the skills of workers could be enhanced, and might also cause an increase in salary of the skilled worker by increasing the bonus and allowance that eventually lead to a job promotion.

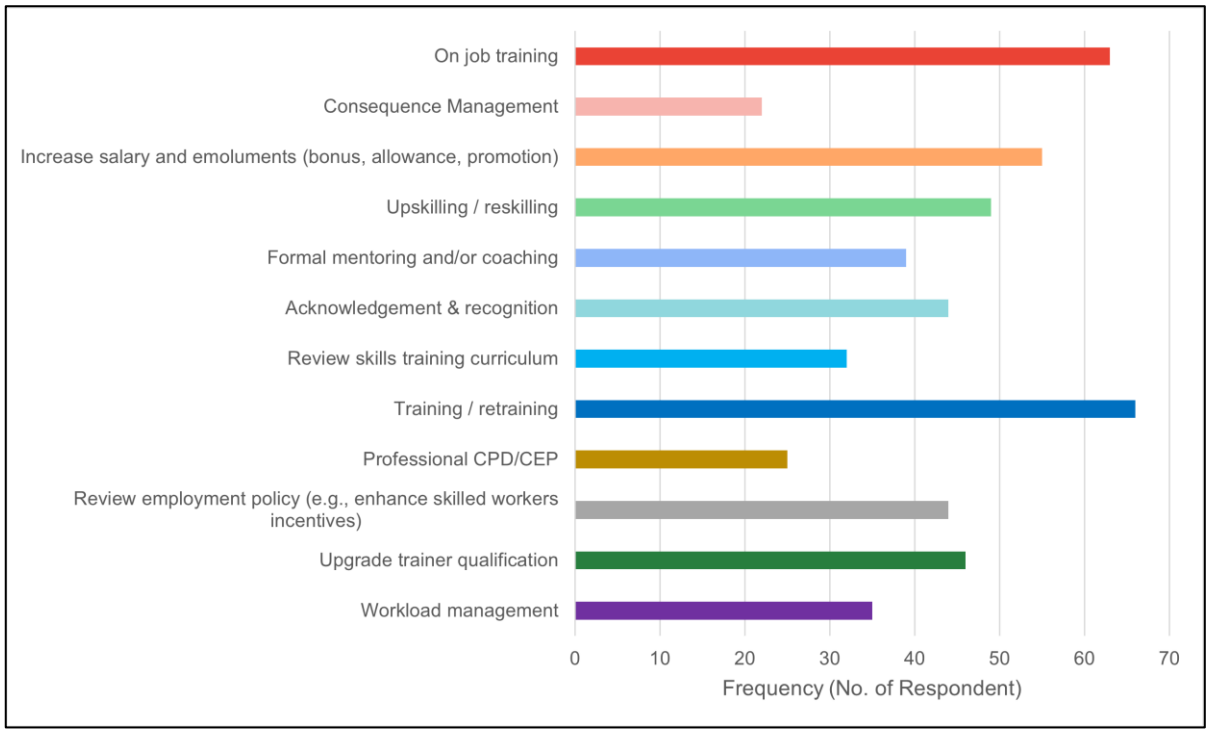


Figure 4.10: Solution for Skill Gap in Sewerage Industry.

4.4.3 **Industrial Revolution Related to Sewerage Industry**

Moving towards the IR, advancement and enhancement of skills are crucial. This is highly imperative to ensure the advancement and expansion of the industry. The skills related to the eleven (11) pillars of IR are listed in Table 4.8. The job area and job titles, according to the MOSQF level agreed upon by the expert panels, are also highlighted. Expert panels have also identified the reasons for the required IR-related skills. Most of the reasons emphasise the importance of skills that could smoothen the management and operation of sewerage in relation to the advent of the IR.

Table 4.8: IR Related Skills in Sewerage Industry

IR Related Skills	Job Area related to IR (From OS)	Reason for required IR Related Skills
• Autonomous Robots • Big Data Analytics • Cloud Computing • Internet of Things (IoT) • Additive Manufacturing (3D Printing) • System Integration • Cybersecurity • Augmented Reality • Simulation • Horizontal and Vertical Integration • New Business Models	• Operation and maintenance of sewerage system (Mechanical & Electrical) – Job titles from levels 3 to 7. • Operation and maintenance of sewerage system (Sewage Treatment Plant Operation) – Job titles from levels 4 to 7. • Treatment of wastewater (Industrial Effluent Treatment System) – Job titles from levels 4 to 7. • Collecting and transporting of septage (Desludging) – Job titles from levels 3 to 7. • Operation and Maintenance of Sewer Network - Job titles from levels 3 to 7.	• Enhance the technical and non-technical skills of the workers related to IR. • Inculcate continuous skill improvement in management and operation. • Increase management and operation productivity. • Create the development of new skills curriculum related to IR • Avoid human error. • Increase the effectiveness and efficiency of the process. • Inculcate empowerment of soft skills or non-technical skills. • Inculcate cost-effective operation.

A survey on the Sewerage Industrial players was also obtained to support the importance of adopting IR-related technology in the Sewerage Industry. About 57.1 % of respondents from the Sewerage Industry players also agreed that IR would impact the economic activities of the Sewerage Industry, as illustrated in Figure 4.11. However, 35.7 % of respondents are still uncertain about the impact of IR due to less exposure to the new technology and unreadiness towards technology assimilation in the Sewerage Industry. Another 7.2 % of respondents thought that IR would not affect the current implementation of sewerage.

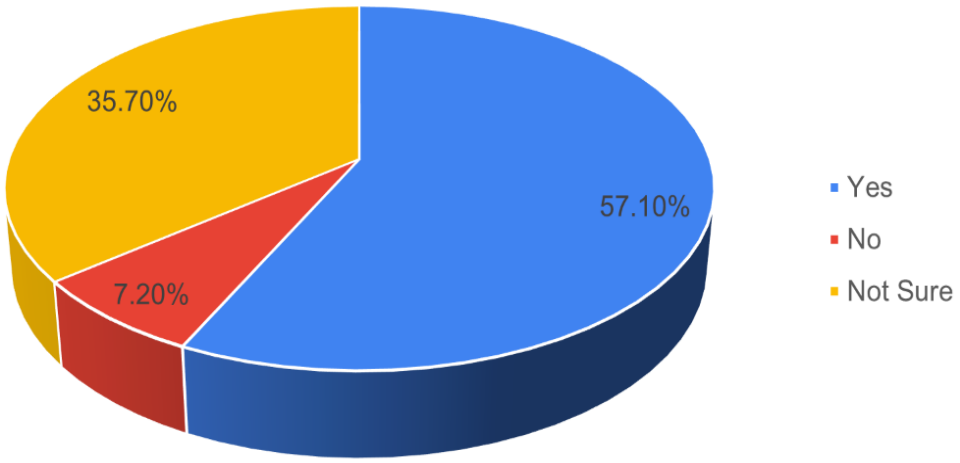


Figure 4.11: Respondent Opinion on IR (Eg. Digitalization) Impact in the Sewerage Industry.

Figure 4.12 highlights the job area in Sewerage Industry that could be affected by IR according to the 11 pillars as listed in Table 4.4. For operation and maintenance related to M&E, the Internet of Things (IoT) and System Integration are emerging technologies that could need new skills to smoothen the M&E related works. For operation and maintenance related to the Sewage Treatment Plant, Big Data Analytics, the Internet of Things (IoT), and Simulation are the emerging skills that could be needed to enhance the sewage treatment operation towards a new automated system plant. For the treatment of wastewater, Cyber Security, System Integration and the Internet of Things (IoT) are the emerging skills that could encourage advanced technology implementation in industrial wastewater treatment. For collecting and transporting septage and operation & maintenance of sewer networks, Cloud Computing, the Internet of Things (IoT), and Big Data Analytics are the related IR skills needed.

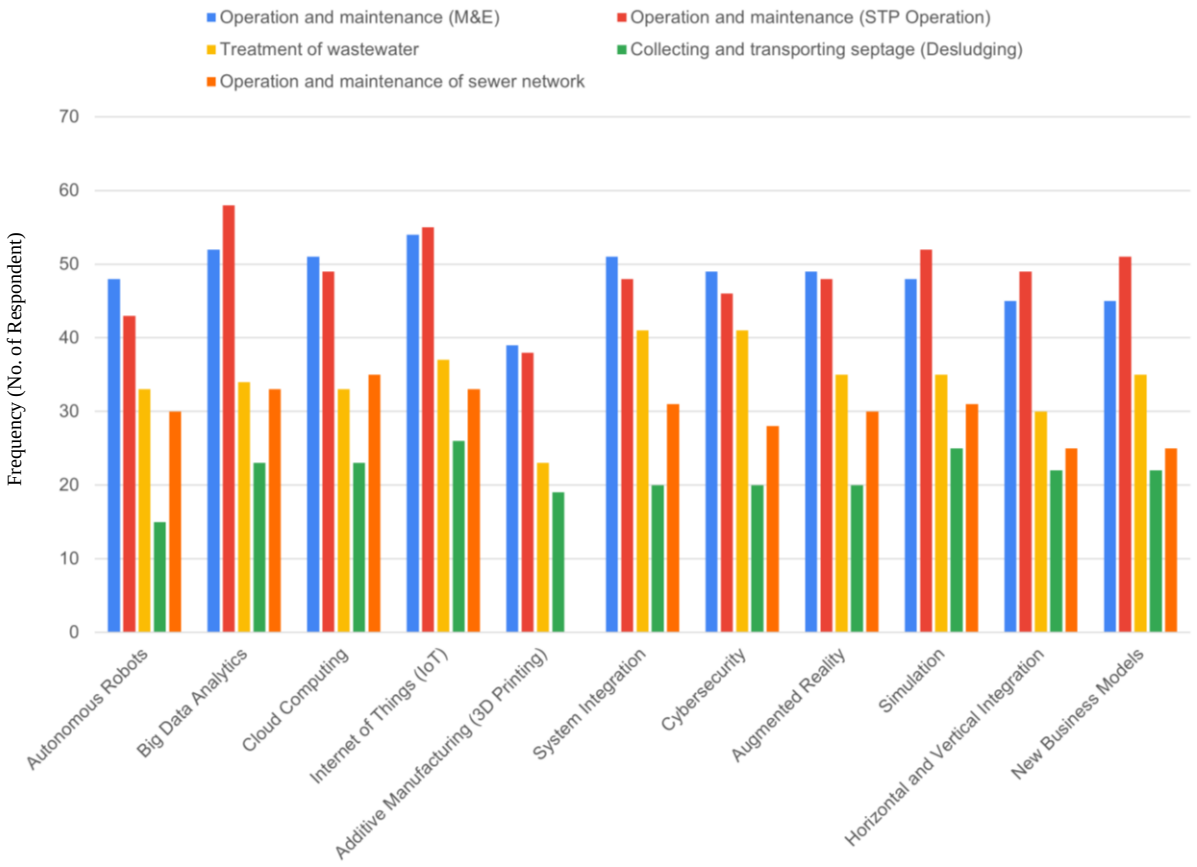


Figure 4.12: Job Area in Sewerage Industry that affected by Industrial Revolution

Response on the pre-requisite to each job area was also collected the since Sewerage Industry is moving forward in assimilating new technology from the findings of emerging skills. Figure 4.13 shows the skills needed as a prerequisite in Sewerage Industry. Response from the survey addressed that all areas, including operation and maintenance related to M&E, sewage treatment plant, treatment of wastewater, desludging and sewer network, require skills related to technical know-how. Since all areas are indeed technical operations, thus this kind of prerequisite could initiate a further enhancement in the skills possession of sewerage workers. Meanwhile, knowledge about ICT is the less selected prerequisite in the Sewerage Industry.

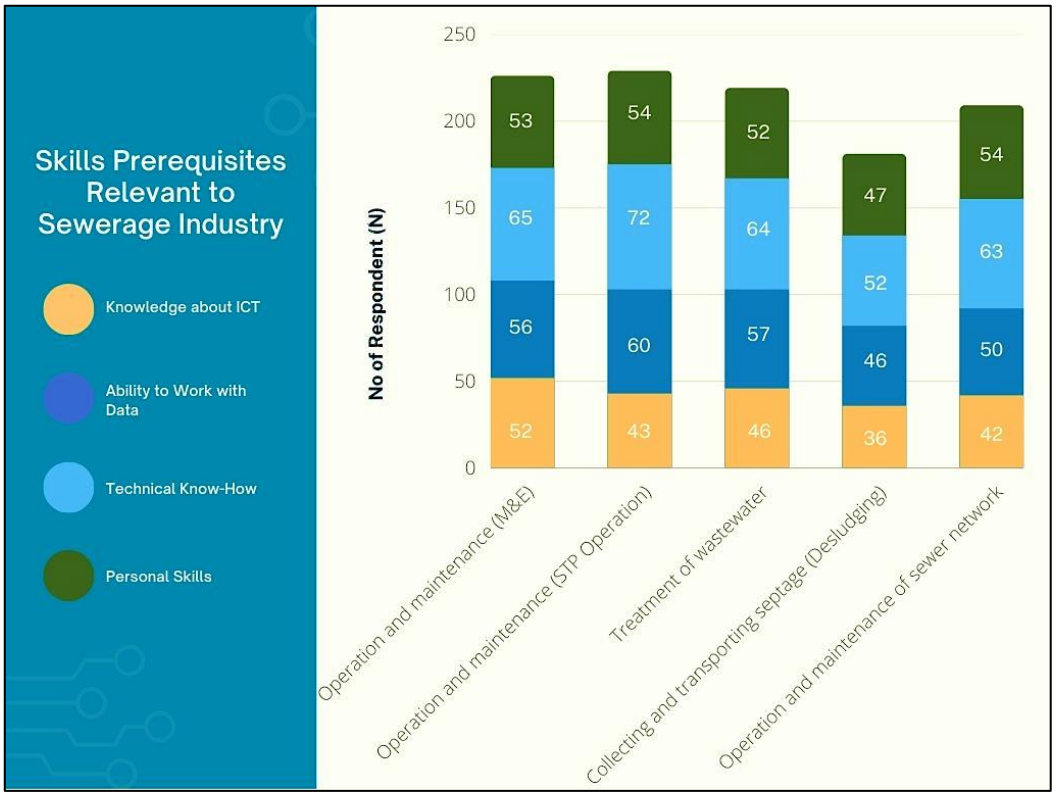


Figure 4.13: Skills Prerequisites Relevant to Sewerage Industry

4.4.4 **Related Issues in the Sewerage Industry**

This section highlights the related common issues that arise in the Sewerage Industry. The expert panels from the Sewerage Industry suggest 24 key issues. The list of related issues in the Sewerage Industry is presented in Table 4.9. The identified key issues might be related to skills requirements in the Sewerage Industry.

Table 4.9: Key Issues in Sewerage Industry.

No.	Key Issues	Discussion	Suggestion
1	Insufficient manpower	• Demanding skilful manpower due to work requirements. • High turnover rate of a skilful worker. • 3D (Dirty, Dangerous, Difficult) industry. • Negative perception by community.	• Minimum wages policy according to skill possession. • Review wages scheme based on skills possession that lead to productivity. • Enhancing TVET and education syllabus, short-term course and long-term course.

No.	Key Issues	Discussion	Suggestion
			• Provide more upskilling training and benefits from skill possession.
2	Low skilled & low performance workforce	• Mismatch between skills training and industry requirements. • Lack of training facilities and talent management from the employees. • Low motivation led to low performance	• Enhancing TVET and education syllabus, short-term course and long-term course. • Provide more technical and non-technical upskilling training and benefits from skills possession.
3	High dependency on foreign labour	• 3D (Dirty, Dangerous, Difficult) industry. • Lack of skills by a local worker. • Limited skills could be offered to local workers. • Unable to convince participation from the young generation.	• Attract more local workers with skills upskilling opportunities. • Attract more local workers with good salary schemes and benefits due to skills possession. • Promote the industry with the benefits of wide skills training opportunities.
4	Underpayment of wages leads to high turn over	• Lack of skills possession by workers led to stagnant salary schemes.	• Provide upskilling and reskilling training programs so that employees could be benefited from reasonable salary schemes and benefits based on skills possession.
5	Quality inconsistency (product & services)	• Low work quality due to lack of skills	• Quality enhancement by upgrading more skilled workers. • Provide an upskilling training program.
6	Maintaining profitability	• Improper budget and expense planning due to a lack of skills in strategising mitigation in monetary matters.	• Provide training for budgetary planning and management skills.
7	Economic conditions	• Low investment for upskilling and reskilling training.	• Diversification of skills for related economic activities in the sewerage industry.
8	Government policy/regulation	• Strict regulation on competent person interpretation in the sewerage industry	• Provide flexibility of the competency programme.
9	Labour costs (sub-contractors)	• Intense outsourcing contracts in sewerage	• Upskilling or reskilling the existing workers

No.	Key Issues	Discussion	Suggestion
		operation activities due to skills requirements.	
10	Technological change	• Slow technological innovation and adoption. • Lack of technological related skills.	• Provide more technology-related skills training.
11	Youth Involvement (Dangerous, Difficult, Dirty (3D) industry)	• Lack of promotion on benefits and skills offered to youth.	• Enhancement of awareness and promotional activity. • Integration of skill training and learning.
12	Lack of infrastructure support	• Slow adoption of new technologies that can offer new skills.	• Upgrade infrastructures that might open opportunities for new skills requirements.
13	Poor facilities and amenities for worker	• Slow adoption of new technologies that can offer new skills.	• Upgrade facilities and amenities that might open opportunities for new skills requirements.
14	Contract extension issues	• Less benefit to skilful workers.	• Provide a proper career pathway to skilful workers.
15	Work environment	• Non-conducive environment. • Uninteresting working environment.	• Change the working environment by introducing new and interesting technology related to IR. • Encourage healthy practices.
16	High risk job	• Lack of youth involvement due to high-risk jobs.	• Promote and educate with safety and health SOP skills.
17	Health issues	• Not practising the correct SOP of safety and health in the workplace.	• Promote and educate with safety and health SOP skills.
18	Reluctancy of skilled worker to extend services	• Salary and wages mismatch with skill and knowledge.	• Provide a proper career pathway that leads to high benefits.
19	Knowledge transfer problem due to huge gap of seniority in service	• Senior workers were unwilling to share and transfer knowledge. • Less programme that needs involvement from the senior and junior workers.	• Conduct a programme that needs involvement from a both junior and senior workers. • Knowledge transfer course by the senior worker.
20	Reluctancy to adopt in ICT application	• Slow adoption of new technology, specifically ICT, by workers.	• Provide training on ICT skills and include them as KPI.
21	Reluctant in knowledge transfer (insecure)	• Senior workers were unwilling to share and transfer knowledge.	• Provide benefits for skilful senior workers.

No.	Key Issues	Discussion	Suggestion
		• Less programme that needs involvement from the senior and junior workers.	• Conduct a skills exchange programme that needs involvement from both junior and senior workers.
22	Social Skills & Social Values	• Lack of non-technical skills.	• Provide more non-technical skills training.
23	Public perception for credible career prospect	• Public is not educated about the real credible career prospect and pathways of the sewerage industry.	• Promote and educate the public with real credible career pathways and skills offered in the sewerage industry.
24	Adoption of modern and green technology	• Slow adoption of new green technology.	• Provide more green technology skills training • Inculcate willingness to adopt new technology in the sewerage industry.

The key issues, as listed in Table 4.9, during the FGD sessions were asked in one of the sections of the survey questionnaire. The issues were asked according to job area in the Sewerage Industry. Based on the observation of the results from the survey, most respondents agreed that most of the key issues listed by the expert panels literally happened in the current Sewerage Industry in Malaysia. This can be observed based on the number of respondents that choose ‘agree’ and ‘strongly agree’.

For operation and maintenance related to Mechanical & Electrical, as depicted in Figure 4.14, the respondents agreed with all the issues listed by the expert panels from a qualitative perspective. Responses from the survey have found that about 36 respondents agreed that underpayment of wages and social skills and social values are the issue that usually happens among the workers in this area. Meanwhile, about nine (9) respondents disagreed that contract extension is a significant issue in the Sewerage Industry.

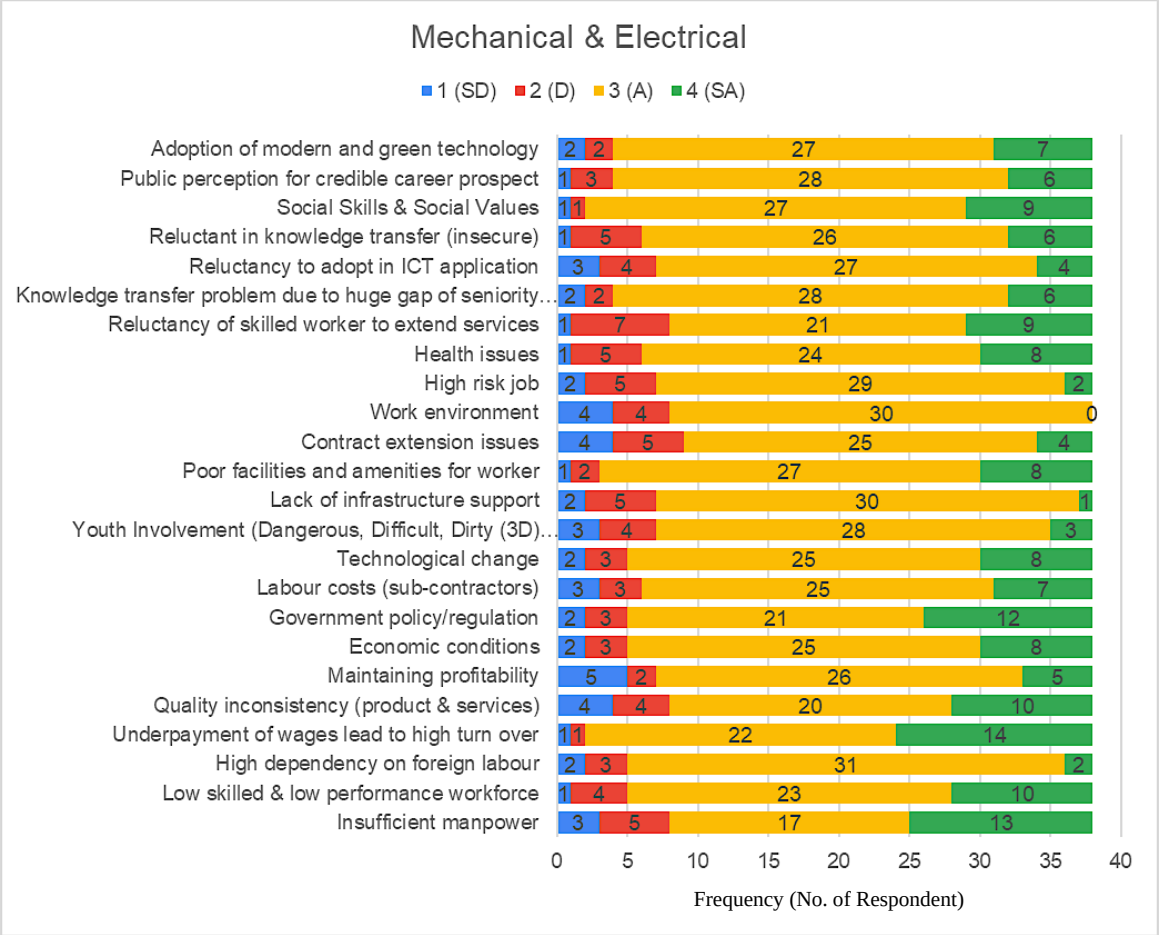


Figure 4.14: Related issues in Mechanical & Electrical Area of Sewerage Industry (SD: Strongly Disagree, D: Disagree, A: Agree, SA: Strongly Agree).

For operation and maintenance related to the Sewage Treatment Plant, as depicted in Figure 4.15, about 17 respondents voted for insufficient manpower and lack of youth involvement as uncomfortable issues to happen in sewage treatment plant operation (STP). Meanwhile, about seven (7) respondents disagreed that high dependency on foreign labour is a significant issue in STP operation.

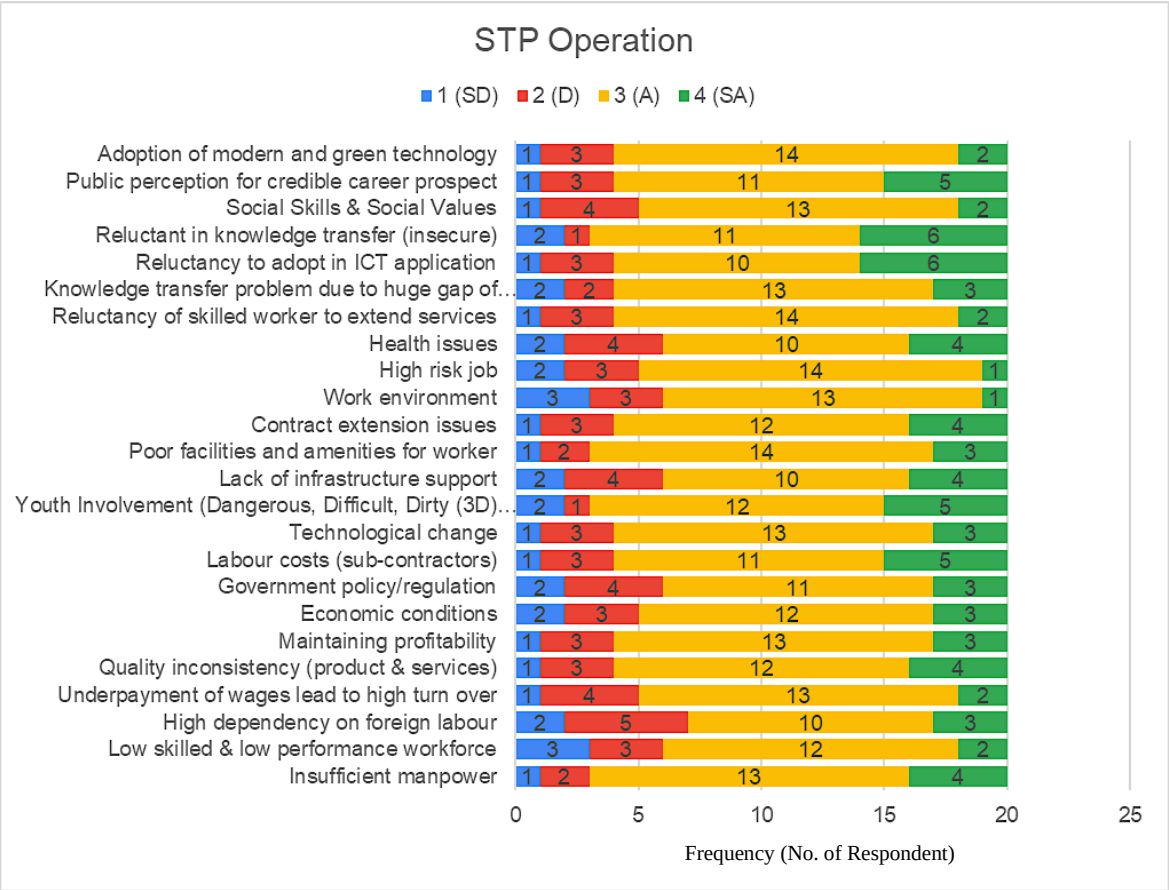


Figure 4.15: Related issues in the Sewage Treatment Plant (STP) Area (SD: Strongly Disagree, D: Disagree, A: Agree, SA: Strongly Agree).

For the treatment of wastewater area, as depicted in Figure 4.16, about twelve (12) respondents agreed that low skilled and performance workforce, insufficient manpower, underpayment of wages, and reluctancy of knowledge transfer and ICT adoption are the issues that arise in this area. Meanwhile, about five (5) respondents disagreed that knowledge transfer problems, health issues, contract extension issues, lack of infrastructure issues, technological change, government policy, quality inconsistence and dependency on foreign workers significantly happened in this area.

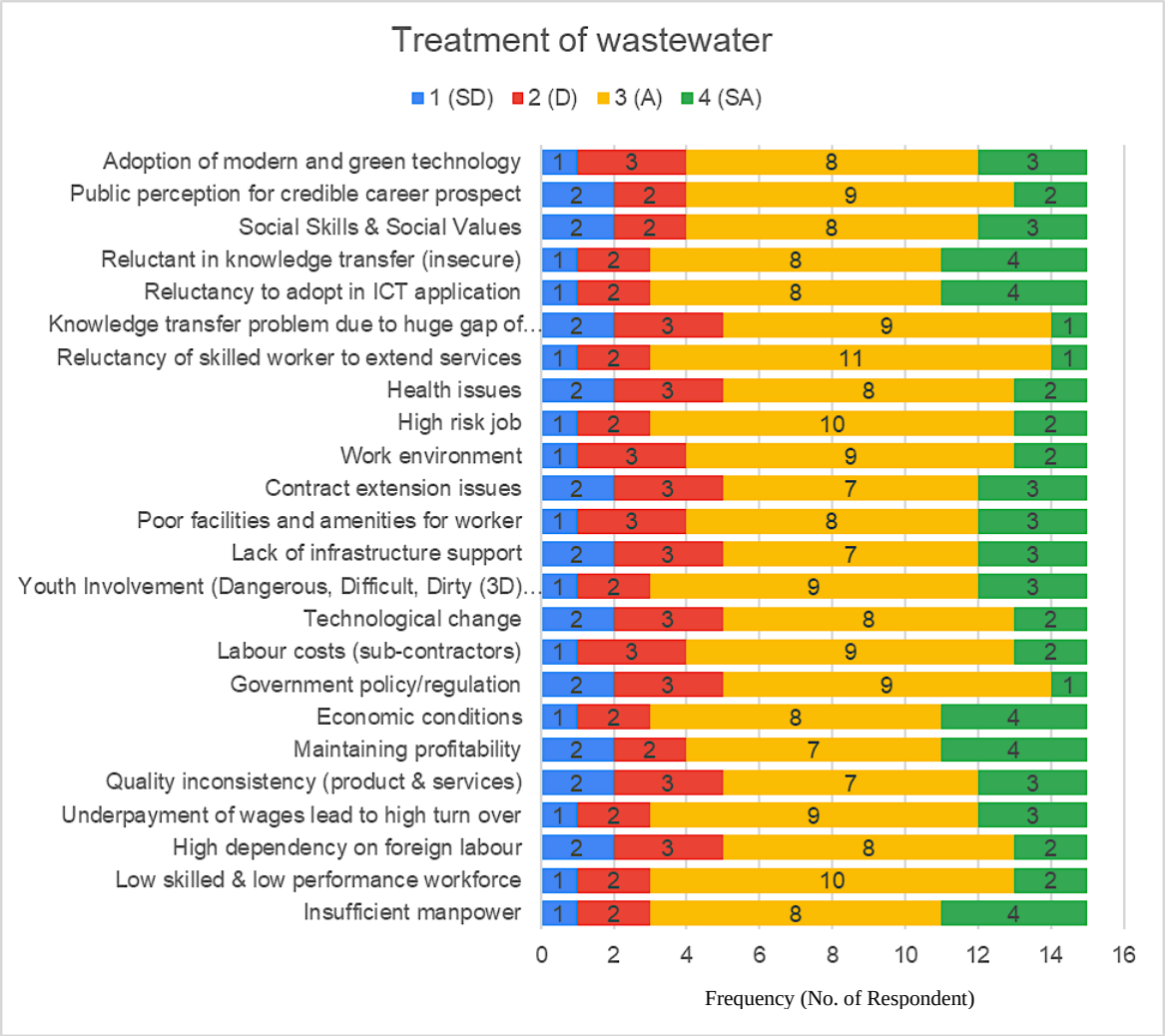


Figure 4.16: Related issues in Treatment of Wastewater Area of the Sewerage Industry (SD: Strongly Disagree, D: Disagree, A: Agree, SA: Strongly Agree).

For the desludging area, as depicted in Figure 4.17, the result from the survey indicates that about thirteen (13) respondents agreed that issues related to knowledge transfer problems are due to a huge gap of seniority in service. Meanwhile, about five (5) respondents disagreed that the reluctancy of skilled workers to extend service, high risk jobs, poor facilities and amenities for worker and quality inconsistency are the arisen issues in the desludging area.

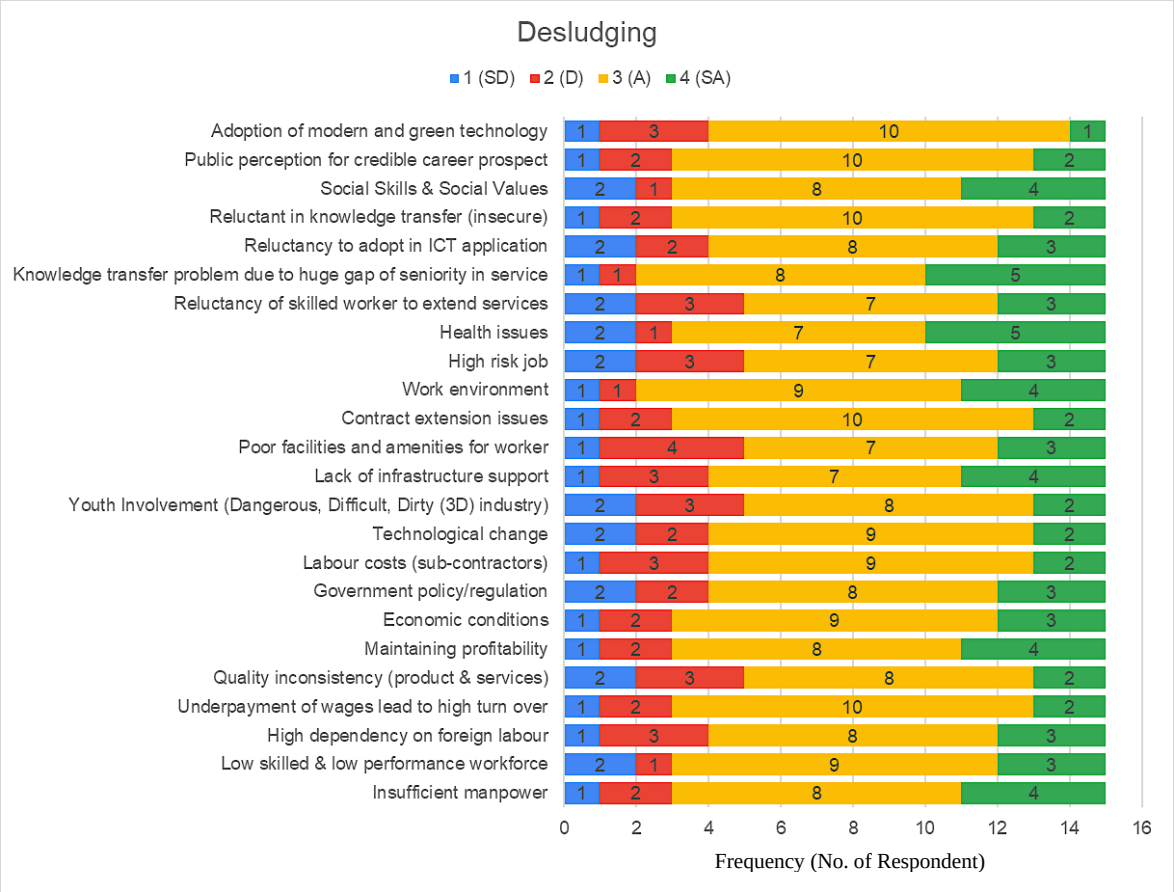


Figure 4.17: Related issues in Desludging Area of the Sewerage Industry (SD: Strongly Disagree, D: Disagree, A: Agree, SA: Strongly Agree).

For the operation and maintenance of the sewer network area, as depicted in Figure 4.18, about 14 respondents agreed that most issues that happened in this area are underpayment of wages that lead to high turnover rate. Meanwhile, about four (4) respondents disagreed that public perception of credible career prospects, knowledge transfer problems and work environment are the significant issues in this area.

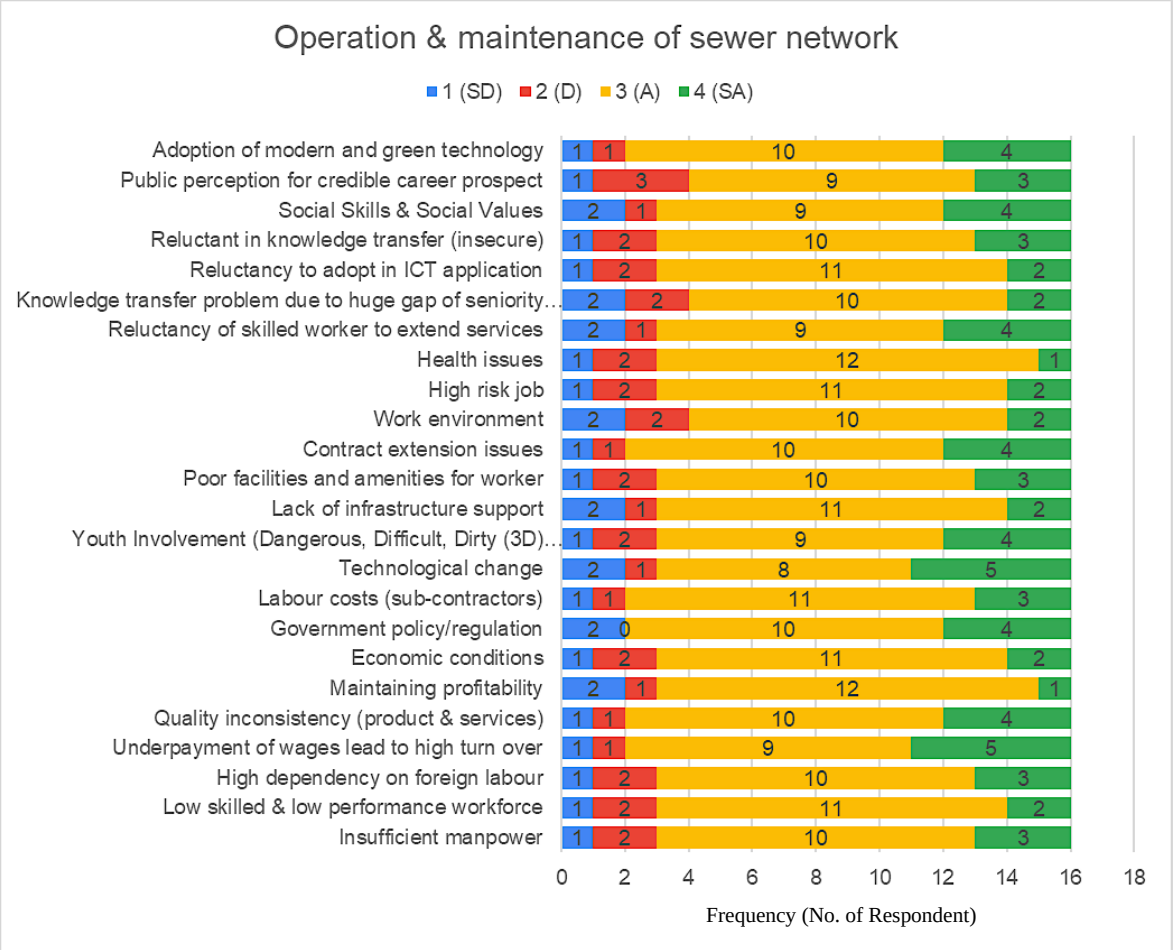


Figure 4.18: Related issues in Operation & Maintenance of the Sewer Network (SD: Strongly Disagree, D: Disagree, A: Agree, SA: Strongly Agree).

4.5 Mapping of Occupational Structure (OS) to Available National Occupational Skills Standard (NOSS)

This section provides a mapping between developed OS with available NOSS to date (Table 4.10). This is to identify the established NOSS that relates to job titles in the OS. There are twelve (12) NOSS that have been developed by the Department of Skills Development (DSD) related to Division 37 in MSIC 2008 as of October 2022. The title of the developed NOSS can be referred to in Table 2.2 in Section 2.2.1.

Table 4.10: Mapping OS vs Available NOSS

Section	**(E) Water Supply; Sewerage, Waste Management and Remediation Activities**				
Division	**(37) Sewerage**				
Group	**(370) Sewerage**				
Area	**Operation and maintenance of sewerage system (Mechanical & Electrical)**	**Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)**	**Treatment of wastewater (Industrial Effluent Treatment System)**	**Collecting and transporting septage (Desludging)**	**Operation and Maintenance of Sewer Network**
8	No Job Title	No Job Title	No Job Title	No Job Title	No Job Title
7	Senior Mechanical & Electrical Technical Manager	Senior Treatment Technical Manager	Senior Treatment Technical Manager (Environmental Officer)	Senior Desludging Technical Manager	Senior Network Technical Manager
6	Mechanical & Electrical Technical Manager	Treatment Manager	Treatment Technical Engineer	Desludging Technical Manager	Network Technical Manager
5	Mechanical & Electrical Executive	E370-001-5:2016	Treatment Executive	E382-001-5:2017	E370-003-5:2022
4	Mechanical & Electrical Supervisor	E370-001-4:2016	Treatment Supervisor	E382-001-4:2017	E370-003-4:2022
3	Mechanical & Electrical Technician	CM-031-3:2014	Treatment Technician	E382-001-3:2017	E370-003-3:2022
2	Mechanical & Electrical Operator	CM-031-2:2014	Treatment Operator	E382-001-2:2017	E370-003-2:2022
1	General Worker	General Worker	General Worker	No Job Title	No Job Title

4.6 Occupational Description

Occupational Description (OD) is a general written statement of a specific job based on the developed OS and OR from the previous sections 4.2 and 4.3, respectively. For this research, OD generally includes responsibilities, knowledge, skills and attributes with regard to attitude, safety and environment. There are 30 ODs for the job titles classified as critical by expert panels of the Sewerage Industry provided in Annex 6.

4.7 Conclusion

In conclusion, this chapter highlighted all the findings from the method implemented for this research. By mainly referring to MSIC 2008, the OS, according to the MOSQF Level Descriptors specifically for the Sewerage Industry, has been developed resulting from thorough discussion by expert panels of the Sewerage Industry during the FGD sessions and collective responses from the survey. There are five (5) job areas, and 33 job titles have been identified that are associated with economic activities classified in MSIC 2008. Eventually, other important findings like critical jobs, demanding competency skills and key issues related to the Sewerage Industry have also been identified. Besides, the responsibilities for job titles and requirements of knowledge, skills and attributes required by each critical job have also been thoroughly described. Twelve (12) NOSS have been identified and mapped with a job titles in the Sewerage Industry. Therefore, the findings from this Occupational Framework can be a reference to the development of NOSS in the future.

CHAPTER V

DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 Discussion

Based on the collective qualitative and quantitative findings from the interview protocol during Focus Group Discussion (FGD) sessions and a survey questionnaire, respectively, all objectives have been achieved, and the discussion of each finding has been arranged in this subchapter.

5.1.1 Occupational Structure

Occupational Structure (OS) has been successfully developed. Five (5) job areas associated with the 'Include' item for 2 digits Malaysia Standards Industrial Classification (MSIC) 2008 Division 37: Sewerage has been identified and mapped to the Malaysian Occupational Skills Qualification Framework (MOSQF) level. The Nominal Group Technique (NGT) brainstorming session among the expert panels have finalised that there are 33 job titles were identified for the Sewerage Industry, of which 30 of them were specified as critical jobs, and 23 of them were specified to relate to Industrial Revolution (IR). Since the Sewerage Industry can be considered a small and essential industry, hence most of the job titles are critical and can relate to the IR. The critical jobs are jobs in demand but hard to fill and are always short of supply due to the nature of the jobs, which require a certain set of skills and qualifications related to Sewerage, such as Sijil Kemahiran Malaysia E 382-001-5:2017 Desludging and Discharge Management Level 5, Sijil Kemahiran Malaysia E 382-001-4:2017 Desludging and Discharge Administration Level, Mechanical & Electrical of Sewerage System, Operation and Maintenance of Sewerage System, Confined Space Skills

Authorized Gas Tester, Effective Soft Skills, etc.

From FGD sessions, expert panels have given their point of view on ‘industrial wastewater’ in the area of Treatment of Wastewater (Industrial Effluent Treatment System, IETS). The term sewage refers only to any discharged liquid containing human excreta, animal or vegetable matters generated from domestic activities like household, commercial, institutional and industrial premises, including liquid discharged from water closets, basins, sinks, bathrooms and other sanitary appliances. However, industrial wastewater or industrial effluent refers to waste in the form of liquid-form waste or wastewater generated from manufacturing industries. For this type of wastewater or effluent, the treatment activities occurred at the industrial premises and were governed by laws like the Department of Environment, Natural Resources and Environment Board Sarawak and Environment Protection Department of Sabah.

The highest skill qualification level for each job area is level 7, which is Senior Technical Manager, and the lowest is level 1, which is the general worker. Meanwhile, job titles like operator, technician, supervisor, executive and technical manager were identified to suit levels 2 to 7 for each job area. It is also found that the job title in the Sewerage Industry is not up to level 8 because the skills related to developing original understanding as described in MOSQF level 8 have yet to be established in the current industry since Malaysia is applying sewerage technology taken from the other country. Besides, the position at this level can flexibly be occupied by personnel with a management background or very minimal technical knowledge. Meanwhile, for the desludging and sewer network area, no job title for level 1 since most of the work conducted by the operator happens at client sites. Hence no general worker is needed.

5.1.2 **Occupational Responsibilities**

For Division 37 Sewerage, the responsibilities of each job title in developed OS are provided narratively from discussion among the expert panels of the industry but without limitation to the list. These responsibilities benefit the National Occupational Skills Standard (NOSS) development for the Sewerage Industry in the future. The identified responsibilities are specific to each job area and different based on the level of the job title. Based on the responsibilities, knowledge and skills could be determined to develop NOSS and other new competent training programmes.

5.1.3 **Jobs in Demand**

Demand in occupation might be driven by the factors that skills, competencies and certifications are limited to fulfilling the requirement of an available job. Jobs in demand are required and important in the smooth running of the company's main operations. The highly demanding jobs are required by critical and essential industries such as the Sewerage Industry. Sewerage Industry can be considered a rare and different industry even though it is classified under the water industry. Indah Water Konsortium dominates about 90% of talents in the Sewerage Industry, and the endeavour to train and upskill the talent to be competitive must be outlined. Therefore, the first step towards this endeavour must be started by identifying the critical job of the Sewerage Industry.

The technician is classified as a semi-skilled worker that requires specific skills, especially for operation and maintenance with regards to Mechanical & Electrical (M&E), Sewage Treatment Plant (STP), desludging and sewer network. This job is considered demanding (refer to Figures 4.2, 4.3 and 4.4 in section 4.4.1) with several factors that cause difficulties in fulfilling the required skills and knowledge to avoid the turnover of existing employees or qualify for new recruitment. This is proven by the responses from the Sewerage Industry players that technician has the highest turnover rate in the Sewerage Industry, as depicted in Figure 4.5. The high turnover rate might be due to skill mismatching by the workers, and the new employment was taken place by not considering sufficient and suitable qualified skills.

5.1.4 **Competencies in Demand**

Competencies are one of the requirements for critical jobs. The limitation encountered in fulfilling the requirement of demanding occupation is competency skills of talent. Besides, competency upskilling and knowledge enhancement are also required for worker improvement. To achieve that, the demanding competency skills according to job titles must be first identified (refer to Table 4.7, section 4.4.2). From that, skills in demand might eventually be identified and useful for occupational improvement through Malaysian Skills Certification System (MSCS). Skills in demand are sought-after skills in a particular industry or sector. This includes both technical/hard and soft/human skills. The acquired skills are the most criteria that employers are looking for in candidates for new recruitment or promotion. In the Sewerage Industry, skills are also the required criteria that need to be

possessed by the workers.

For the technical level (as in Figure 4.6, section 4.4.2), most survey respondents agreed that all competency skills suggested by expert panels during the FGD session are likely required except for accounting skills. Most respondents agreed that a general attitude towards work (Commitment, resourcefulness, teamwork, etc.) is a highly required skill in a technical group. This is also one of the reasons a technician is required in any sewerage organisation for smooth operation and needs various skills that eventually cause this position to be highly demanded. For the management group, respondents agreed that four (4) competency skills highly required by this level are general attitude towards work, troubleshooting/problem solving skills, Communication and Interpersonal skills and sewerage system knowledge. This justified that management is one of the job categories that is hard to fulfil. All the training examples needed based on the related competencies skills in demand are summarised in Table 5.1.

Table 5.1: Summary of Competencies Skills in Demand.

Level	**Related Competencies Skills in Demand**	**Example of Specific Skills Training Needed**
Technical	General attitude towards work (Commitment, resourcefulness, teamwork, etc.)	Training on Self-Empowerment and Motivation, Safety Passport Programme, Renewable Energy & Energy Efficiency, Managing Disciplinary, Effective Time Management, sewer cleaning vehicle (SCV)/Jetter Works, etc.
	Sewerage System Knowledge	Training on Sewer Network Maintenance, STP equipment, M&E Sewerage System, Sludge Dewatering, Confined Space, Environmental Impact Assessment, Pump & Pumping System, Sewer Rehabilitation, Construction of STP, Construction of Sewers, etc.
	Operation and Maintenance	Training on operation and maintenance according to job areas, for example, Treatment Module 1 and 2: Introduction to Sewage Treatment O&M Requirements And Process Monitoring And Control, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, etc.
	Troubleshooting / problem solving skills	Fault Finding and Troubleshooting training on STP, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, Hazard Identification Risk Assessment & Risk Control & Workplace Inspection etc.
Management	General attitude towards	Training on Self-Empowerment and Motivation, Safety Passport Programme, Renewable Energy

	work (Commitment, resourcefulness, teamwork, etc.)	& Energy Efficiency, Managing Disciplinary, Effective Time Management, etc.
	Troubleshooting / problem solving skills	Fault Finding and Troubleshooting training on STP, Network Pumping Station (NPS) and Sludge Treatment Facilities (STF), desludging, Hazard Identification Risk Assessment & Risk Control & Workplace Inspection, etc.
	Communication and Interpersonal skills	Training on Effective Communication, Motivation and Self-Empowerment, Critical Thinking, etc
	Sewerage System Knowledge	Training on Sewer Network Maintenance, STP equipment, M&E Sewerage System, Sludge Dewatering, Fault Finding & Troubleshooting, Confined Space, Environmental Impact Assessment, Pump & Pumping System, Sewer Rehabilitation, Construction of STP, Construction of Sewers, etc.

Besides, it can be summarised that (refer to Figure 4.7 in section 4.4.2) the competencies qualification needed the most in the Sewerage Industry includes the capabilities to reformulate, use relevant skills to address problematic situations, responsibility to plan, develop action courses, practice broad autonomy and judgment. It also reflects the understanding of the theoretical and develop relevant theoretical and methodology perspective. This means that the competencies needed are not limited to technical skills but include soft and related skills. These required skills can be attributed to the competencies for the managerial level. Besides, reformulating and applying understanding, methods and skills to address problematic situations are also needed. Although the current sewerage workers in Malaysia still possess the skills needed to operate and manage sewerage operation (refer to Figure 4.8), as moving towards the Industrial Revolution, more upskilling programme is needed.

Furthermore, there are still problems with regard to the skill gap among workers. The result from the survey depicted in Figure 4.9 (Section 4.4.2) has exposed that education and training mismatch and lack of knowledge are contributing to such problems. Academic qualification versus experience has become one of the debatable issues. Recruitment with academic qualifications might lead to education mismatching, while experienced workers might encounter with lack of knowledge and qualification mismatching. Moreover, training mismatch might also contribute to skill gap issues as technology advances. Besides, attitude, insufficient salary issues and lack of motivation are also the reasons that caused the skill gap

problem significantly happens among sewerage workers. This might be due to the lack of skills that the organisation demands. When employees are not skilful, this might affect a stagnant salary issue. Thus, upskilling is needed to ensure a better salary scheme might be given to skilful workers. These problems also might lead to an increase in turnover rate and eventually encourage a severe skill gap problem.

The result from the survey in Figure 4.10 (Section 4.4.2) indicates that the best solution to overcome the skill gap issue is by providing training, retraining, on-job training, upskilling and re-skilling programmes to the current sewerage workers so that with relevant and matched competency, this could fill the current gap between the worker and their job requirement. Providing sufficient training programmes to the workers might also indirectly encourage the knowledge transfer between experienced and less-experienced workers. Thus, competencies in demand issues can also be solved.

5.1.5 **Industrial Revolution Related with the Sewerage Industry**

Figure 4.12 (Section 4.4.3) highlighted that the job area in Sewerage Industry could be affected by IR. It can be observed that all areas are eligible to be implemented with all skills related to IR. Table 5.2 summarises the IR-related skills needed by each job area and some examples suggested for skills related to IR. For operation and maintenance related to the Sewage Treatment Plant (STP), Big Data Analytics, the Internet of Things (IoT), and Simulation are the IR-related skills that could be needed to enhance the sewage treatment operation towards a new automated system plant. The treatment plant operation might incorporate a software system like Supervisory Control and Data Acquisition (SCADA) for equipment control and data gathering. With this technology system, data acquisition might be enhanced where equipment and condition control could be done in real-time from remote locations. Thus, the skills related to Big Data, IoT and simulation are recommended to be implemented in such operations. Besides, this also shows that the respondents from this area indicate their readiness to enhance sewage treatment plants with IR.

Table 5.2: Summary of IR Related Skills Needed

Job Area	IR Related Skills Needed	Example of Skills Training
Operation and maintenance of sewerage system (Sewage Treatment Plant)	• Big Data Analytics • Internet of Things (IoT) • Simulation	Training on Big Data Management, Application of Artificial Intelligent, Facility Management (Maintenance Scheduling, Analysis, Manpower) System, Integrated Management System (IMS), Supervisory Control and Data Acquisition (SCADA) System, Application and Products (SAP), etc.
Operation and maintenance of sewerage system (Mechanical & Electrical)	• Internet of Things (IoT) • System Integration	Training on Integrated Management System (IMS), Facility Management (Maintenance Scheduling, Analysis, Manpower) System, Application and Products (SAP), etc.
Treatment of wastewater (Industrial Effluent Treatment System)	• Cyber Security • System Integration • Internet of Things (IoT)	Training on Integrated Management System (IMS), System Application and Products (SAP) and etc.
Collecting and transporting of septage (Desludging)	• Cloud Computing • Internet of Things (IoT) • Big Data Analytics	Training on Desludging Management System (DMS), Billing, Records and Information System (BRAINS), Big Data Management and etc.
Operation and Maintenance of Sewer Network	• Cloud Computing • Internet of Things (IoT) • Big Data Analytics	Training on Integrated Management System (IMS), Billing, Records and information System (BRAINS), Big Data Management and etc.

For operation and maintenance related to M&E, the Internet of Things (IoT) and System Integration are the emerging technologies that could need new skills to smoothen the M&E related works. Since the M&E involves periodic maintenance and responsive work, thus both skills might help to manage the M&E department properly. This might also facilitate recording the data for maintenance and responsive work so that the historical data could be used for reporting and future reference.

For the treatment of wastewater, Cyber Security, System Integration and the Internet of Things (IoT) are the skills that could encourage advanced technology implementation in industrial wastewater treatment. Since industrial wastewater is not under the responsibility of the sewerage operator, thus each industry had to develop and manage its own Industrial Effluent Treatment System (IETS). Usually, each industry, especially the manufacturing industry, has innovative IETS to treat their effluent. For that, the treatment will be patented with copyright in order to avoid any plagiarism. Therefore, most respondents from the survey think that industries will need a cyber security system to protect their patented IETS. From that, IOT and system integration could also be implemented in IETS without the risk of being plagiarised.

For collecting and transporting septage and operation & maintenance of sewer networks, Cloud Computing, the Internet of Things (IoT), and Big Data Analytics are the skills needed. Conventionally, the work order related to desludging and sewer networking was updated physically without any systems. This might cause a delay in updating and reporting the input data since the works are conducted at sites. Therefore, cloud computing is needed to develop a proper management system so that a smart device can update the data input, work assigned, and reporting daily. Besides, with IOT and Big Data technologies, a one-stop data centre could be developed to facilitate asset management, and historical data could be referred to anytime through a system.

Moreover, since the Sewerage Industry is moving forward to assimilate new skills through new technology, hence responses on the pre-requisite to each job area were also collected. As in Figure 4.13 (section 4.4.3), operation and maintenance related to M&E, sewage treatment plant, treatment of wastewater, desludging and sewer networks show that the technical know-how is the required prerequisite because this skill needs the capability of carrying out maintenance-related activities and inter-disciplinary & generic knowledge about technology. Meanwhile, knowledge about ICT is the less selected prerequisite needed to be in the Sewerage Industry.

5.1.6 **Related Issues in Sewerage Industry**

Table 5.3 summarises the key issues encountered by each job area in Sewerage Industry (also depicted in Figure 4.14 – 4.18 in section 4.4.4). For operation and maintenance related to Mechanical & Electrical, most of the respondents from this area agreed with all

the listed key issues. From the responses, it is found that underpayment of wages is the issue that usually happens among the workers in this area. This might also be the reason for the higher rate of turnover of technician positions. Basically, this issue could be used to motivate workers to be more upskilled. For this, more training should be offered to the workers so that skills possession could be enhanced and a better salary scheme could be given to the skilled worker. Other than that, social skills and values are also significant issues in this area. This might also be due to the lack of non-technical upskilling or reskilling. As sewerage is moving with the emerging technology of IR, non-technical skills related to IR are also important to lift the management and operation of sewerage to more modern practice.

Table 5.3: Summary of Key Issues for Each Job Area

Job Area	**Issues**
Operation and maintenance of sewerage system (Sewage Treatment Plant)	• Underpayment of wages • Social skills and social values
Operation and maintenance of sewerage system (Mechanical & Electrical)	• Insufficient manpower • Lack of youth involvement
Treatment of wastewater (Industrial Effluent Treatment System)	• Low skilled and performance workforce • Insufficient manpower • Underpayment of wages • Reluctancy of knowledge transfer and ICT adoption
Collecting and transporting of septage (Desludging)	• Knowledge transfer problem due to huge gap of seniority in service • Work environment
Operation and Maintenance of Sewer Network	• Underpayment of wages that leads to high turnover rate

For operation and maintenance related to Sewage Treatment Plants, most respondents selected insufficient manpower and lacking youth involvement as the uncomfortable issues in sewage treatment plant operation. Since sewerage is a dangerous, difficult and dirty (3D) industry with a non-conducive working environment, this job has been negatively assumed as a blue-collar class job. Besides, unattractive wages and fringe benefits are also contributing to this issue. Moreover, issues like reluctancy in knowledge transfer and adoption of ICT are also issues that were selected by the respondents in STP operation.

For the treatment of wastewater area, low-skilled and performance workforce, insufficient manpower, underpayment of wages, and the reluctancy of knowledge transfer and ICT adoption are the issues mostly agreed upon by the respondent from this area. The treatment of industrial wastewater is the responsibility of each industry. With the high turnover rate shown by the technical group, as highlighted in the previous section (Section 4.2.2), this might be correlated to the problem of skills mismatch with industry requirements. This also leads to insufficient manpower problems when workers tend to leave the job due to difficulties in conducting the required job responsibilities. Besides, a lack of training facilities and talent management might contribute to these issues.

For the desludging area, the result from the survey indicates that most respondents agreed with issues related to knowledge transfer problems due to the huge gap of seniority in service. This issue might be caused by the unwillingness of senior workers to share and transfer knowledge to the junior worker. Since the junior workers were employed through academic qualifications, thus senior workers assumed that the junior workers also carried sufficient skills to conduct the job responsibilities. Therefore, this might be one of the reasons for the unwillingness of the senior worker. Moreover, less programme that needs senior and junior worker involvement is also rarely organised. Besides that, the work environment is also an issue in the desludging area. Since sewerage is a dangerous, difficult and dirty (3D) industry, the non-conducive working environment is indeed an issue to be faced by the workers every day.

For the operation and maintenance of the sewer network area, respondents agreed that most of the issues in this area are underpayment of wages that lead to high turnover rate. This also reflects a high turnover number in the technical group. This might be due to irrelevant salary and wages scheme offered to the workers, especially the technical group. The mismatch of salary with skills and productivity caused the high tendency of the worker to leave the job. To solve this, more upskilling and reskilling training should be offered so that the workers would be benefited from a reasonable salary scheme and eventually retain the skilled worker that might smoothen the operation and maintenance of the sewer network.

5.1.7 Mapping of Occupational Structure (OS) to National Occupational Skills Standards (NOSS)

As shown in Figure 5.1, there are twelve (12) National Occupational Skills Standards (NOSS) have been developed by the Department of Skills Development (DSD) to suit the identified job titles in OS for Sewerage Industry. These 12 NOSS have been mapped with the job titles identified in OS. This is crucial to avoid any redundancies in the development of NOSS in the future. This might also provide a clear career path according to skills development and encourage sewerage industry players towards career enhancement with technical and non-technical upskilling and re-skilling.

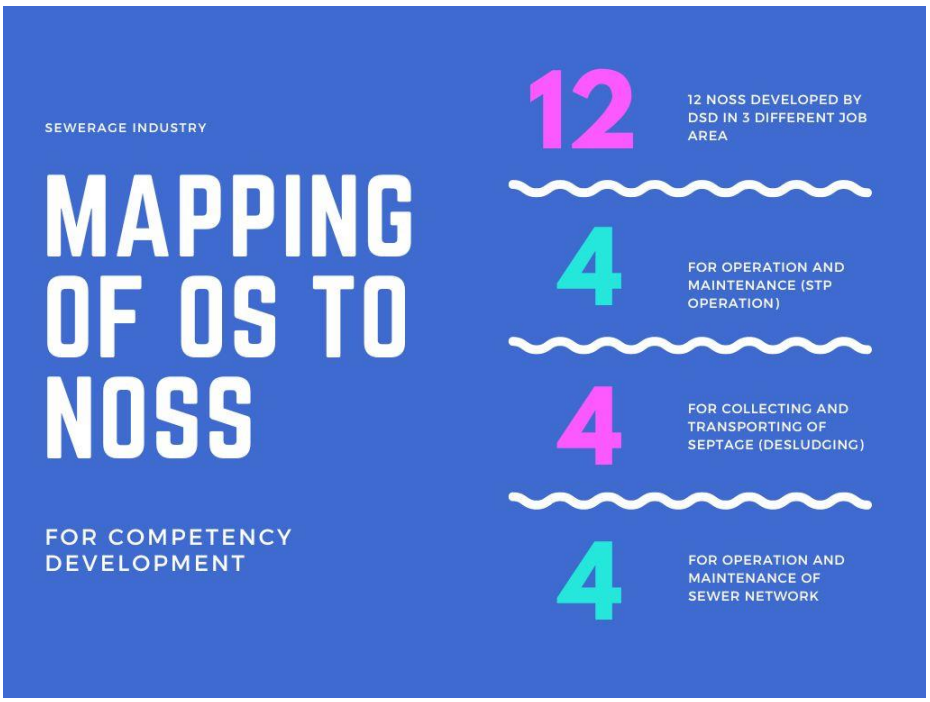


Figure 5.1: Summary of Mapping of OS to NOSS

5.1.8 Occupational Description

Occupational Description (OD) was determined based on the critical jobs that have been identified during the development of OS. ODs of each critical job were arranged by including the statements of responsibilities, knowledge, skills and attributes. Knowledge and skills stated in OD could be used to plan suitable competency training.

Besides, OD also states a more specific description of work for each job title. As identified in OS, the job title uses more generic terms. In order to avoid any confusions and

practicality issues of this Occupational Framework (OF), any specific terms could be included in OD. For area M&E and STP operation, the expert panels have suggested including Network Pump Station (NPS) as related knowledge and skills required by all job titles under these areas to avoid any confusion. Besides, the usual position like tanker and jetter drivers were also specified in OD at the same level as the technician. Therefore, OD is important in providing a self-explanatory description of critical job titles identified in OS.

5.2 Recommendations

Occupational Framework (OF) development is an imperative endeavour by the Department of Skills Development (DSD) for the current and future expansion of Malaysian economics, especially in the Sewerage Industry. For current economic expansion in the Sewerage Industry, referring to the identified job titles associated with MSIC 2008 in this OF, this could lead to occupational re-structuring of an organisation that eventually avoids the mismatching of skills. Besides, an enhancement and advancement plan could be commenced for an organisation to implement knowledge and skills related to IR. For future economic expansion planning, OF development will help encourage the improvement of quality in holistic aspects of the organisation that might lead to the healthy growth of Malaysian economics, especially for the Sewerage Industry. Development of skilled certification could also be empowered to support the economic expansion plan and entice sewerage industries together with Water Services Industry to achieve the aims outlined in policies and initiatives introduced by the government of Malaysia, the Green Technology Master Plan 2017-2030 (GTMP 2017-2030), Sustainable Sewerage Planning & Development for Infrastructure Improvements and Twelfth Malaysia Plan, 2021-2025.

The specific recommendations for Sewerage Industry are listed below:

a) To further streamline the efforts in developing skills for all job areas in the Sewerage Industry in line with the findings of this OF. This includes the development of NOSS for identified job titles in each job area.
b) To have more training and courses at the accredited training centre or provider related to each job area in Sewerage Industry.
c) To enhance training programmes that cover non-technical aspects, including implementing IR like the Internet of Things (IoT), Big Data Analytics, Cyber Security and System Integration.

d) To promote knowledge and skills exchange among industry players. This might also indirectly attract new talent to join Sewerage Industry.
e) To collaborate with educational institutes to develop training curriculum and syllabus matching the industry and stakeholder requirements.
f) To implement advanced systems in operation and management.
g) To provide more upskilling and reskilling training programmes for the workers to benefit from reasonable salary schemes and eventually attract local workers and youngsters to join Sewerage Industry.

5.3 Conclusion

The conclusion based on the specified objectives of the OF is elaborated below:

Objective 1: To develop an Occupational Structure (OS) in the Sewerage Industry based on MSIC 2008.

From the FGD session, the OS was developed according to five (5) job areas that have been identified to be associated with the 'Include" item of 37000 Sewerage and similar activities of Division 37 Sewerage as classified in MSIC 2008. There are 33 job titles identified for the Sewerage Industry. The highest skill qualification level for each job area is level 7, which is Senior Technical Manager, and the lowest is level 1, which is a general worker. Meanwhile, the rest job titles, like operator, technician, supervisor, executive and technical manager, were identified to suit levels 2 to 7 for each job area. No job is identified in level 8 because the skills related to developing original understanding have not been established since the Sewerage Industry in Malaysia is applying technology from other countries.

Objective 2: To determine the critical jobs in the sewerage industry.

From the developed OS, there are 30 job titles specified as critical jobs, which are in the MOSQF level range of 2 to 7. These critical jobs were identified based on factors like qualification, knowledge, skills, working nature, recruitment and many others. The mismatching of qualifications led to the unproductivity of workers since the skills and knowledge could limit workers' ability to perform job functions. Besides, without a proper salary scheme, some of the jobs in the Sewerage Industry will not be selected as careers, which leaves a bad perception that leads to an increase in turnover rate. Therefore, some

strategies like providing upskilling and reskilling training to improve the skills possession of the worker so that benefits like proper salary scheme could be introduced. Moreover, matching the knowledge and skills with specified job titles must be outlined in order to mitigate such concerning problems.

Objective 3: To determine the job titles for the sewerage industry that is relevant to Industrial Revolution (IR).

From a thorough discussion among the expert panels in the Sewerage Industry, 23 job titles were specified to relate to IR. The skills related to IR will bring this industry to go towards modernization and digitalisation. This will direct to a healthy organisational expansion by increasing productivity, effectiveness and efficiency. Quantitively, it was determined by more than 60 respondents that the Internet of Things (IoT), Big Data Analytics, System Integration, Cloud Computing and Cyber Security are the related emerging skills that are required in implementing IR in Sewerage Industry. The summary of IR-related emerging skills for the Sewerage Industry is summarised in Figure 5.2.

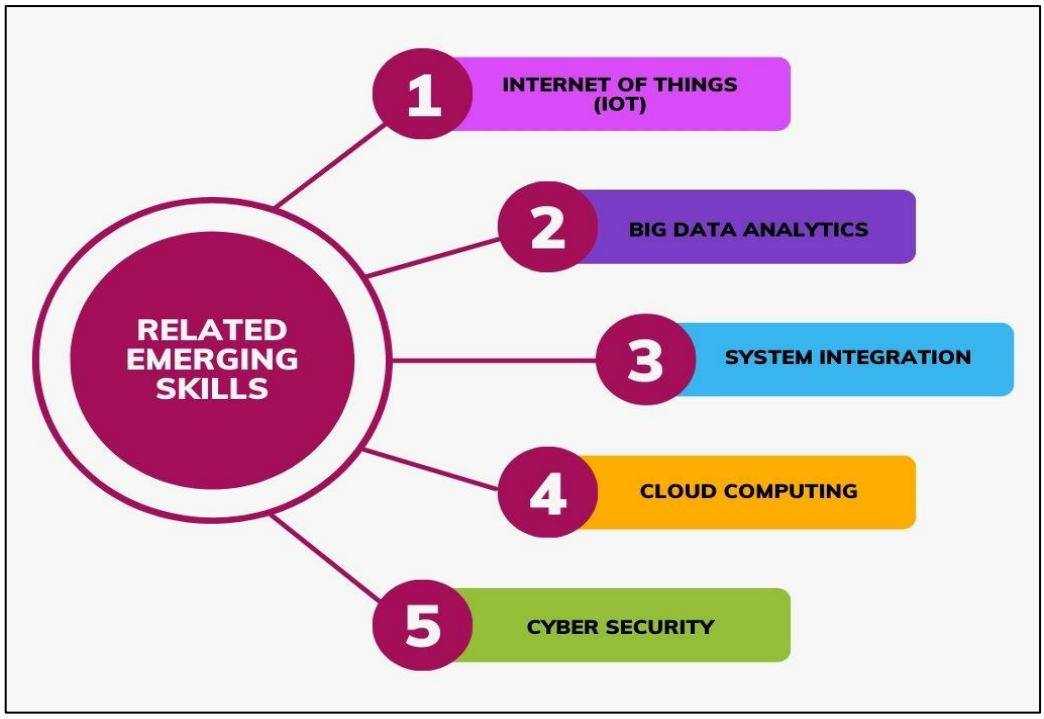


Figure 5.2: Summary of IR Related Emerging Skills for the Sewerage Industry

Objective 4: To determine the skills in demand of the sewerage industry.

Determination of required competencies skills will overcome the limitation to fulfilling the requirement of a demanding occupation. For worker improvement, competency upskilling, together with knowledge enhancement, is also required. In the FGD sessions, some skills and knowledge required in the Sewerage Industry have been determined, like knowledge of sewerage operation, maintenance, language, IT literacy, troubleshooting, analytical and many others. Moreover, it was also quantitatively determined by 90% of the respondents that competency skills considered as demanded by all levels of job titles are related to strong technical aptitude (natural ability) / manual dexterity (hands-on) and general attitude towards work (Commitment, resourcefulness, teamwork, etc.).

Objective 5: To determine Occupational Descriptions (OD) of the sewerage industry for critical jobs based on developed OS.

Occupational descriptions for critical jobs were determined based on the developed OS and Occupational Responsibilities (OR). There are 30 ODs for the job titles categorised as critical by the expert panels from the Sewerage Industry and were described according to responsibilities, knowledge, skills and attribute with regard to attitude, safety and environment. The description of the critical job titles is crucial to ensure the qualification for promotion and recruitment will be conducted correctly and directly overcome the knowledge and skills mismatching issue. Besides, the complete OF with information in regard to OS, demanding skills, critical job titles, IR-related job titles and sufficient description of the critical job will fulfil the needs and requirements of stakeholders. Eventually, the correct career path will be identified, and the required training curriculum for developing skilled personnel in Sewerage Sector can be planned.

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ANNEX 1: MOSQF LEVEL DESCRIPTORS

Malaysian Occupational Skills Qualification Framework (MOSQF) Level Descriptor

(Source: Department of Skills Development)

Level	Level Descriptors
8	Achievement at this level reflects the ability to develop original understanding and extend a sub-area of knowledge or professional practice. It reflects the ability to address problematic situations that involve many complexes, interacting factors through initiating, designing and undertaking research, development or strategic activities. It involves the exercise of broad autonomy, judgement and leadership in sharing responsibility for the development of a field of work or knowledge, or for creating substantial professional or organisational change. It also reflects a critical understanding of relevant theoretical and methodological perspectives and how they affect the field of knowledge or work.
7	Achievement at this level reflects the ability to reformulate and use relevant understanding, methodologies and approaches to address problematic situations that involve many interacting factors. It includes taking responsibility for planning and developing courses of action that initiate or underpin substantial change or development, as well as exercising broad autonomy and judgment. It also reflects an understanding of theoretical and relevant methodological perspectives, and how they affect their sub-area of study or work.
6	Achievement at this level reflects the ability to refine and use relevant understanding, methods and skills to address complex problems that have limited definition. It includes taking responsibility for planning and developing courses of action that are able to underpin substantial change or development, as well as exercising broad autonomy and judgment. It also reflects an understanding of different perspectives, approaches of schools of thought and the theories that underpin them.
5	Achievement at this level reflects the ability to identify and use relevant understanding, methods and skills to address broadly-defined, complex problems. It includes taking responsibility for planning and developing courses of action as well as exercising autonomy and judgment within broad parameters. It also reflects understanding of different perspectives, approaches or schools of thought and the reasoning behind them.
4	Achievement at this level reflects the ability to identify and use relevant understanding, methods and skills to address problems that are well defined but complex and non-routine. It includes taking responsibility for overall courses of action as well as exercising autonomy and judgment within fairly broad parameters. It also reflects under-standing of different perspective or approaches within a sub-area of study or work.
3	Achievement at this level reflects the ability to identify and use relevant understanding, methods and skills to complete task and address problems that

Level	Level Descriptors
	are well defined with a measure of complexity. It includes taking responsibility for initiating and completing tasks and procedures as well as exercising autonomy and judgments within limited parameter. It also reflects awareness of different perspectives or approaches within a sub-area of study or work.
2	Achievement at this level reflects the ability to select and use relevant knowledge, ideas, skills and procedures to complete well-defined tasks and address straightforward problem. It includes taking responsibility for completing tasks and procedures, and exercising autonomy and judgment subject to overall direction or guidance.
1	Achievement at this level reflects the ability to use relevant knowledge, skills and procedures to complete routine and predictable tasks that include responsibility for completing tasks and procedures subject to direction or guidance.

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NO.	NAME	POSITION	ORGANISATION
1.	Dr. Ghalip bin Spahat	Director	Department of Skills Development (DSD)
2.	Dr. Zool Hilmi bin Mohamed Ashari	Deputy Director	Department of Skills Development (DSD)
3.	Ts. Dr. Suhaila binti Ali	Deputy Director	Department of Skills Development (DSD)
4.	Dr. Norhuda binti Salim	Head of Programme Skills Instructor Development Programme (PPK)	Centre of Instructors and Advanced Skills Training (CIAST)
5.	Ts. Dr. Wan Nasarudin bin Wan Jalal	Principal Assistant Director (Policy Coordination)	Department of Skills Development (DSD)
6.	Dr. Khuzainey binti Ismail	Senior Assistant Director (Policy Planning 2)	Department of Skills Development (DSD)
7.	Dr. Fairus Atida binti Said	Senior Assistant Director (SLDN Assessment)	Department of Skills Development (DSD)
8.	Dr. Nor Salwa binti Hamdan	Senior Assistant Director (SLaPB Accreditation)	Department of Skills Development (DSD)
9.	Ts. Dr. Norhayati binti Yahaya	Head of Unit (Competencies Advancement and Quality Assurance) Skills Professional Development (SPD) Programme	Centre of Instructors and Advanced Skills Training (CIAST)
10.	Ts. Dr. Nurul Amin bin Badrul	Head of Unit (Research and Innovation)	Centre of Instructors and Advanced Skills Training (CIAST)
11.	Dr. Saidi bin Zain	Innovation Coordinator Research and Innovation Unit	Centre of Instructors and Advanced Skills Training (CIAST)

LIST OF DEPARTMENTS OF SKILLS DEVELOPMENT (DSD) OFFICERS INVOLVED IN OCCUPATIONAL FRAMEWORK DEVELOPMENT FOR SEWERAGE INDUSTRY

NO.	NAME	POSITION	ORGANISATION
1.	Khadijah Binti Isaak	Principal Assistant Director	Department of Skills Development (DSD)
2.	Ahmad Azran bin Ranaai	Senior Assistant Director	Department of Skills Development (DSD)
3.	Noor Azura bin Adnan	Senior Assistant Director	Department of Skills Development (DSD)
4.	Nazrul Hilmi bin Mohammad	Senior Assistant Director	Department of Skills Development (DSD)
5.	Ts. Nor Aini Binti Abdullah	Senior Skills Development Officer	Department of Skills Development (DSD)
6.	Yuhazreen Bin Yusof	Skills Development Officer	Department of Skills Development (DSD)

LIST OF WORKFORCE TEAMS IN OCCUPATIONAL FRAMEWORK DEVELOPMENT FOR SEWERAGE INDUSTRY

NO.	NAME	POSITION	ORGANISATION
1.	Ts. Ah Faezal Husni Bin Arshad	Project Director	PFH Resources (M) Sdn. Bhd.
2.	Ts. Dr. Zulkifli Mohd Sidi	Lead Researcher	PFH Resources (M) Sdn. Bhd.
3.	Akhsan Kamil Azizi Bin Lokman Hakim	Project Executive	PFH Resources (M) Sdn. Bhd.
4.	Dr. Mohd Razealy Anuar	Researcher	PFH Resources (M) Sdn. Bhd.
5.	Ahmad Ramdan bin M. Yusof	Assistant Researcher	PFH Resources (M) Sdn. Bhd.
6.	Ahmad Hayaton Jamely Salehuddin	Assistant Researcher	PFH Resources (M) Sdn. Bhd.
7.	Fatin Nadia binti Mahmud	Proof-reader Team	PFH Resources (M) Sdn. Bhd.

ANNEX 3: QUESTIONNAIRE

PFH Resources (M) Sdn. Bhd.

&

Jabatan Pembangunan Kemahiran (JPK)

Ministry of Human Resources

E37 – Sewerage Industry

Occupational Framework Survey

The Department of Skills Development (DSD), Ministry of Human Resources is currently conducting an analysis on the Occupational Framework (OF) of the Industry. From this analysis, the industry framework, occupational structure, occupational job titles, and job description will be summarised for the use of the government, private sector, investors, employers, employees, educators or any personnel involved either directly or indirectly with the industry.

The main objectives of this research is to:

1. Determine the skills in demand in Sewerage Industry;
2. Determine the Job Titles in Sewerage Industry;
3. Determine the critical jobs in Sewerage Industry; and
4. Determine related current & future issues in Sewerage Industry.

It will also provide a reference competency for skills required by workers to perform as required in the industry.

This survey will be used as field data in order to conduct a comprehensive analysis of the industry's Occupational Framework (OF). The target group for this survey is the organisation's representative either from the Human Resource Department or personnel at Management level.

We would like to extend our heartfelt gratitude upon your cooperation in answering this survey. Please fill in where necessary in the forms provided. There will be further communication with survey respondents in order to verify our findings. We are also subject to Act 709 where all personal information and data relating to the respondents are **CONFIDENTIAL**. All the given information and finding of the study are Malaysian Government property enabling the planning of the TVET development and reflects to national economy.

Survey Respondent Details

Name :…….

Position :..……

Organisation :……

Date :

Please answer the questions below in the space provided, additional pages may be added if necessary.

There are 5 Sections in these 9 pages survey.

SECTION 1: CRITICAL JOB CLASSIFICATION

1.1 Which of the classification is your **core sewerage jobs scope**?

(can ✓ more than once)

a. Operation and maintenance (mechanical & electrical). ☐

b. Operation and maintenance (Sewage Treatment Plant). ☐

c. Treatment of wastewater. ☐

d. Collecting and transporting septage (Desludging). ☐

e. Maintenance and operation of sewer network. ☐

1.2 Which of the job title requires a certain set of skills that are hard to fill in your industry? (can ✓ more than once)

a. Technical Manager ☐

b. Executive ☐

c. Supervisor ☐

d. Technician ☐

f. Operator ☐

1.3 Which of the job title is required for the **smooth operation** in your industry? (✓ once only)

a. Technical Manager ☐

b. Executive ☐

c. Supervisor ☐

d. Technician ☐

f. Operator ☐

1.4 Which of the job title is highly pursued by the employee/future employee in your industry? (✓ once only)

a. Technical Manager ☐

b. Executive ☐

c. Supervisor ☐

d. Technician ☐

f. Operator ☐

1.5 Which job title has the highest turnover rate in your industry? (✓ once only)

a. Technical Manager	
b. Executive	
c. Supervisor	
d. Technician	
e. Driver	
f. Operator	

SECTION 2: OCCUPATIONAL QUALIFICATION

2.1 Which of the occupational qualification competency description needed to your organisation?

a.	Competent performing a range of varied, routine, and predictable activities	
b.	Competent performing significant range of varied, non-routine, responsibility and autonomy activities.	
c.	Competent performing varied, complex, non-routine, responsibility, autonomy & guidance of others required	
d.	Competent performing complex technical/professional with a substantial degree of personal responsibility & autonomy	
e.	Competent applying a fundamental principles & complex technique across a wide & often unpredictable contexts. Very substantial personal autonomy & personal accountabilities for analysis, diagnosis, planning, execution & evaluation	
f.	Competent performing in reflection of ability to refine & relevant understanding/methods/skills to address complex problems, includes able to underpin substantial change/development & exercising broad autonomy & judgement.	
g.	Competent performing to reformulate & use relevant understanding/methods/skills to address problematic situations including responsibility for planning & developing activities. Also reflects of theoretical & relevant methodological perspective & area of work.	
h.	Competent performing to develop original understanding & extend an area of knowledge/professional practice. Involves the exercise of broad autonomy, judgement and leadership in sharing responsibility for development a field of work or knowledge, reflects a critical understanding of relevant theoretical & methodological perspective and how they affect the field of knowledge or work.	

2.2 Which of the **academic critical qualifications** to be met in the **Sewerage Industry**? (✓ once only)

a.	Certificate	
b.	Diploma	
c.	Degree	
d.	Master	
e.	Ph.D	

2.3 Which of the **Technical & Vocational critical qualifications** to be met in the **Sewerage Industry**? (✓ once only)

a.	Certificate	
b.	Skill Diploma (Technical/Skill Colleges)	

c.	Skill Advanced Diploma (Technical/Skill Colleges)	
d.	Others ……..	

SECTION 3: SKILLS IN DEMAND

Listed below are set of skill categories related to personnel involve in **Sewerage Industry**. Rate the level of demand to the set of skills by using the Likert scale below:

Level	Job Title
Management	Technical Manager and Executive
Technical	Supervisor, Technician and Operator
General	General Workers

No	Competency	Management	Technical	General
a	Sewerage system knowledge			
b	Operation costing			
c	Raw material & procurement			
d	Operation & Maintenance			
e	Service/System operation			
f	Quality assurance – system			
g	General attitude towards work (Commitment, resourcefulness, teamwork, etc.)			
h	Competent in IT literacy			
i	Troubleshooting / problem solving skills			
j	Communication & Interpersonal skills			
k	Strong technical aptitude (natural ability) / manual dexterity (hands-on)			
l	Competent in using electronic or mechanical devices and tools			
m	English language competency			

n	Accounting skills			
o	Technopreneur skills			
p	Analytical skills			
q	Mechanical & Electrical skills			
r	Green technology skills			

3.1 Based on your observation, do you think the workers possess the skills required by the **Sewerage Industry**?

[__] Yes

[__] No

3.2 What is/are the reason/s for the skills gap? Tick (✓) where applicable, may (✓) more than once.

	Education / training mismatch	Lack of guidance for future career path	
	Major changes in traditional training & new skill requirements	Insufficient salary	
	Attitude (e.g. lack of desire to work)	Lack of staff welfare (personal & family insurance, annual leave etc.)	
	Gap between technology and skills	Lack of motivation	
	Lack of knowledge	Lack of communication in team	
	Lack of opportunities for hands-on	Attitude	
	Not willing to take new challenge	Others, please specify: …….	

3.3 What is/are solution/s for the skills gap would you recommend? Tick (✓) where applicable, may (✓) more than once.

	Workload management	Upskill modules and approaches	
	Upgrade trainer qualification	Formal mentoring and/or coaching	
	Review employment policy (e.g., enhance skilled workers incentives)	Upskilling / reskilling	
	Professional CPD/CEP	Continuous learning	
	Training / retraining	Increase salary and emoluments (bonus, allowance, promotion)	
	Review skills training curriculum	Consequence Management	
	On job training	Others, please specify: …….	
	Acknowledgement & recognition		

SECTION 4: EMERGING SKILLS

(Note: Emerging Skills are skills that are predicted to be imperative to the industry in the near future based on recent development, trend or study)

4.1 Do you think Industry Revolution (IR) (eg. Digitalization) would give an impact to the economic activities of **Sewerage Industry**?

[__] Yes

[__] No

[__] Not sure

4.2 Listed below are the 11 technology drives/pillars of IR.

Which **Sewerage Industry** job area is likely to be affected by these IR? Tick (✓) where applicable, may (✓) more than once.

No.	TECHNOLOGY DRIVES / PILLARS	JOB AREAS				
		Operation and maintenance (Mechanical & Electrical)	Operation and maintenance (Sewage Treatment Plant)	Treatment of wastewater.	Collecting and transporting septage (Desludging)	Operation and maintenance of sewer network
a	**Autonomous Robots** (coordinated and automated actions of robots to complete tasks intelligently, with minimal human input)					
b	**Big Data Analytics** (the analysis of ever larger volumes of data. Circulation, collection, and analysis of information is a necessity because it supports productivity growth based on a real-time decision-making process)					
c	**Cloud Computing** (storing and accessing data and programs over the Internet instead of your computer's hard drive)					
d	**Internet of Things (IoT)** (all machines and systems connected to the production plant (as well as other systems) must be able to collect, exchange and save these massive volumes of information, in a completely autonomous way and without the need of human intervention)					

e	**Additive Manufacturing (3D Printing)** (use in prototyping, design iteration and small-scale production and often described as "rapid prototyping" - produce the desired components faster, more flexibly and more precisely than ever before)					
f	**System Integration** (the process of linking together different computing systems and software applications physically or functionally to act as a coordinated whole via Internet of Things-IoT)					
g	**Cybersecurity** (with the increased connectivity and use of standard communications protocols, the need to protect critical industrial systems and manufacturing lines from cybersecurity threats is increasing)					
h	**Augmented Reality** (Augmented-reality-based systems support a variety of services, such as selecting parts in a warehouse and sending repair instructions over mobile devices - provide workers with real-time information to improve decision making and work procedures)					

i	**Simulation** (simulations will leverage real-time data to mirror the physical world in a virtual model, which can include machines, products, and humans. This allows operators to test and optimize the machine settings for the next product in line in the virtual world before the physical changeover, thereby driving down machine setup times and increasing quality)					
j	**Horizontal and Vertical Integration** Horizontal: Integrate through network & value chain from Suppliers, the company itself, and the customers. Vertical: Integrate through network & value chain across functional department i.e., Sales, R&D, Procurement until customer services					

k	**New Business Models** (Business model is a combination of two functions: the process of value creation and the process of value capture. The process of value creation refers to the process of creating value for the target consumer. The process of value capture refers to converting market opportunities into performance outcomes for the firm, which then justifies value creation)					

List of important prerequisite and skills required in order to equip the workforce for IR.

The description of important pre-requisite and skills for workforce in the age of IR published in Skill Development for Industry Revolution, Whitepaper by *Roland Berger GMBH in 2016.*

Prerequisite & Skills	**Knowledge About ICT**	**Ability to Work with Data**	**Technical Know-How**	**Personal Skills**
Details	▪ Basic Information Technology Knowledge ▪ Ability to Use and Interact with Computers And Smart Machines Like Robots, Tablets Etc. ▪ Understanding Machine to Machine Communication, It Security & Data Protection	▪ Ability to Process and Analyze Data and Information Obtained from Machines ▪ Understanding Visual Data Output & Making Decisions ▪ Basic Statistical Knowledge	▪ Inter-Disciplinary & Generic Knowledge About Technology ▪ Specialized Knowledge About Warehouse and Storage Activities and Processes in Place ▪ Technical Know-How of Machines to Carry Out Maintenance Related Activities	▪ Adaptability & Ability to Change ▪ Decision Making ▪ Working in Team ▪ Communication Skills ▪ Mindset Change for Lifelong Learning

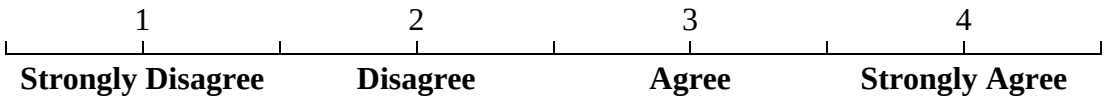
4.3 Select prerequisite and skills that are relevant to the job area. Tick (✓) where applicable, may (✓) more than once

	Job Areas	**IMPORTANT PREREQUISITE AND SKILLS FOR IR4.0**			
		Knowledge About ICT (KA)	**Ability to Work with Data (AW)**	**Technical Know-How (TK)**	**Personal Skills (PS)**
a	Operations and Maintenance of sewerage system (Mechanical & Electrical)				
b	Operations and Maintenance of sewerage system (Sewage Treatment Plant)				
c	Treatment of wastewater				
d	Collecting and transporting septage (Desludging)				
e	Operation and maintenance of sewer network				

SECTION 5: RELATED ISSUES

5.1 What is/are the key issue/s related to **Sewerage Industry**?

Please rate **ALL** the key issues by using the Likert scale below.



No	KEY ISSUES	JOB AREAS				
		Operation and maintenance (Mechanical & Electrical)	Operation and maintenance (Sewage Treatment Plant)	Treatment of wastewater.	Collecting and transporting septage (Desludging)	Operation and maintenance of sewer network
a	Insufficient manpower					
b	Low skilled & low performance workforce					
c	High dependency on foreign labour					
d	Underpayment of wages lead to high turn over					
e	Quality inconsistency					

	(product & services)					
f	Maintaining profitability					
g	Economic conditions					
h	Government policy/regulation					
i	Labour costs (sub-contractors)					
j	Technological change					
k	Youth Involvement (Dangerous, Difficult, Dirty (3D) industry)					
l	Lack of infrastructure support					
m	Poor facilities and amenities for worker					
n	Contract extension issues					
o	Work environment					
p	High risk job					
q	Health issues					
r	Reluctancy of skilled worker to extend services					

s	Knowledge transfer problem due to huge gap of seniority in service					
u	Reluctancy to adopt in ICT application					
v	Reluctant in knowledge transfer (insecure)					
w	Social Skills & Social Values					
x	Public perception for credible career prospect					
y	Adoption of modern and green technology					
z	Regulatory requirement					

End of Questionnaire

ANNEX 4: LIST OF CRITICAL JOB TITLES

No	Critical Job Title	Area	Level
1	Senior Mechanical & Electrical Technical Manager	Operation and maintenance of sewerage system (Mechanical & Electrical)	7
2	Mechanical & Electrical Technical Manager	Operation and maintenance of sewerage system (Mechanical & Electrical)	6
3	Mechanical & Electrical Executive	Operation and maintenance of sewerage system (Mechanical & Electrical)	5
4	Mechanical & Electrical Supervisor	Operation and maintenance of sewerage system (Mechanical & Electrical)	4
5	Mechanical & Electrical Technician	Operation and maintenance of sewerage system (Mechanical & Electrical)	3
6	Mechanical & Electrical Operator	Operation and maintenance of sewerage system (Mechanical & Electrical)	2
7	Senior Treatment Technical Manager	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	7
8	Treatment Technical Manager	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	6
9	Treatment Executive	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	5
10	Treatment Supervisor	Operation and maintenance of sewerage system	4

No	Critical Job Title	Area	Level
		(Sewage Treatment Plant Operation)	
11	Treatment Technician	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	3
12	Treatment Operator	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	2
13	Senior Treatment Technical Manager (Environmental Officer)	Treatment of wastewater	7
14	Treatment Technical Engineer	Treatment of wastewater	6
15	Treatment Executive	Treatment of wastewater	5
16	Treatment Supervisor	Treatment of wastewater	4
17	Treatment Technician	Treatment of wastewater	3
18	Treatment Operator	Treatment of wastewater	2
19	Senior Desludging Technical Manager	Collecting and transporting septage (Desludging)	7
20	Desludging Technical Manager	Collecting and transporting septage (Desludging)	6
21	Desludging Executive	Collecting and transporting septage (Desludging)	5
22	Desludging Senior Supervisor	Collecting and transporting septage (Desludging)	4
23	Desludging Field Supervisor	Collecting and transporting septage (Desludging)	3

No	Critical Job Title	Area	Level
24	Desludging Operator	Collecting and transporting septage (Desludging)	2
25	Senior Network Technical manager	Operation and Maintenance of Sewer Network	7
26	Network Technical Manager	Operation and Maintenance of Sewer Network	6
27	Network Executive	Operation and Maintenance of Sewer Network	5
28	Network Supervisor	Operation and Maintenance of Sewer Network	4
29	Network Technician	Operation and Maintenance of Sewer Network	3
30	Network Operator	Operation and Maintenance of Sewer Network	2

ANNEX 5: JOB TITLES RELEVANT TO INDUSTRIAL REVOLUTION

No	Critical Job Title	Area	Level
1	Senior Mechanical & Electrical Technical Manager	Operation and maintenance of sewerage system (Mechanical & Electrical)	7
2	Mechanical & Electrical Technical Manager	Operation nd maintenance of sewerage system (Mechanical & Electrical)	6
3	Mechanical & Electrical Executive	Operation and maintenance of sewerage system (Mechanical & Electrical)	5
4	Mechanical & Electrical Supervisor	Operation and maintenance of sewerage system (Mechanical & Electrical)	4
5	Mechanical & Electrical Technician	Operation and maintenance of sewerage system (Mechanical & Electrical)	3
6	Senior Treatment Technical Manager	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	7
7	Treatment Technical Manager	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	6

8	Treatment Executive	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	5
9	Treatment Supervisor	Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)	4
10	Senior Treatment Technical Manager (Environmental Officer)	Treatment of wastewater	7
11	Treatment Technical Engineer	Treatment of wastewater	6
12	Treatment Executive	Treatment of wastewater	5
13	Treatment Supervisor	Treatment of wastewater	4
14	Senior Desludging Technical Manager	Collecting and transporting septage (Desludging)	7
15	Desludging Technical Manager	Collecting and transporting septage (Desludging)	6
16	Desludging Executive	Collecting and transporting septage (Desludging)	5
17	Desludging Senior Supervisor	Collecting and transporting septage (Desludging)	4

18	Desludging Field Supervisor	Collecting and transporting septage (Desludging)	3
19	Senior Network Technical manager	Operation and Maintenance of Sewer Network	7
20	Network Technical Manager	Operation and Maintenance of Sewer Network	6
21	Network Executive	Operation and Maintenance of Sewer Network	5
22	Network Supervisor	Operation and Maintenance of Sewer Network	4
23	Network Technician	Operation and Maintenance of Sewer Network	3

ANNEX 6: OCCUPATIONAL DESCRIPTION (OD)

SECTION : (E) WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES

DIVISION : (37) SEWERAGE

GROUP : (370) SEWERAGE

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Senior Mechanical & Electrical Technical Manager

LEVEL : 7

Responsibility

Senior Mechanical & Electrical Technical Manager provides technical direction for development, design and integration on the operation of the sewerage systems or the sewage treatment facilities. They are responsible to establish, plan, advise, monitor and review the mechanical and electrical works in the organisation to meet the performance standard and targeted level of service.

Knowledge:

- Sewerage and Network Pumping Station (NPS) system operation planning.
- Technical knowledge in Sewerage and Network Pumping Station (NPS) electrical system (Circuit, panel switchgear, circuit breaker, starter, and other related tools).
- Technical knowledge in sewerage and Network Pumping Station (NPS) mechanical system (mechanical drawing, installation, pump system, equipment, and other related system).
- M&E Facility management system.
- Human resource management (labour law, industrial relation act, SOCSO/EPF, and training).
- Integrated management system (IMS).
- Technical knowledge in plant M&E installation process and its standard requirement.
- Quality management system/ ISO.
- Business development analysis.
- Budget management.
- Environmental management system (scheduled waste).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Effective problem-solving and decision-making skills
- Well-verse in ISO integrated management system
- Develop a plan and implement financial management
- Well-versed in the procurement procedure.
- Ability to coordinate with the government and other related parties.
- Ability to coordinate M&E activities.
- Proficient in computer skills and related software.

Attributes (Attitude/Safety/Environmental):

- Adhere to Health, Safety & Environment (HSE) regulations and policy.
- Develop teamwork concept.
- Demonstrate the strong value of leadership.
- Demonstrate good communication.
- A clear vision to the team members
- Ability to make sustainable decisions and problem-solving

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Mechanical & Electrical Technical Manager

LEVEL : 6

Responsibility:

A Mechanical & Technical Manager is responsible to lead, manage, implement and coordinate the operation and maintenance of the sewerage system in M&E section related operations in order to meet the required performance standard and target level of service.

Knowledge:

- Sewerage system and Network Pumping Station (NPS) operation planning.
- Technical knowledge in sewerage and Network Pumping Station (NPS) electrical system (Circuit, panel switchgears, circuit breaker, starter, and other related tools).
- Technical knowledge in sewerage and Network Pumping Station (NPS) mechanical system (mechanical drawing, installation, pump system, equipment, and other related system).
- Human resource management (labour law, industrial relation act, SOCSO/EPF, and training).
- M&E Facility management.
- Integrated management system (IMS).
- Quality management system/ ISO.
- Business development analysis.
- Budget and tender management.
- Environmental management system (scheduled waste).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Presentation skills
- Leadership skills
- Team coordination
- Technical skills in mechanical and electrical.

Attributes (Attitude/Safety/Environmental):

- Ability to communicate effectively.
- Possess good leadership.
- Demonstrate the strong value of integrity.
- Demonstrate the strong value of leadership.
- Ability to make sustainable decisions and problem solving.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Mechanical & Electrical Executive

LEVEL : 5

Responsibility:

A Mechanical & Electrical Executive is responsible to organise, monitor and ensure the M&E operations meets the performance standard and targeted level of service.

Knowledge:

- Sewerage system and Network Pumping Station (NPS) operation planning.
- Technical knowledge in sewerage and Network Pumping Station (NPS) electrical system (Circuit, panel switchgears, circuit breaker, starter and other related tools).
- Technical knowledge in sewerage and Network Pumping Station (NPS) mechanical system (mechanical drawing, installation, pump system, equipment and other related system).
- Basic knowledge in human resource management (labour law, industrial relation act, SOCSO/EPF, and training).
- M&E Facility management.
- Environmental management system.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.
- Sewerage service act and regulation.
- Basic knowledge of finance and procurement processes.

Skills:

- Leadership skills
- Documentation skills
- Communication skills.
- Time management skills
- Motivation and self-empowerment skills

- Critical thinking skills
- Problem-solving skills
- Technical skills in Mechanical and electrical.

Attributes (Attitude/Safety/Environmental):

- Ability to work as a part of a team.
- Communicate with the other team members.
- Ability to persuade subordinates.
- Ability to execute a directive.
- Demonstrate a strong value of integrity.
- Ability to make sustainable decisions and problem-solving.
- Adhere to safety, health, and environmental regulations.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Mechanical & Electrical Supervisor

LEVEL : 4

Responsibility:

A Mechanical & Electrical Supervisor is responsible to implement and supervise the M&E teams and execute the M&E operations and maintenance work to meet the required performance standard and targeted level of service.

Knowledge:

- Mechanical system (motor, pumping system, aeration system, surge suppression system, vacuum system etc.).
- Electrical system (circuit, earthing and lighting, circuit drawing, electrical motor, etc.).
- Basic sewerage system and Network Pumping Station (NPS) function.
- Installation procedure, testing and commissioning of electric panels.
- Basic understanding of the sewerage service act.
- Supervisory control (work order, team coordination, work permit).
- Safety and health regulation and act.
- Environment quality act and regulation.

Skills:

- Technical skills in mechanical and electrical
- Teamwork skills
- Motivation and self-empowerment skills
- Analytical skills
- Critical thinking and strategic problem-solving skills
- Effective communication skills
- Time management skills
- Leadership skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Mechanical & Electrical Technician

LEVEL : 3

Responsibility:

A Mechanical & Electrical Technician is responsible to conduct and report the M&E responsive and maintenance work to meet the required performance standard and targeted level of service.

Knowledge:

- Sewerage and Network Pumping Station (NPS) mechanical system (motor, pumping system, aeration system, surge suppression system, vacuum system etc.).
- Sewerage and Network Pumping Station (NPS) electrical system (circuit, earthing and lighting, circuit drawing, electrical motor, etc.).
- Basic understanding of sewerage system and facility.
- Repair and servicing of electrical and mechanical equipment.
- Installation and periodic maintenance of M&E equipment.
- Safety and health act & regulation.

Skills:

- Motivation and self-empowerment skills.
- Teamwork skills
- Communication skills
- Analytical skills
- Technical skills in mechanical and electrical

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate good communication with other team members/supervisor.
- Demonstrate the strong value of integrity.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Mechanical & Electrical)

JOB TITLE : Mechanical & Electrical Operator

LEVEL : 2

Responsibility:

A Mechanical & Electrical Operator is responsible to carry out and assist for M&E operation and maintenance work in order to achieve the required performance standard and targeted level of service.

Knowledge:

- Sewerage and Network Pumping Station (NPS) mechanical system (motor, pumping system, aeration system, surge suppression system, vacuum system etc.).
- Sewerage and Network Pumping Station (NPS) electrical system (circuit, earthing and lighting, circuit drawing, electrical motor, etc.).
- Basic understanding of sewerage system and facility.
- Basic understanding of repair and service of electrical and mechanical equipment.

Skills:

- Communication skill
- Technical skills in mechanical and electrical
- Teamwork skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Ability to work as part of a team.
- Demonstrate good communication with team members.
- Demonstrate the strong value of integrity.
- Adhere to safety, health and environmental regulation.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Senior Treatment Technical Manager

LEVEL : 7

Responsibility:

A Senior Treatment Technical Manager is responsible to established, plan, monitor, advice and report the operation and maintenance for sewage treatment plant in the organisation to meet the required performance standard and targeted level of service.

Knowledge:

- Sewage Treatment plant and Network Pumping Station (NPS) operation process.
- Technical understanding in troubleshooting and process control of sewage treatment and Network Pumping Station (NPS).
- Personnel Human Resources management (labour law, industrial relation act, SOCSO/EPF, and training).
- Knowledge in Financial and budgeting management.
- Integrated management system (IMS) and Quality management system (ISO).
- Technical knowledge of the STP installation process and its standard requirement.
- Business development analysis.
- Environmental management system (scheduled waste).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Decision making skills
- Complex problem solving
- Critical thinking skills
- Problem-solving skills
- Presentation skills

- Communication skills
- Team Coordination
- Technical skill in the sewage treatment process
- Time management skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Adhere to Health, Safety & Environment (HSE) regulations and policy.
- Ability to communicate effectively.
- Demonstrate the strong value of leadership.
- Demonstrate the strong value of integrity.
- A clear vision to the team members.
- Being supportive of team members.
- Possess good leadership personality.
- Trustworthiness
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Treatment Technical Manager

LEVEL : 6

Responsibility:

A Treatment Technical Manager is responsible to plan, lead, implement, monitor, determine and report the operation and maintenance for sewage treatment plant in the section to meet the required performance standard and targeted level of service.

Knowledge:

- Sewage Treatment plant and Network Pumping Station (NPS) operation process
- Technical understanding in troubleshooting and process control of sewage treatment and Network Pumping Station (NPS).
- Personnel Human Resources management (labour law, industrial relation act, SOCSO/EPF, and training).
- Knowledge in Financial and budgeting management.
- Integrated management system (IMS) and Quality management system (ISO).
- Technical knowledge of the STP installation process and its standard requirement.
- Business development analysis.
- Environmental management system (scheduled waste).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Presentation skills
- Leadership skills
- Team coordination
- Technical skill in the sewage treatment process
- Time management skills

- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills

Attributes (Attitude/Safety/Environmental):

- Ability to communicate effectively.
- Possess good leadership.
- Demonstrate the strong value of integrity.
- Demonstrate the strong value of leadership.
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Treatment Executive

LEVEL : 5

Responsibility:

A Treatment Executive is responsible to execute, organise, implement, monitor, and report the sewage treatment plant maintenance and operation work to meet the required performance standard and targeted level of service.

Knowledge:

- Sewage Treatment plant and Network Pumping Station (NPS) operation process.
- Technical understanding in troubleshooting and process control of sewage treatment and Network Pumping Station (NPS).
- Basic Human Resources management (labour law, industrial relation act, SOCSO/EPF, and training).
- Basic Financial and budgeting management.
- Integrated management system (IMS) and Quality management system (ISO).
- Technical knowledge of the STP installation process and its standard requirement.
- Environmental management system (scheduled waste).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Leadership skills
- Documentation skills
- Communication skills
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills

- Problem-solving skills
- Technical skill in the sewage treatment process

Attributes (Attitude/Safety/Environmental):

- Ability to work as part of a team.
- Communicate with other team members.
- Ability to persuade subordinates.
- Ability to execute the directive.
- Demonstrate the strong value of integrity.
- Ability to make sustainable decisions and problem-solving.
- Adhere to safety, health, and environmental regulations.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Treatment Supervisor

LEVEL : 4

Responsibility:

A Treatment Supervisor is responsible to supervise, coordinate and report the sewage treatment plant maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Sewage Treatment plant and Network Pumping Station (NPS) operation process.
- STP and NPS installation process and its standard requirement.
- Supervisory control (Schedule, Work order, etc.).
- Sewerage service act and regulation.
- Occupational health and safety act and regulation.
- Environment Quality Act and regulation.

Skills:

- Technical skills for maintenance activity
- Teamwork skills
- Motivation and self-empowerment skills
- Analytical skills
- Critical thinking and strategic problem-solving skills
- Effective communication skills
- Time management skills
- Leadership skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate the strong value of integrity.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Treatment Technician

LEVEL : 3

Responsibility:

A Treatment Technician is responsible to perform, implement and report the sewage treatment plant maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Basic Sewage Treatment plant and Network Pumping Station (NPS) operation process.
- Maintenance and service of STP and NPS.
- Maximum operable limit for STP and NPS.
- STP and NPS installation procedure.
- Sewerage service act and regulation.
- Basic Occupational health and safety act and regulation.
- Basic Environment Quality Act and regulation.

Skills:

- Motivation and self-empowerment skills.
- Teamwork skills
- Communication skills
- Analytical skills
- Technical skills in mechanical and electrical

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate good communication with other team members/supervisor.
- Demonstrate the strong value of integrity.

MSIC GROUP : 370

AREA : Operation and maintenance of sewerage system (Sewage Treatment Plant Operation)

JOB TITLE : Treatment Operator

LEVEL : 2

Responsibility:

A Treatment Operator is responsible to carry out and assist the sewage treatment plant maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Basic Sewage Treatment plant and Network Pumping Station (NPS) operation process.
- Maintenance and service procedure of STP and NPS.
- Basic Occupational health and safety act and regulation.
- Basic Environment Quality Act and regulation.

Skills:

- Communication skill
- Technical skills in mechanical and electrical
- Teamwork skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Ability to work as a part of a team
- Demonstrate good communication with team members
- Demonstrate the strong value of integrity
- Adhere to safety, health and environmental regulation.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Senior Treatment Technical Manager (Environmental Officer)

LEVEL : 7

Responsibility:

A Senior Treatment Technical Manager (Environmental Officer) is responsible to establish, plan, monitor, advice and report the wastewater treatment operational and maintenance work in the organisation to meet the required performance standard and targeted level of service.

Knowledge:

- Effluent treatment system.
- Technical knowledge in wastewater treatment.
- Administrative and procurement system procedure.
- Human Resources management (labour law, industrial relation act, SOCSO/EPF, and training).
- Asset management system.
- Finance and budget management.
- Organisational policies and procedures.
- Integrated management system and quality management system.
- Safety and health act & regulation.
- Environment quality act and regulation.

Skills:

- Complex problem-solving and decision making
- Ability to respond and react to any issues that arise
- Excellent presentation and communication skills
- Technical skill in the wastewater treatment process
- Time management and good coordination skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Adhere to Health, Safety & Environment (HSE) regulations and policy.
- Ability to communicate effectively.
- Demonstrate the strong value of leadership.
- Demonstrate the strong value of integrity.
- A clear vision to the team members.
- Being supportive of team members.
- Possess good leadership personality.
- Trustworthiness.
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Treatment Technical Engineer

LEVEL : 6

Responsibility:

A Treatment Technical Engineer is responsible to establish, plan, monitor, perform and report the wastewater treatment operational and maintenance work in the section to meet the required performance standard and targeted level of service.

Knowledge:

- Effluent treatment system.
- Technical knowledge in wastewater treatment.
- Administrative and procurement system procedure.
- Human Resources management (labour law, industrial relation act, SOCSO/EPF, and training).
- Asset management system.
- Finance and budget management.
- Organisational policies and procedures.
- Integrated management system and quality management system.
- Safety and health act & regulation.
- Environment quality act and regulation.

Skills:

- Presentation skills
- Leadership skills
- Team coordination
- Technical skill in the sewage treatment process
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills

- Problem-solving skills

Attributes (Attitude/Safety/Environmental):

- Ability to communicate effectively.
- Possess good leadership.
- Demonstrate the strong value of integrity.
- Demonstrate the strong value of leadership.
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Treatment Executive

LEVEL : 5

Responsibility:

A Treatment Executive is responsible to organise, execute, lead, monitor and report the wastewater treatment operational and maintenance work to meet the required performance standard and targeted level of service.

Knowledge:

- Effluent treatment system.
- Technical knowledge in wastewater treatment.
- Administrative and procurement system procedure
- Basic Human Resources management procedures (labour law, industrial relation act, SOCSO/EPF, and training).
- Asset management system.
- Organisational policies and procedures.
- Integrated management system and quality management system.
- Safety and health act & regulation.
- Environment quality act and regulation.

Skills:

- Leadership skills
- Documentation skills
- Communication skills
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills
- Technical skill in the sewage treatment process.

Attributes (Attitude/Safety/Environmental):

- Ability to work as a part of a team.
- Communicate with other team members.
- Ability to persuade subordinates.
- Ability to execute the directive.
- Demonstrate the strong value of integrity.
- Ability to make sustainable decisions and problem-solving.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Treatment Supervisor

LEVEL : 4

Responsibility:

A Treatment Supervisor is responsible to supervise, coordinate and report the wastewater treatment maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Effluent treatment system process.
- Technical knowledge in the wastewater treatment procedure.
- Supervisory control.
- Safety and health act & regulation.
- Environment quality act and regulation.

Skills:

- Technical skills for maintenance activity
- Teamwork skills
- Motivation and self-empowerment skills
- Analytical skills
- Critical thinking and strategic problem-solving skills
- Effective communication skills
- Time management skills
- Leadership skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Treatment Technician

LEVEL : 3

Responsibility:

A Treatment Technician is responsible to perform, implement and report the wastewater treatment maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Basic Effluent treatment system process.
- Technical knowledge in the wastewater treatment procedure.
- Basic Safety and health act & regulation.
- Basic Environment quality act and regulation.

Skills:

- Motivation and self-empowerment skills.
- Teamwork skills
- Communication skills
- Analytical skills
- Technical skill in maintenance activity

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate good communication with other team members/supervisor.
- Demonstrate the strong value of integrity.

MSIC GROUP : 370

AREA : Treatment of wastewater (Industrial Effluent Treatment System)

JOB TITLE : Treatment Operator

LEVEL : 2

Responsibility:

A Treatment Operator is responsible to assist and implement the wastewater treatment maintenance and responsive work to meet the required performance standard and targeted level of service.

Knowledge:

- Basic Effluent treatment system process.
- Technical knowledge in the wastewater treatment procedure.
- Basic Safety and health act & regulation.
- Basic Environment quality act and regulation.

Skills:

- Communication skill
- Technical skills in mechanical and electrical
- Teamwork skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Ability to work as a part of a team.
- Demonstrate good communication with team members.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370
AREA : Collecting and transporting septage (Desludging)
JOB TITLE : Senior Desludging Technical Manager
LEVEL : 7

Responsibility

Senior Desludging Technical Manager provides technical direction on the desludging system development, design and integration of emptying and cleaning cesspools and septic tanks, sinks and pits from sewage. He/she is required to establish, plan, monitor, advise and report the related operational work in the organisation to meet the performance standard and targeted level of service.

Knowledge:

- Knowledge of development programs for executives (Role, responsibility and KPI).
- Technical knowledge in desludging operation and process.
- Knowledge in desludging facility management.
- Knowledge in desludging budget management.
- Knowledge of the integrated management system and quality management system.
- Knowledge in IR for desludging management systems.
- Knowledge in environment quality act.
- Knowledge in safety, health and environment act.
- Knowledge in desludging and discharge management.
- Knowledge in desludging and discharge administrative level.

Skills:

- Decision-making skills
- Complex problem-solving
- Critical thinking skills
- Problem-solving skills
- Presentation skills
- Communication skills.

- Team coordination
- Time management skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Adhere to Health, Safety & Environment (HSE) regulations and policy.
- Ability to communicate effectively.
- Demonstrate the strong value of leadership.
- Demonstrate the strong value of integrity.
- A clear vision to the team members.
- Being supportive of team members.
- Possess a good leadership personality.
- Trustworthiness.
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370
AREA : Collecting and transporting septage (Desludging)
JOB TITLE : Desludging Technical Manager
LEVEL : 6

Responsibility:

Desludging Technical Manager manages technical direction on the desludging system, support in the development, design and integration of collecting and transporting of human wastewater.

Knowledge:

- Desludging budget management.
- IR for desludging management system, system application and product.
- Integrated management system for the quality management system and environmental management system.
- Safety and health act and regulation.
- Environmental quality act and regulation.
- Sanitation and sewerage.
- Operation and maintenance of sludge reception facility.
- Desludging management system.
- Desludging and discharge administration.
- Desludging and discharge management.

Skills:

- Presentation skills
- Leadership skills
- Team coordination
- Technical skill in the desludging process
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills

Attributes (Attitude/Safety/Environmental):

- Ability to communicate effectively.
- Possess good leadership.
- Demonstrate the strong value of integrity.
- Demonstrate the strong value of leadership.
- Ability to make sustainable decisions and problem-solving.

MSIC GROUP : 370

AREA : Collecting and transporting septage (Desludging)

JOB TITLE : Desludging Executive

LEVEL : 5

Responsibility

Desludging Executive conducts the research and improve or develop concepts, theories and operational methods, or apply existing knowledge concerning the emptying & cleaning cesspools and septic tanks, sinks and pits from sewage.

Knowledge:

- IR for desludging management system, system application and product.
- Basic Integrated management system for the quality management system and environmental management system.
- Safety and health act and regulation.
- Environmental quality act and regulation.
- Sanitation and sewerage.
- Operation and maintenance of sludge reception facility.
- Desludging management system.
- Desludging and discharge administration.
- Desludging and discharge management.

Skills:

- Leadership skills
- Documentation skills
- Communication skills.
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills
- Technical skill in the sewage treatment process.

Attributes (Attitude/Safety/Environmental):

- Ability to work as part of a team.
- Communicate with other team members.
- Ability to persuade subordinates.
- Ability to execute the directive.
- Demonstrate a strong value of integrity.
- Ability to make sustainable decisions and problem-solving.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Collecting and transporting septage (Desludging)

JOB TITLE : Desludging Senior Supervisor

LEVEL : 4

Responsibility

Desludging Senior Supervisor coordinate and supervise teams in desludging works for collecting and transporting of human or industrial wastewater.

Knowledge:

- IR for desludging management system, system application and product.
- Safety and health act and regulation.
- Environmental quality act and regulation.
- Technical understanding of sanitation and sewerage.
- Operation and maintenance of sludge reception facility.
- Basic knowledge of the Desludging management system.
- Basic knowledge in Desludging and discharge administration.
- Supervisory control.

Skills:

- Teamwork skills
- Motivation and self-empowerment skills
- Critical thinking and strategic problem-solving skills
- Effective communication skills
- Time management skills
- Leadership skills

Attributes (Attitude/Safety/Environmental):

- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate a strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Collecting and transporting septage (Desludging)

JOB TITLE : Field Supervisor

LEVEL : 3

Responsibility

Field Supervisor coordinate and supervise teams in desludging works for collecting and transporting of human or industrial wastewater.

Knowledge:

- IR for desludging management system, system application and product.
- Safety and health act and regulation.
- Environmental quality act and regulation.
- Technical understanding of sanitation and sewerage.
- Operation and maintenance of sludge reception facility.
- Basic knowledge of the Desludging management system.
- Basic knowledge in Desludging and discharge administration.
- Supervisory control.

Skills:

- Motivation and self-empowerment skills.
- Teamwork skills
- Communication skills
- Technical skill in desludging operation activity

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate good communication with other team members/supervisors.
- Demonstrate the strong value of integrity.

MSIC GROUP : 370
AREA : Collecting and transporting septage (Desludging)
JOB TITLE : Desludging Operator (Tanker Driver/Operator)
LEVEL : 2

Responsibility

A Desludging Operator is responsible to identify tools, equipment and the safety apparatus and obtain signature and consent from premise occupier. The personnel is designated to assist in performing desludging services, checking septic tank for any defect and clean the desludging tanker. He/she must assist in providing all necessary information and feedback to supervisor after attending to the services.

Knowledge:

- IR for desludging management system, system application and product.
- Safety and health act and regulation.
- Environmental quality act and regulation.
- Technical understanding of sanitation and sewerage.
- Operation and maintenance of sludge reception facility.
- Basic knowledge of the Desludging management system.
- Basic knowledge in Desludging and discharge administration.
- SCV driver and operator.

Skills:

- Communication skill
- Technical skills in desludging work
- Teamwork skills
- Motivation and self-empowerment skills

Attributes (Attitude/Safety/Environmental):

- Ability to work as a part of a team.
- Demonstrate good communication with team members.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370

AREA : Operation and Maintenance of Sewer Network

JOB TITLE : Senior Network Technical Manager

LEVEL : 7

Responsibility

Senior Network Technical Manager provides technical direction on the sewerage network system development, design and integration of maintenance and cleaning of sewers and drains, including sewer rodding.

Knowledge:

- Sewer Managerial development.
- Sewer network maintenance – SCV/Jetter work.
- Sewer rehabilitation and property connection.
- Planning, design and construction of sewerage system.
- Financial and budget management.
- Sewer facility and asset management.
- Occupational health and safety act and regulation.
- Environmental quality act and regulation.
- Network maintenance record using GIS.
- Construction of sewer network.

Skills:

- Effective time management skills
- Management skills (Strategic problem solving and decision making)
- Communication skills
- Documentation skills
- Management skills
- Presentation skills
- Team coordination
- Technical skill in sewer network operation
- Time management skills

- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills

Attributes (Attitude/Safety/Environmental):

- Ability to communicate effectively.
- Demonstrate the strong value of integrity.
- Demonstrate the strong value of leadership.
- Ability to make sustainable decisions and problem solving.

MSIC GROUP : 370

AREA : Operation and Maintenance of Sewer Network

JOB TITLE : Network Technical Manager

LEVEL : 6

Responsibility

Network Technical Manager provides technical direction on the sewerage network system development, design and integration of maintenance and cleaning of sewers and drains, including sewer rodding.

Knowledge:

- Sewer Managerial development.
- Sewer network maintenance – SCV/Jetter work.
- Sewer rehabilitation and property connection.
- Planning, design and construction of sewerage system.
- Financial and budget management.
- Sewer facility and asset management.
- Occupational health and safety act and regulation.
- Environmental quality act and regulation.
- Network maintenance record using GIS.
- Construction of sewer network.

Skills:

- Effective scientific, technical writing and communication
- Skills of technical and regulatory disposal requirements
- Management skills (Strategic problem solving and decision making)
- Leadership skills
- Communication skills
- Documentation skills
- Technical skill in the sewer network operation
- Time management skills

- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulations.

MSIC GROUP : 370
AREA : Operation and Maintenance of Sewer Network
JOB TITLE : Network Executive
LEVEL : 5

Responsibility

Network Executive conducts the research and improve or develop concepts, theories and operational methods, or apply existing knowledge concerning the maintenance and cleaning of sewers and drains, including sewer rodding.

Knowledge:

- Knowledge in supervisory development (roles, responsibility and performance).
- Knowledge of the health and safety act and regulations.
- Knowledge of the environmental quality act and regulation.
- Knowledge in sewer network maintenance.
- Knowledge of asset management systems.
- Knowledge for Authorised Gas Tester.
- Knowledge of Confined space entry.

Skills:

- Effective scientific, technical writing and communication
- Effective time management skills
- Supervisory development
- Leadership skills
- Communication skills
- Documentation skills
- Technical skill in sewer network operation
- Time management skills
- Motivation and self-empowerment skills
- Critical thinking skills
- Problem-solving skills

- Supervisory skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate good analytical skills.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370
AREA : Operation and Maintenance of Sewer Network
JOB TITLE : Network Supervisor
LEVEL : 4

Responsibility

A Network Supervisor is responsible to execute selection of sewerage pipe sizes, assemble and secure sewerage pipes, tubes, fittings, and related equipment, according to specifications. He/ she also must supervise installed sewerage systems and pipelines, supervise work sites for obstructions and ensure that holes will not cause structural weakness. The personnel are also designated to execute measurement and mark sewerage pipes for cutting and threading.

Knowledge:

- Pipe installation method and procedures.
- Sewer network system.
- Product specification and technology requirements.
- Basic welding methods and procedures.
- Repair and maintain sewer equipment.
- Occupational safety and health act and regulation.
- Environment quality act and regulation.

Skills:

- Skills in pipe installation methods and procedures
- Skills in the sewerage network system
- Skills in basic welding methods and procedures
- Skills of minor repair.
- Leadership skills
- Communication skills
- Supervisory skills

Attributes (Attitude/Safety/Environmental):

- The ability to work as a part of a team.
- Demonstrate effective communication with other team members.
- Demonstrate the strong value of integrity.
- Adhere to safety, health, and environmental regulation.

MSIC GROUP : 370
AREA : Operation and Maintenance of Sewer Network
JOB TITLE : Network Technician
LEVEL : 3

Responsibility

A Sewer Network Technician is responsible to determine the sewerage pipe sizes and specification. The personnel are designated to determine sewerage pipe threaders and benders and determine the measurement of pipes for cutting and threading. He/she must also assist in test the installed sewerage systems and pipelines and measurement of the sewerage pipes.

Knowledge:

- Pipe installation method and procedures.
- Sewer network maintenance.
- Sewer network tools and equipment.
- Basic occupational safety and health act.
- Basic environment quality act.

Skills:

- Skills in pipe installation methods and procedures
- Skills in the sewer network system
- Skills in sewer network tools and equipment
- Communication skills

Attributes (Attitude/Safety/Environmental):

- To adhere to Occupational Health and Safety regulations.
- Apply green technology and sustainability.
- The ability to work as a part of a team.
- Demonstrate good communication with other team members/supervisor
- Demonstrate the strong value of integrity.

MSIC GROUP : 370
AREA : Operation and Maintenance of Sewer Network
JOB TITLE : Network Operator (SCV driver/Jettor Driver)
LEVEL : 2

Responsibility:

A Sewer Network Operator is responsible to identify the sewerage pipe sizes, specification, pipe threaders, benders and related equipment. The personnel must assist in sewerage pipe measurement, and testing installed systems and pipelines.

Knowledge:

- Pipe installation method and procedures.
- Sewer network maintenance procedure.
- Sewer network tools and equipment.
- Basic occupational safety and health act.
- Basic environment quality act.
- SCV driver and operator.

Skills:

- Skills in pipe installation methods and procedures
- Skills in the sewerage network system
- Skills in sewerage network tools and equipment
- The ability to work as a part of a team
- Communication skills

Attributes (Attitude/Safety/Environmental):

- To adhere to Occupational Health and Safety regulations.
- Apply green technology and sustainability.
- The ability to work as part of a team.
- Demonstrate good communication with other team members/supervisors.
- Demonstrate strong value of integrity.