SKILLS GAP ASSESSMENT

PLUMBING

DEPARTMENT OF WORKFORCE PLANNING AND SKILLS DEVELOPMENT (DWPSD)

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PLUMBING COURSE

PART 1 INTRODUCTION

The Department of Workforce Planning and Skills Development (DWPSD), Ministry of Education and Skills Development (MoESD) is mandated to develop and implement policies, programs, and initiatives related to Technical and Vocational Education and Training (TVET) in Bhutan. This includes developing strategies for improving quality and relevant skills, preparing the young workforce for gainful employment, and providing training and development opportunities to the workforce to help them stay relevant and productive in the labour force. The Workforce Planning and Information Division (WPID) under the DWPSD in particular is responsible for providing guidance and direction on the skills development needs and carrying out regular skills assessments to guide the internal stakeholders within the DWPSD for appropriate TVET planning and interventions. As such, the ten TVET institutes under the direct administration of the DWPSD play a crucial role in supplying relevant and adequate talent for the economy, by equipping the trainees with practical skills and competencies that are directly applicable to the job market and industry requirements.

Therefore, the WPID in consultation with the Department and institutes, decided to focus the skills gap assessment to be carried out in the construction sector, since construction continues to be one of the key economic sectors. With the initiation of a mega-city project in the South-East, the sector's importance in TVET planning becomes even more pronounced. The Mega-City project will typically involve large-scale infrastructure development, urban planning, and construction of various facilities like international airports, residential buildings, commercial spaces, transportation systems, and more. Therefore, there will be a substantial demand for highly skilled and competent workers in construction-related trades to execute the project successfully.

In this context, ten occupations were identified under the construction sector: masonry, construction carpentry, plumbing, house wiring, welding, excavator operator, backhoe operator, heavy vehicle driving, industrial electrician and tower crane operator. Upon extensive discussions within the department, institutes, and the TVET-QC, from the list, Masonry, Plumbing and House Wiring were shortlisted as critical and important occupations due to its high demand and attractiveness to youth. However, for the purpose of piloting this study, a single occupation from the shortlist was selected for carrying out the skills gap assessment. For this purpose, a survey was employed to select the occupation expected to hold significant importance in the future job market from the three shortlisted occupations. The survey was sent out to the chief program officers and relevant institute principals. Based on the outcomes of the online survey, plumbing was chosen as the designated occupation for the pilot phase of the skills gap assessment.

As Jigme Wangchuck Power Training Institute (JWPTI) and TTI Chumey (TTI-C) are the only institutes that provide plumbing courses during the study period, to carry out the assessment effectively, a focal person from each institute was identified to be part of the assessment team. The focal person's role has been pivotal in providing insights and guidance throughout the assessment process, in providing the department with the information needed for the assessment and in ensuring that the department's efforts are targeted and aligned with the real-world demands of the plumbing industry.

1.1 Plumbing Workforce and Graduates

The JWPTI and TTI-C institutes offer comprehensive plumbing courses that serve as vital pathways for individuals seeking a rewarding and essential career in the field of plumbing. These courses are meticulously designed to equip students with the practical skills and theoretical knowledge required to excel in the plumbing industry. As critical contributors to the infrastructure and well-being of communities, plumbers are in high demand, and the public TVET institutes play a crucial role in meeting this demand by providing accessible and quality education in plumbing.

The plumbing courses offered by these institutes typically cover a range of topics, including pipefitting, installation and maintenance of plumbing systems, water supply management, and adherence to safety regulations. Practical, hands-on training is a cornerstone of these programs, allowing students to gain real-world experience and develop the competency needed for success in the field. Additionally, public TVET institutes often collaborate with industries in terms of on-the-job training.

The two institutes regularly offer plumbing courses for both NC 2 and NC 3 levels with a total intake of about 30 to 50 a year. Between 2016 and 2021, a total of 163 graduated from the two institutes at NC 2 and NC 3 levels.

Table 1.1: Plumbing graduates at NC levels from the two institutes between 2016 and 2021

Institutes	Level	2016	2017	2018	2019	2020	2021	Total
JWPTI	NC 2	5	4	1	0	1	0	11
	NC 3	0	1	19	13	20	12	65
TTI-C	NC 2	3	5	13	11	25	0	57
	NC 3	0	5	12	12	1	0	30
	Total	**8**	**15**	**45**	**36**	**47**	**12**	**163**

As per the Labour Force Survey, there were a total of 432 plumbers in 2021 and 651 in 2022. The LFS 2022 indicated that 248 of these plumbers were working in the government agencies, 155 in the state-owned companies and 248 in the private businesses. Majority of the plumbers were working in the construction sector (255) and public administration (193). The majority of these plumbers were working as regular paid employees (526), with only a few working as casual paid employees (89). About 222 plumbers had middle secondary qualification, 136 had lower secondary qualification, and 70 had

primary level qualification. The average monthly earnings of a plumber was about Nu. 16,968 as per the LFS 202. Plumbers were also found to be working longer hours, with 627 indicating that they work for more than 40 hours in a week. 500 of these plumbers were working in the urban areas with only 151 working in the rural areas.

Table 1.2: Number of plumbers as per Labour Force Survey 2021 and 2022

	LFS 2021			LFS 2022		
Occupation	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Pipe Fitter	18	0	**18**	48	0	**48**
Plumber	389	25	**414**	496	107	**603**
Total	**407**	**25**	**432**	**544**	**107**	**651**

1.2 Objectives

The skills gap assessment results can serve as valuable input and information for DWPSD, TVET-QC and the relevant institutes to make guided decisions about improving training delivery. By focusing on relevant skills, updating curricula, enhancing trainer capabilities, staying current with industry demands, and making program improvements, TVET institutes can ensure that the graduates are well-equipped to meet the needs of the job market and contribute to the economy effectively. Some of the key objectives of this study are:

1. **Improve relevancy of skills delivery by institutes:** The skills gap assessment results enable TVET institutes to identify the specific skills and competencies that are required for the identified skills occupation. With this information, the institutes can work on reviewing the existing skills and competencies provided during training. This will ensure that trainees receive training that aligns with industry needs, making them more job-ready and increasing their chances of successful employment.

2. **Update of curriculum and standards to meet industry needs:** Based on the skills gap assessment findings, TVET Quality Council (TVET QC) and Technical Teacher Training and Research Centre (TTTRC) will have key information needed to update the existing curriculum and occupational standards to match industry requirements. This will involve reviewing the existing standards and curriculum to meet the industry trends and demand. With updated standards and curriculum, relevant TVET institutes can align their training delivery to produce graduates who are work-ready and world ready.

3. **Assessing skills requirement of TVET trainers:** The skills gap assessment will also entail information and intelligence to enhance the critical capabilities of TVET trainers and instructors. The assessment results can help identify areas where trainers might need additional training or

upskilling themselves. This information will be useful for the TTTRC in planning and delivery of its occupational skills development programs for the TVET trainers.

4. **Update technology and industry demand:** The assessment results can shed light on the technological advancements and changes in industry demand that influence the occupation's skills requirements. DWPSD and TTIs can use this information to invest in updated technology and equipment used in training labs and workshops. This ensures that students have exposure to the latest tools and practices, improving their readiness to enter the workforce.

5. **Sharpen and improve existing programs:** The skills gap assessment results can help TVET institutes identify areas where their existing programs may be lacking or falling short in meeting industry demands. With this knowledge, institutes can make targeted improvements to their training delivery methodologies, course content, and assessments. These improvements lead to a more effective and comprehensive learning experience for students, better preparing them for their future careers.

1.3 Methodology

The skills gap assessment for the plumbing course was carried out using the following methods:

a. **Examination of National Competency Standards (NCS) and Curriculum:** Thorough desk review of the National Competency Standards and course curriculum was carried out. This analysis served as the foundation for creating comprehensive checklists and questionnaires. By delving into these materials, the assessment team could gain insights into the current skill sets and competencies. The curriculum was the key point of focus when developing questionnaires for the industry and plumbing graduates as shown in annexure 1, 2 and 3.

b. **Conducting Field Surveys and Interviews:** A total of three questionnaires were employed for conducting face-to-face and phone-call surveys and interviews with different stakeholders, including plumbing graduates at NC 2 and NC 3 level, representatives from industries, employers, and technical experts. This multifaceted approach allowed the assessment team to gather a diverse range of perspectives and insights. The graduates provided insights into their firsthand experiences and how well their training prepared them for the job market. Input from industries and employers was crucial to comprehend the demands of the current job market, and insights into the industry's evolving skill and technology requirements.

c. **Focus groups and coordination meetings:** Collaborative sessions with institute focals and experts provided a platform for in-depth discussions and knowledge sharing. Institute focals provided valuable insights into the content and elements within the standards and curriculum, including use of tools and equipment for the delivery of training. While one-to-one interviews

were conducted with graduates, employers and experts, selected individuals were approached for a focus group discussion to get more information and intelligence on the emerging trends and technological advancements in the plumbing field and what skills and competencies are needed besides the ones already being provided by the institutes.

1.4 Structure of the Study

This report has five parts:

a. **Part 1: Introduction** provides background on the skills gap assessment study and the reasons for opting the plumbing course for this pilot study. This part also provides objectives, methodology used, and limitations of the study.

b. **Part 2: Skill Supply** looks at the skills and competencies acquired by a plumbing graduate at the time of graduation from the two institutes. Therefore, in this part, key information on the content of the standards and curriculum, soft skills provided, and tools and equipment used during training delivery are assessed.

c. **Part 3: Skills Demand** looks at the relevancy of skills provided through the training from graduates who are working as plumbing professionals and plumbing industries' point of view. All information gathered through the three surveys are used to look at the relevance of different skills and competencies, soft skills provided, and tools and equipment used.

d. **Part 4: Gap Assessment** highlights additional skills and competencies requirements, new business opportunities including technologies changes happening within the industry, requirements for additional soft skills, use of new tools and equipment by plumbing professionals among other things. This information was collected through interviews and focus group discussions with both the plumbing professionals and the industries.

e. **Part 5: Recommendations** provide key areas of interventions required from the relevant divisions/departments and institutes to be implemented to address the skills gap in order to make the plumbing course provided by the two institutes more relevant to the labour market requirements.

1.5 Limitation of the Study

This study was carried out mainly with the intention to assess the relevancy of skills supplied by the two public institutes. In doing this, the main focus was on the curriculum used by the two institutes, which determines the skills and competencies taught during training. The content within the curriculum, in terms of course content, soft skills provided, and tools and equipment used were the key points in

designing the survey tools. A total of three survey tools were developed, targeting NC 2 graduates, NC 3 graduates, and the industries to determine the relevancy of skills taught in the institutes.

The gap assessment result is limited to the input provided by plumbers and industries located within the country, therefore, the results are a reflection of our current plumbing and industry situation and practices. Within the global labour market, advanced technological changes such as IR 4.0 are determining how skills are evolving within different occupations. However, this study does not focus on the global labour market requirement but rather the evolving needs within our own industries. Therefore, the skills gap is limited to the industry dynamics within our national labour market.

The survey tool designed for the industry mainly focuses on the relevancy of skills provided through the curriculum. Industries were also asked to provide additional skills that are required as per the changes in the plumbing profession. This does not contain questions on the performance of plumbing graduates, which is covered through the TVET employer survey, which provides more insight into the industry's feedback on the TVET graduates.

PART 2 SKILLS SUPPLY

Plumbing is a critical occupation that plays a fundamental role in society. Plumbers are responsible for installing, repairing, and maintaining the intricate network of pipes and fixtures that deliver water to homes, businesses, and public facilities. They play a crucial role in safeguarding the well-being of communities by ensuring that water is delivered reliably and that sewage is effectively removed. Bhutanese plumbers contribute to the construction and maintenance of residential, commercial, and industrial structures, ensuring that these spaces have the necessary plumbing systems for daily activities. A breakdown in plumbing can lead to significant disruptions, affecting sanitation, hygiene, and the overall quality of life. Therefore, the skills and expertise of plumbers are indispensable for the functioning of society, making plumbing a critical occupation that directly impacts public health and well-being.

Plumbing courses are currently offered in JWPTI and TT-C, two of the institutes under the direct administration of the DWPSD. The two institutes offer plumbing training at NC 2 and NC 3 levels. Like all TVET courses, the competency standards for this occupation are set by the TVET-QC. The standards are developed with input from the industry, with industry experts providing key information on the skills and competencies required for the plumbing professional in the labour market. Once the standards are set, the institutes then use it as a reference for the development of the curriculum.

2.1 National Competency Standards

The National Competency Standards (NCS) for the plumbing occupation at NC 2 and NC 2 level has been developed by the TVET-QC. The first standard for the plumbing occupation was developed in 2009. Since then, the standard for the occupation has been revised in 2012, 2016 and 2020. The standards highlighted in the following table are the latest revisions carried out in 2020. The NCS contains units, elements and performance criteria for each occupation. This basically highlights the skills and competencies required by a practicing plumbing professional in the labour market. Interpretation of drawing and specifications, selection of tools, equipment, PPE and estimation of materials for each element has not been included under the assumption that graduates learn this theoretically. The NCS for the plumbing course at NC 2 is as follows:

Unit	Element	Performance Criteria
Carryout installation of internal domestic water supply system and sanitary fixtures	1. Install water pipes and Chrome Plated(CP) fittings	1.1. Perform pipe joint as per the job requirement following standard procedures 1.2. Lay pipes and fittings as per the job requirement following standard procedures 1.3. Perform installation of CP fittings as per the job requirement following standard procedures 1.4. Perform test of the installation following standard procedures

	2. Lay soil and waste pipe and fittings	2.1. Perform soil and waste pipe joint as per the job requirement following standard procedures 2.2. Lay soil and waste pipes and fittings as per the job requirement following standard procedures
	3.Install sanitary fixtures and fitting	3.1. Perform installation of sanitary fixtures as per the job requirement following standard procedures 3.2. Perform test of installation following standard procedures
	4.Install water based floor radiant heating system	4.1. Install hot water pressure pumps following standard procedures 4.2. Perform installation of water based floor radiant heating system following standard procedures 4.3. Perform test of installation following standard procedures
	5.Install water tanks and pumps	5.1. Select the location for installation of water tank as per the job requirement 5.2. Prepare the base as per the job requirement following standard procedures 5.3. Fix the tank components as per the job requirement following standard procedures 5.4. Perform installation of water tank as per the drawing following standard procedures 5.5. Select the size of the water pump as per the job requirement 5.6. Perform installation of water pump as per the specifications and manufacturers' manual following standard procedures 5.7. Conduct functionality test of the installation as per the standard procedures
	6.Repair plumbing system	6.1. Diagnose the faults following standard procedures 6.2. Perform maintenance (replace and repair) of plumbing system following standard procedures 6.3. Conduct functionality test of repaired plumbing system as per the standard procedures
Carryout installation of external water supply system	1. Lay external pipelines and valves	1.1. Prepare trenches and bedding to the required sizes as per the job requirement following standard procedures 1.2. Lay pipes and fittings for main and distribution lines as per the job specification and design layout following standard procedures 1.3. Join the pipes and fittings as per the standard procedures 1.4. Perform connection to reservoir and break pressure tank as per the standard procedures 1.5. Backfill the trenches as per the job requirement following standard procedures 1.6. Fix valves and water meter as per the standard procedures 1.7. Conduct test and take necessary action as per the job requirement following standard procedures

	2. Repair plumbing system	2.1. Diagnose faults (leakage, blockage) as per system the job requirement following standard procedures 2.2. Repair the defective pipe and fittings as per the job requirement following standard procedures 2.3. Replace the defective pipe and fittings as per the job requirement following standard procedures 2.4. Conduct functional test of the repaired plumbing system as per the job requirement
	3. Conduct operation and maintenance of water intake and treatment plant	3.1. Clean and remove foreign materials from the treatment plant as per the job requirement following standard procedures 3.2. Back wash the water filter as per the treatment plant manual following standard procedures 3.3. Service water treatment units as per the job requirement following standard procedures 3.4. Perform water quality test and add alum following standard procedures 3.5. Disinfect the water as per the treatment plant manual 3.6. Record the data and regulate the raw water flow and treated water flow as per the standard procedures

The NCS for plumbing course at NC 3 is as follows:

Unit	Element	Performance criteria
Carryout installation of main sewer system	1. Install sewer lines	1.1. Perform installation of sewer lines following standard procedures 1.2. Perform maintenance of sewer lines as per the job requirement following standard procedures 1.3. Perform test of sewer lines following standard procedures
	2. Install chambers and manholes	2.1. Perform installation of chambers and manholes following standard procedures 2.2. Perform test chambers and manholes following standard procedures
	3. Conduct operation and maintenance of sewerage treatment plant	3.1. Perform operation of sewerage treatment plant following standard procedures 3.2. Perform maintenance of sewerage treatment plant as per the job requirement following standard procedures
Carryout installation of advanced sanitary and bathroom	1. Install advanced sanitary fixtures	1.1. Perform installation of Jacuzzi as per the standard procedures 1.2. Perform installation of bathtub as per the standard procedures
	2. Install cubicle shower	2.1. Perform installation of cubicle shower as per the standard procedures

	3. Install advanced sanitary fixtures with sensors	3.1 Perform installation of advanced sanitary fixtures with sensors as per the standard procedures

2.2 Curriculum

Following the standard curriculum development guidelines, the curriculum for plumbing at NC 2 level was developed in 2017, based on the NCS. The NC 3 level curriculum was developed in 2016. The TTTRC recently carried out a review of the NC 2 curriculum in 2023. However, for the purpose of this survey, the curriculum used for training delivery between 2016 to 2022, by the two institutes were used, which is the curricula developed in 2016 and 2017.

The curriculum mainly contains competency areas, learning outcomes, and list of competencies required. The curriculum also includes a list of soft skills requirements and tools and equipment requirements during the training delivery. Similar to standards, the interpretation of drawing and specifications, selection of tools, equipment, PPE, site and identification and estimation of materials for each learning outcome has not been included under the assumption that graduates learn this theoretically. Competency area of maintaining career professionalism and safety has been included under the soft skill component.

The Curriculum for the plumbing course at NC 2 is as follows:

Competency area	**Learning outcomes**	**List of competencies**
Carryout installation of internal domestic water supply system and sanitary fixtures	1. Install water pipes and Chrome Plated(CP)fittings	1.1 Cut Pipe 1.2 Ream Pipe 1.3 Thread Pipe manually 1.4 Thread pipe mechanically 1.5 Perform GI Pipe Joint 1.6 Perform CPVC pipe joint 1.7 Perform PPR pipe joint 1.8 Perform HDPE pipe joint 1.9 Prepare Layout 1.10 Cut Channel 1.11 Lay Pipe 1.12 Fix Clamp 1.13 Conduct Leak Test 1.14 Insulate Pipe
	2. Carryout basic masonry works	2.1 Prepare mortar 2.2 Construct wall 2.3 Perform plastering 2.4 Perform basic RCC work

	3. Install water storage Tanks	3.1 Prepare bedding 3.2 Fix tank components 3.3 Mount storage tank 3.4 Check leakages
	4. Install water pump	4.1 Prepare layout 4.2 Construct pump base 4.3 Fix pump and its accessories 4.4 Test pump
	5.Maintain internal domestic water supply system	5.1 Locate fault 5.2 Prepare estimate and costing of maintenance 5.3 Clear pipe blockage 5.4 Repair/Replace defective pipes and fittings(CP fittings) 5.5 Service pump 5.6 Service storage tank
Carry out installation of sanitary fixtures and sewerage pipelines	1. Install sanitary fixtures	1.1 Prepare layout 1.2 Fix fixture bracket 1.3 Install wash basin 1.4 Install European type water closet pan 1.5 Fix Cistern 1.6 Install Asian/Indian type water closet pan 1.7 Fix geyser 1.8 Fix Urinal 1.9 Install Bath tub 1.10 Fix bathroom accessories 1.11 Install kitchen sink 1.12 Install bidet 1.13 Install urinal with automatic cistern 1.14 Install Jacuzzi bathtub 1.15 Install shower (cubical/rectangular) 1.16 Apply adhesive to the fixtures 1.17 Check fixtures installation
	2. Install sewerage pipelines	2.1 Excavate trench 2.2 Perform bedding 2.3 Join PVC/HDPE pipes 2.4 Lay pipe 2.5 Construct chamber 2.6 Check leakage 2.7 Backfill the trenches 2.8 Fix Stacks

The Curriculum for plumbing course at NC 3 is as follows:

Competency	Learning Outcome	List of competencies
Carry out installation of external pipelines and valves	1. Install water pipelines and fittings	1.1 Excavate trench 1.2 Perform bedding 1.3 Join GI pipe 1.4 Join HDPE pipe 1.5 Join DI pipe 1.6 Fix valves 1.7 Fix water meter 1.8 Conduct leak test
	2. Maintain external pipelines and fittings	2.1 Clear blockage 2.2 Repair defective pipes and fittings
Maintain treatment plant	1. Maintain intake	1.1 Clean intake
	2. Maintain water treatment plant	2.1 Backwash filter 2.2 Clean sand filter 2.3 Disinfect water 2.4 Perform chlorine test 2.5 Perform pH test
	3. Maintain sewerage treatment plant	3.1 Remove sludge 3.2 Perform BOD test 3.3 Perform suspended solid test 3.4 Perform COD test 3.5 Perform coliform test

The training materials, in terms of pipes and fittings, currently used for the delivery of the two NC levels courses in the two institutes are: PPR pipes and fittings for water supply, GI Pipes and Fittings for water supply, PVC Pipe and fitting for water/soil, CPVC pipes and fittings for water supply, Pex pipes and fittings for water supply, and HDPE Pipe and fitting for both water and waste/soil.

The PPEs provided during the training are: Gloves, safety shoes, dust mask, Safety gears, Workshop dress, Safety belt, helmet, safety boot, apron, Safety Helmet , Safety Goggles, Ear muff, Ear, plugs, Hair net, Safety harness, safety boots, and safety gloves.

The curriculum also includes the following soft skills, which are provided during the training delivery process:

1. Team work
2. Communication skills
3. Planning (work)
4. Workplace housekeeping
5. Time management

6. Negotiation
7. Problem solving
8. Basic ICT skills
9. Basic research skills
10. Social Skills
11. Driglam Namzha
12. Self presentation and personal hygiene
13. Waste management

PART 3 SKILLS DEMAND

In assessing the skills demand, practicing plumbing graduates and industries were approached for an interview using a standardized survey tool. The Survey tools (annexure 1, annexure 2, and annexure 3) were used to collect data and information on the relevancy of skills delivered and requirements for new skills from the plumbing professionals as well as from the industry experts. All plumbers and industries located in Thimphu were approached in person for a face-to-face interview. Plumbers and industries located outside Thimphu were interviewed through a phone call survey.

3.1 Assessment of Skills and Competencies by Plumbing Graduates

While a total of 163 individuals graduated from the two institutes at NC 2 and NC 3 level between 2016 and 2021, the survey targeted only those who were working as plumbing professionals at the time of the survey. Therefore, a tracer phone call survey was conducted in the 1st week of November 2023 during which all 163 graduates were called. During the phone call survey, graduates were asked to provide their employment status and details.

From the 163 graduates, only 78 graduates were found to be employed and working as plumbing professionals during the tracer phone calls. Therefore, a total of 78 graduates were targeted for the survey purpose. **Out of the 78 graduates, a total of 68 participated in the survey, which accounts for a response rate of 87.2 percent.**

Institutes	Qualification Level	Total Graduates	Survey target
JWPTI	NC 2	11	6
	NC 3	65	38
TTI-C	NC 2	57	16
	NC 3	30	18
Total		**163**	**78**

78/163 employed + working as plumbing professional
68/78 responded to the plumbing graduate survey

The following table provides the summarized assessment by NC 2 graduates on their current skills levels in different areas of competencies. The table also provides the use of skills by these graduates as plumbing professionals. The former should provide an understanding of the quality of training provided by the institutes and the latter should provide an understanding of the use and relevancy of these skills as a practicing plumbing professional.

Carryout installation of internal domestic water supply system	List of Competencies (NC 2)	How would you rate your current skill level in different areas of competencies?			How frequently do you use this skill as a plumbing professional?		
		Highly Skilled	Moderately Skilled	Low Skilled	Not at all	Sometimes	Frequently
Install water pipes and fittings	1.1 Cut Pipe	83.3%	16.7%	0.0%	0.0%	33.3%	66.7%
	1.2 Ream Pipe	55.6%	44.4%	0.0%	11.1%	66.7%	22.2%
	1.3 Thread Pipe manually	50.0%	50.0%	0.0%	16.7%	61.1%	22.2%
	1.4 Thread pipe mechanically	50.0%	50.0%	0.0%	16.7%	66.7%	16.7%
	1.5 Perform GI Pipe Joint	72.2%	22.2%	5.6%	22.2%	44.4%	33.3%
	1.6 Perform CPVC pipe joint	83.3%	11.1%	5.6%	11.1%	22.2%	66.7%
	1.7 Perform PPR pipe joint	61.1%	33.3%	5.6%	33.3%	16.7%	50.0%
	1.8 Perform HDPE pipe joint	50.0%	44.4%	5.6%	22.2%	44.4%	33.3%
	1.9 Prepare Layout	61.1%	38.9%	0.0%	5.6%	44.4%	50.0%
	1.10 Cut Channel	77.8%	16.7%	5.6%	5.6%	44.4%	50.0%
	1.11 Lay Pipe	83.3%	16.7%	0.0%	0.0%	38.9%	61.1%
	1.12 Fix Clamp	88.9%	11.1%	0.0%	5.6%	50.0%	44.4%
	1.13 Conduct Leak Test	61.1%	38.9%	0.0%	11.1%	27.8%	61.1%
	1.14 Insulate pipe	66.7%	33.3%	0.0%	11.1%	55.6%	33.3%
Carryout basic masonry works	2.1 Prepare mortar	44.4%	50.0%	5.6%	11.1%	55.6%	33.3%
	2.2 Construct wall	38.9%	55.6%	5.6%	22.2%	55.6%	22.2%
	2.3 Perform plastering	22.2%	66.7%	11.1%	33.3%	55.6%	11.1%
	2.4 Perform basic RCC work	22.2%	50.0%	27.8%	38.9%	50.0%	11.1%
Install water storage Tanks	3.1 Prepare bedding	50.0%	38.9%	11.1%	27.8%	44.4%	27.8%
	3.2 Fix tank components	72.2%	27.8%	0.0%	22.2%	44.4%	33.3%
	3.3 Mount storage tank	38.9%	50.0%	11.1%	22.2%	44.4%	33.3%
	3.4 Check leakages	72.2%	27.8%	0.0%	0.0%	50.0%	50.0%
Install water pump	4.1 Prepare layout	61.1%	33.3%	5.6%	5.6%	50.0%	44.4%
	4.2 Construct pump base	61.1%	27.8%	11.1%	11.1%	66.7%	22.2%
	4.3 Fix pump and its accessories	66.7%	22.2%	11.1%	16.7%	61.1%	22.2%
	4.4 Test pump	55.6%	33.3%	11.1%	16.7%	50.0%	33.3%
Maintain internal domestic water supply system	5.1 Locate fault	55.6%	33.3%	11.1%	22.2%	50.0%	27.8%
	5.2 Prepare estimate and costing of maintenance	66.7%	27.8%	5.6%	5.6%	50.0%	44.4%
	5.3 Clear pipe blockage	66.7%	27.8%	5.6%	5.6%	61.1%	33.3%
	5.4 Repair/Replace defective pipes and fittings(CP fittings)	77.8%	16.7%	5.6%	11.1%	55.6%	33.3%
	5.5 Service pump	33.3%	55.6%	11.1%	38.9%	27.8%	33.3%
	5.6 Service storage tank	50.0%	50.0%	0.0%	22.2%	50.0%	27.8%

Carry out installation of sanitary fixtures and sewerage pipelines	List of Competencies (NC 2)	How would you rate your current skill level in different areas of competencies?			How frequently do you use this skill as a plumbing professional?		
		Highly Skilled	Moderately Skilled	Low Skilled	Not at all	Sometimes	Frequently
Install sanitary fixtures	1.1 Prepare layout	72.2%	27.8%	0.0%	0.0%	61.1%	38.9%
	1.2 Fix fixture bracket	61.1%	38.9%	0.0%	11.1%	61.1%	27.8%
	1.3 Install wash basin	77.8%	22.2%	0.0%	5.6%	55.6%	38.9%
	1.4 Install European type water closet pan	77.8%	22.2%	0.0%	5.6%	50.0%	44.4%
	1.5 Fix Cistern	94.4%	5.6%	0.0%	11.1%	44.4%	44.4%
	1.6 Install Asian/Indian type water closet pan	77.8%	22.2%	0.0%	22.2%	44.4%	33.3%
	1.7 Fix geyser	66.7%	27.8%	5.6%	38.9%	38.9%	22.2%
	1.8 Fix Urinal	72.2%	27.8%	0.0%	16.7%	44.4%	38.9%
	1.9 Install Bath tub	27.8%	55.6%	16.7%	33.3%	55.6%	11.1%
	1.10 Fix bathroom accessories	83.3%	16.7%	0.0%	16.7%	44.4%	38.9%
	1.11 Install kitchen sink	77.8%	16.7%	5.6%	16.7%	44.4%	38.9%
	1.12 Install bidet	44.4%	33.3%	22.2%	38.9%	50.0%	11.1%
	1.13 Install urinal with automatic cistern	44.4%	33.3%	22.2%	38.9%	44.4%	16.7%
	1.14 Install Jacuzzi bathtub	27.8%	44.4%	27.8%	44.4%	44.4%	11.1%
	1.15 Install shower (cubical/rectangular)	88.9%	11.1%	0.0%	11.1%	50.0%	38.9%
	1.16 Apply adhesive to the fixtures	72.2%	16.7%	11.1%	11.1%	55.6%	33.3%
	1.17 Check fixtures installation	72.2%	27.8%	0.0%	5.6%	44.4%	50.0%
Install sewerage pipelines	2.1 Excavate trench	61.1%	27.8%	11.1%	11.1%	61.1%	27.8%
	2.2 Perform bedding	61.1%	27.8%	11.1%	11.1%	55.6%	33.3%
	2.3 Join PVC/HDPE pipes	77.8%	22.2%	0.0%	0.0%	38.9%	61.1%
	2.4 Lay pipe	72.2%	27.8%	0.0%	0.0%	44.4%	55.6%
	2.5 Construct chamber	66.7%	22.2%	11.1%	16.7%	50.0%	33.3%
	2.6 Check leakage	61.1%	38.9%	0.0%	5.6%	33.3%	61.1%
	2.7 Backfill the trenches	66.7%	27.8%	5.6%	11.1%	55.6%	33.3%
	2.8 Fix Stacks	44.4%	44.4%	11.1%	5.6%	61.1%	33.3%

The following table provides the summarized assessment by NC 3 graduates on their current skills levels in different areas of competencies. The table also provides the use of skills by these graduates as plumbing professionals.

NC level 2 content	List of Competencies (NC 3)	How would you rate your current skill level in different areas of competencies?			How frequently do you use this skill as a plumbing professional?		
		Highly Skilled	Moderately Skilled	Low Skilled	Not at all	Sometimes	Frequently
Carryout installation of internal domestic water supply system	Install water pipes and fittings	84.0%	16.0%	0.0%	6.0%	30.0%	64.0%
	Carryout basic masonry works	28.0%	54.0%	18.0%	28.0%	50.0%	22.0%
	Install water storage Tanks	72.0%	28.0%	0.0%	10.0%	60.0%	30.0%
	Install water pump	68.0%	26.0%	6.0%	6.0%	54.0%	40.0%
	Maintain internal domestic water supply system	80.0%	20.0%	0.0%	4.0%	40.0%	56.0%
Carry out installation of sanitary fixtures and sewerage pipelines	Install sanitary fixtures	84.0%	14.0%	0.0%	8.0%	42.0%	50.0%
	Install sewerage pipelines	80.0%	20.0%	0.0%	10.0%	48.0%	42.0%
Carry out installation of external pipelines and valves	**List of Competencies (NC 3)**	**How would you rate your current skill level in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**		
		Highly Skilled	**Moderately Skilled**	**Low Skilled**	**Not at all**	**Sometimes**	**Frequently**
Install water pipelines and fittings	1.1 Excavate trench	70.0%	30.0%	0.0%	4.0%	70.0%	26.0%
	1.2 Perform bedding	64.0%	34.0%	2.0%	10.0%	70.0%	20.0%
	1.3 Join GI pipe	86.0%	14.0%	0.0%	6.0%	72.0%	22.0%
	1.4 Join HDPE pipe	90.0%	10.0%	0.0%	4.0%	54.0%	42.0%
	1.5 Join DI pipe	28.0%	42.0%	30.0%	48.0%	46.0%	6.0%
	1.6 Fix valves	74.0%	26.0%	0.0%	6.0%	56.0%	38.0%
	1.7 Backfill the trenches	76.0%	24.0%	0.0%	4.0%	72.0%	24.0%
	1.8 Fix water meter	66.0%	28.0%	6.0%	22.0%	60.0%	18.0%
	1.9 Conduct leak test	76.0%	22.0%	2.0%	14.0%	46.0%	40.0%
Maintain external pipelines and fittings	2.1 Locate faults	60.0%	38.0%	2.0%	12.0%	54.0%	34.0%
	2.2 Prepare estimate and cost of maintenance	50.0%	48.0%	2.0%	4.0%	58.0%	38.0%
	2.3 Clear blockage	78.0%	16.0%	6.0%	10.0%	44.0%	46.0%
	2.4 Repair defective pipes and fittings	82.0%	16.0%	2.0%	2.0%	52.0%	46.0%
Maintain treatment plant	**List of Competencies (NC 3)**	**How would you rate your current skill level in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**		
		Highly Skilled	**Moderately Skilled**	**Low Skilled**	**Not at all**	**Sometimes**	**Frequently**
Maintain intake	1.1 Clean intake	46.0%	44.0%	10.0%	20.0%	60.0%	20.0%
Maintain water	2.1 Backwash filter	34.0%	52.0%	14.0%	36.0%	54.0%	10.0%

treatment plant	2.2 Clean sand filter	32.0%	52.0%	16.0%	36.0%	56.0%	8.0%
	2.3 Disinfect water	30.0%	54.0%	16.0%	36.0%	54.0%	10.0%
	2.4 Perform chlorine test	40.0%	40.0%	20.0%	42.0%	44.0%	14.0%
	2.5 Perform pH test	32.0%	44.0%	24.0%	54.0%	28.0%	18.0%
Maintain sewerage treatment plant	3.1 Screen sewage	24.0%	56.0%	20.0%	42.0%	48.0%	10.0%
	3.2 Measure flow rate	28.0%	46.0%	26.0%	50.0%	42.0%	8.0%
	3.3 Clean treatment pond	38.0%	38.0%	24.0%	42.0%	44.0%	14.0%
	3.4 Measure sludge depth	20.0%	56.0%	24.0%	50.0%	46.0%	4.0%
	3.5 Remove sludge	16.0%	58.0%	26.0%	48.0%	46.0%	6.0%
	3.6 Perform BOD test	14.0%	50.0%	36.0%	58.0%	36.0%	6.0%
	3.7 Perform suspended solid test	18.0%	46.0%	36.0%	58.0%	36.0%	6.0%
	3.8 Perform COD test	16.0%	50.0%	34.0%	60.0%	34.0%	6.0%
	3.9 Perform coliform test	18.0%	48.0%	28.0%	56.0%	38.0%	6.0%

3.2 Assessment of Soft Skills by Plumbing Graduates

Besides the skills and competencies listed in the curriculum, the graduates were asked to assess the soft skills learned from the training in the institutes. They were asked to assess their learning from 'very poor' to 'very good'. Graduates were also asked to assess if these soft skills are needed as a plumbing professional. These results are shown in the table below.

Soft Skills	**How would you assess the soft skills you learned from the training in the institute? Use the following scale to score.**					**Is this soft skill needed as a plumbing professional?**
	Very poor	**Poor**	**Average**	**Good**	**Very Good**	
Team work	0.0%	1.5%	7.4%	32.4%	58.8%	100.0%
Communication skills	0.0%	0.0%	8.8%	30.9%	60.3%	100.0%
Planning (work)	0.0%	0.0%	13.2%	36.8%	50.0%	100.0%
Workplace housekeeping	1.5%	0.0%	11.8%	35.3%	51.5%	100.0%
Time management	1.5%	1.5%	11.8%	36.8%	48.5%	100.0%
Negotiation	2.9%	1.5%	11.8%	44.1%	39.7%	100.0%
Problem solving	0.0%	1.5%	14.7%	26.5%	57.4%	100.0%
Basic ICT skills	2.9%	4.4%	23.5%	32.4%	36.8%	95.6%
Basic research skills	4.4%	5.9%	23.5%	35.3%	30.9%	100.0%
Social Skills	0.0%	2.9%	11.8%	41.2%	44.1%	100.0%
Driglam Namzha	0.0%	1.5%	5.9%	27.9%	64.7%	98.5%
Self presentation and personal hygiene	0.0%	0.0%	7.4%	36.8%	55.9%	100.0%
Waste management	0.0%	1.5%	7.4%	33.8%	55.9%	100. 0%

3.3 Assessment of Tools and Equipment by Plumbing Graduates

The graduates were asked to assess the use of plumbing tools and equipment as a practicing plumbing professional. These are the tools and equipment provided at the institute during the training delivery process.

SN	Hand tools	As a plumbing professional, do you use the following hand tools?		
		NC 2 (total 18)	NC 3 (total 50)	Total Percent
1	Ratchet die	14	40	79.4%
2	Bench Vice	12	34	67.6%
3	Tongue groove plier	14	41	80.9%
4	Locking plier	13	33	67.6%
5	GI Pipe cutter	12	38	73.5%
6	Pipe wrench	17	50	98.5%
7	Adjustable wrench	17	49	97.1%
8	Screw driver	17	48	95.6%
9	Pipe vise with tripod stand	10	33	63.2%
10	Measuring tape	15	49	94.1%
11	Hacksaw frame	15	49	94.1%
12	Flat file	15	44	86.8%
13	Round File	10	37	69.1%
14	Chisel (Flat)	14	47	89.7%
15	Yarning Chisel	12	32	64.7%
16	Hammer	17	50	98.5%
17	Adjustable wrench	18	49	98.5%
18	CPVC pipe cutter	14	41	80.9%
19	CPVC pipe reamer	13	33	67.6%
20	GI Pipe Reamer	11	27	55.9%
21	Spirit level	16	45	89.7%

SN	Equipment	As a plumbing professional, do you use the following equipment?		
		NC 2 (total 18)	NC 3 (total 50)	Total Percent
1	Electrical drilling machine	18	49	98.5%
2	PP-R welding machine	15	37	76.5%
3	Pedestal Drilling Machine	12	27	57.4%
4	Pressure Testing Machine	14	39	77.9%
5	Portable Threading Machine	14	29	63.2%
6	Tiles Cutter	16	41	83.8%
7	HDPE Bud welding machine	9	35	64.7%
8	Universal threading machine	10	26	52.9%
9	Angle grinder machine	15	40	80.9%

10	Pipe bender machine	8	20	41.2%

3.4 Assessment of Skills and Competencies by Industry

A total of 17 employers/industries engaged in the plumbing field were targeted for this industry survey. All participated in the survey accounting for 100 percent response rate. Similar to the questionnaire designed for the NC 2 and NC 3 graduates, industries were asked to assess the different areas of skills and competencies. They were asked to assess the skills requirement in different areas of competencies by asking whether these skills are needed or not needed for a plumbing professional working with them.

1.1	**Carryout installation of internal domestic water supply system**	**How would you assess the skill requirement by a plumbing professional in these different areas of competencies?**	**Number who said 'needed'**	**Percent**
1	Install water pipes and fittings	1.1 Cut Pipe	16	94.1%
		1.2 Ream Pipe	15	88.2%
		1.3 Thread Pipe manually	15	88.2%
		1.4 Thread pipe mechanically	16	94.1%
		1.5 Perform GI Pipe Joint	15	88.2%
		1.6 Perform CPVC pipe joint	16	94.1%
		1.7 Perform PPR pipe joint	16	94.1%
		1.8 Perform HDPE pipe joint	15	88.2%
		1.9 Prepare Layout	17	100.0%
		1.10 Cut Channel	16	94.1%
		1.11 Lay Pipe	17	100.0%
		1.12 Fix Clamp	16	94.1%
		1.13 Conduct Leak Test	17	100.0%
		1.14 Insulate pipe	17	100.0%
2	Carryout basic masonry works	2.1 Prepare mortar	16	94.1%
		2.2 Construct wall	14	82.4%
		2.3 Perform plastering	13	76.5%
		2.4 Perform basic RCC work	15	88.2%
3	Install water storage Tanks	3.1 Prepare bedding	16	94.1%
		3.2 Fix tank components	17	100.0%
		3.3 Mount storage tank	17	100.0%
		3.4 Check leakages	17	100.0%
4	Install water pump	4.1 Prepare layout	17	100.0%
		4.2 Construct pump base	17	100.0%
		4.3 Fix pump and its accessories	17	100.0%
		4.4 Test pump	17	100.0%
5	Maintain internal domestic water supply system	5.1 Locate fault	16	94.1%
		5.2 Prepare estimate and costing of maintenance	17	100.0%
		5.3 Clear pipe blockage	17	100.0%

		5.4 Repair/Replace defective pipes and fittings(CP fittings)	17	100.0%
		5.5 Service pump	17	100.0%
		5.6 Service storage tank	17	100.0%
1.2	**Carry out installation of sanitary fixtures and sewerage pipelines**	**How would you assess the skill requirement by a plumbing professional in these different areas of competencies?**	**Number who said 'needed'**	**Percent**
	Install sanitary fixtures	1.1 Prepare layout	16	94.1%
		1.2 Fix fixture bracket	16	94.1%
		1.3 Install wash basin	16	94.1%
		1.4 Install European type water closet pan	16	94.1%
		1.5 Fix Cistern	16	94.1%
		1.6 Install Asian/Indian type water closet pan	16	94.1%
		1.7 Fix geyser	16	94.1%
		1.8 Fix Urinal	16	94.1%
		1.9 Install Bath tub	16	94.1%
		1.10 Fix bathroom accessories	16	94.1%
		1.11 Install kitchen sink	16	94.1%
		1.12 Install bidet	16	94.1%
		1.13 Install urinal with automatic cistern	16	94.1%
		1.14 Install Jacuzzi bathtub	16	94.1%
		1.15 Install shower (cubical/rectangular)	16	94.1%
		1.16 Apply adhesive to the fixtures	16	94.1%
		1.17 Check fixtures installation	16	94.1%
	Install sewerage pipelines	2.1 Excavate trench	14	82.4%
		2.2 Perform bedding	15	88.2%
		2.3 Join PVC/HDPE pipes	15	88.2%
		2.4 Lay pipe	16	94.1%
		2.5 Construct chamber	15	88.2%
		2.6 Check leakage	16	94.1%
		2.7 Backfill the trenches	14	82.4%
		2.8 Fix Stacks	14	82.4%
1.3	**Carry out installation of external pipelines and valves**	**How would you assess the skill requirement by a plumbing professional in these different areas of competencies?**	**Number who said 'needed'**	**Percent**
1	Install water pipelines and fittings	1.1 Excavate trench	13	76.5%
		1.2 Perform bedding	15	88.2%
		1.3 Join GI pipe	15	88.2%
		1.4 Join HDPE pipe	16	94.1%
		1.5 Join DI pipe	16	94.1%
		1.6 Fix valves	17	100.0%
		1.7 Backfill the trenches	15	88.2%
		1.8 Fix water meter	15	88.2%

		1.9 Conduct leak test	16	94.1%
2	Maintain external pipelines and fittings	2.1 Locate faults	16	94.1%
		2.2 Prepare estimate and cost of maintenance	17	100.0%
		2.3 Clear blockage	17	100.0%
		2.4 Repair defective pipes and fittings	17	100.0%

3.5 Assessment of Soft Skills Providing during Training by Industry

The industries were also asked to assess the soft skills required by plumbing professionals. All industries were asked if the following soft skills are required for practicing plumbing professionals working with them, the results of which are highlighted in the table below.

Soft skills	**Number who said 'required'**	**Percent**
Team work	17	100.0%
Communication skills	17	100.0%
Planning (work)	17	100.0%
Workplace housekeeping	17	100.0%
Time management	17	100.0%
Negotiation	15	88.2%
Problem solving	16	94.1%
Basic ICT skills	14	82.4%
Basic research skills	13	76.5%
Social Skills	16	94.1%
Driglam Namzha	16	94.1%
Self presentation and personal hygiene	17	100.0%
Waste management	17	100.0%

3.6 Assessment of Tools and Equipments used during Training by Industry

The industries were asked if they provided the following hand tools and equipment to the plumbing professionals working with them. These are the hand tools and equipment provided by the two institutes during the training process.

Do you provide the following hand tools to plumbing professionals working with you?	**Number who said 'yes'**	**Percent**
Ratchet die	11	64.7%
Bench Vice	12	70.6%
Tongue groove plier	15	88.2%
Locking plier	13	76.5%

GI Pipe cutter	11	64.7%
Pipe wrench	17	100.0%
Adjustable wrench	17	100.0%
Screw driver	17	100.0%
Pipe vise with tripod stand	12	70.6%
Measuring tape	17	100.0%
Hacksaw frame	17	100.0%
Flat file	14	82.4%
Round File	14	82.4%
Chisel (Flat)	16	94.1%
Yarning Chisel	11	64.7%
Hammer	17	100.0%
Adjustable wrench	17	100.0%
CPVC pipe cutter	17	100.0%
CPVC pipe reamer	14	82.4%
GI Pipe Reamer	11	64.7%
Spirit level	16	94.1%
Do you provide the following equipment to plumbing professionals working with you?	**Number who said 'yes'**	**Percent**
Electrical drilling machine	17	100.0%
PP-R welding machine	15	88.2%
Pedestal Drilling Machine	13	76.5%
Pressure Testing Machine	14	82.4%
Portable Threading Machine	11	64.7%
Tiles Cutter	17	100.0%
HDPE Bud welding machine	13	76.5%
Universal threading machine	9	52.9%
Angle grinder machine	16	94.1%
Pipe bender machine	12	70.6%

PART 4 GAP ASSESSMENT

As indicated in part 3 of this report, most of the skills and competencies provided through the NC 2 and NC3 level programs are considered relevant by both the plumbing graduates as well as the industries. In this section, we look at the additional skills and competencies, softs skills, and tools and equipment listed by the industry and plumbing professionals as important in the current labour market. This section also provides key information on the technological and other development in the plumbing industry, with feedback from both the graduates and industries to improve the plumbing course.

4.1 Additional Skills and competencies listed by the industries

☐ Installation of sensor equipped sanitary fixtures ☐ Auto urinal flush systems	☐ Masonry Skills ☐ Basic knowledge on construction technology (machinery) ☐ Cutting of Granite/Marble slabs for wash basin installation ☐ Laying and repair and maintenance of tiles	☐ Basic Electrical Skills ☐ Basic knowledge in wiring (geyser and water pump connection,wiring, single phase/3 phase geyser)
☐ Bud fusion joint ☐ Kitec and composite pipe ☐ Composite pipe ☐ Rain-gutter fixing/pipe fixing ☐ UPVC pipe	☐ Operating core machine ☐ Operating Electro fusion welding machine with electrofusion couplers (HDPE) ☐ Repairing and maintenance of sensor equipped fixtures (electronic skills) ☐ Repairing of tools	☐ Swimming pool layout
☐ Floor heating systems	☐ Portable leak testing ☐ Waterproofing: Usually plumbers have to seal jams of installations & need good waterproofing ideas	☐ Water filtration
☐ Heat pump (central heating system)	☐ Green kitchen (solar technology)	☐ External drainage system ☐ Sewerage layout ☐ Artificial Sewerage treatment

4.2 Additional Skills and competencies listed by the the graduates (NC 2)

☐ Architectural drawings interpretation ☐ DWG drawing interpretation ☐ Taught only simple drawing, specifically engineer drawing (building fixtures/design) ☐ Required skillings on building map drawings (Designs)	☐ Fixing of UPVC pipe ☐ Joining of UPVC pipes ☐ Pex pipe related fitting and accessories	☐ Plastering walls ☐ Tile works
☐ Civil and mechanical carpenter ☐ Need for basic civil, mechanical and carpentry skills ☐ Welding skills	☐ Field training and practical skills	☐ Need advance tools and competencies during training in the institute
☐ More bathtub fixing skills	☐ Teach basic electronic skills along with plumbing ☐ Water-efficient fixtures ☐ Teach heat pump and borewell pump	

4.3 Additional Skills and competencies listed by the the graduates (NC 3)

☐ Basic electrical skills ☐ Electrical appliances (working)	☐ Basic construction skills	☐ Basic welding for modification of GI fittings ☐ Welding knowledge
☐ Basic training for solar water heating system	☐ DI pipe skills ☐ Pipeline construction ☐ PE pipe skills ☐ Required skills to fix DWV and pex pipe ☐ UPVC pipe fixing and joining	☐ How to use and maintain machines

☐ Civil drawing & design interpretation ☐ Drawing interpretation of structure & architecture drawing ☐ Layout of plumbing system for buildings ☐ Need drawing theory class (DWG drawing) ☐ Reading satellite points ☐ Advanced drawing skills ☐ Engineering drawing ☐ In need of more drawing/pictures interpretation of buildings	☐ Irrigation systems ☐ More knowledge on plumbing, water treatment and sewage treatment plants is needed to perform water testing ☐ More practical meter readings and sewage readings needed ☐ Safety tank (pond) training ☐ Sewerage practical training	☐ Field training and practical skills

4.4 Additional Soft skills listed by the industries

☐ Appreciation for the jobs that they do ☐ Attitude ☐ Change mindset ☐ Coordination ☐ Innovation/Creativity ☐ Readiness to make hands dirty ☐ Physical endurance	☐ General contractor training ☐ Mechanical skills (equipment repair and maintenance) ☐ Report writing ☐ Knowledge on basic mathematics ☐ Workmanship skills ☐ Work Ethics

4.5 Additional Soft skills listed by the graduates (NC 2)

• Confidence • Creativity • Critical thinking • Dexterity • Integrity • Interpersonal skills • Interview skills • Leadership skills • Positive attitude	• Administrative skills. Eg.: Organizing & maintaining records, files and database, preparing records & reports • Business management skills • Calculation and estimation skills • Customer service • Entrepreneur skills • Health & safety regulations • Mechanical skills

	• ICT skills • Need for good planning and management • Require knowledge about the working environment • Safety measures • Work ethics • Customer handling • Driving • Making bills • Stock entry

4.6 Additional Soft skills listed by the graduates (NC 3)

• Accountability • Adaptability • Cooperation • Creativity • Credibility • Critical thinking • Dedication • Flexibility • Growth mindset • Hardworking • Innovation • Integrity • Interest and motivation • Patience • Sincerity	• Autocad Drawing • ICT skills • Business management • Customer service • Decision making • Digital skills • Enforcing safety • Entrepreneurship skills • Estimating and costing skills • Grammar and writing skills • Interview skills • Safety measures • Work ethics • Workmanship

4.7 Additional tools and equipments listed by the industries

☐ Digital plumbing level ☐ Electric soldering ☐ Hole-saw cutter ☐ Laser measuring light ☐ Laser leveling instrument ☐ Multi-meter ☐ Cordless Screw drilling ☐ Tool set based on material (SS, Pex, DI, GI, Copper, PVC, UPVC, CPVC and others)	☐ Concrete Breaker/ Hammer drill/Demolition Jack Hammer/ Wall Chisel machine ☐ Advanced and portable pressure checking ☐ Core Cutting Machine (drilling) ☐ Electrical budding machine ☐ Electrofusion machine ☐ Flow meter with sensor ☐ Laser machine ☐ Laser welding machine ☐ Wall cutter/ Wall chaser ☐ Pipe pressure testing with inbuilt pump in compressed air ☐ Pipe welding machine (SS)

	☐ Water leakage detector machine

4.8 Additional tools and equipments listed by the graduates (NC 2)

☐ Face Shield ☐ Knife ☐ Laser light ☐ Strap wrench	☐ Blockage clearing machine ☐ Core cutting machine ☐ Demolition hammer ☐ Electrical screw machine ☐ Laser machine for floor tile and water pipe layouts ☐ Machines for checking water leakages ☐ Water level machine

4.9 Additional tools and equipments listed by the graduates (NC 3)

☐ Crowbar ☐ Hand Auger bit ☐ Inspection camera ☐ Laser level ☐ Leakage detector ☐ Pump plier ☐ Socket wrench ☐ Basic masonry tools like trowel	☐ Block clearing machine ☐ Cordless drill machine ☐ Core drilling machine ☐ Coring machine ☐ DWC pipe butt joint machine ☐ Electrofusion welding machine ☐ Fideral machine ☐ Floor lasering machine ☐ Heating gun machine ☐ New leakage machine ☐ Wall chaser machine ☐ Water level machine

4.10 New areas of opportunities or technological developments in the plumbing field listed by the industries

- ☐ Advance equipment such as electrical drilling machines, pressure checker
- ☐ Change in plumbing materials (more electrical machine operation)/ Change in plumbing materials such as shift from GI pipes to PPR and CPVC pipes
- ☐ Advanced types of pumps (pressure booster/auto sensor pump, submersible pump - centrifugal, rotary, and others)
- ☐ Usage of automatic devices (sensor)
- ☐ Advanced joining of pipes (using machine)
- ☐ Sensor fittings/ Digitize plumbing/ Water saving smart toilet/ Installation of advanced plumbing fittings

- ☐ Instant geyser (single phase and three phase)
- ☐ Usage of stainless steel pipe
- ☐ Mechanizing the work components for higher efficiency
- ☐ Opportunities for smart technologies
- ☐ Rain water harvesting
- ☐ Solar heating
- ☐ Opportunities for freelance plumbers and private sector/ Specialized job fields such as residential building, hotel and water supply plumbing

4.11 Feedback from the industries to increase the quality of plumbing program

☐ Attractive working dress ☐ Attractive working environment ☐ Mechanization	☐ Basic training on electrical, masonry civil work & carpentry ☐ Good quality of workmanship (plumbing) ☐ In Depth study on water treatment plant	☐ Change the mindset of the youths ☐ Inculcate readiness to make hands dirty ☐ Motivation
☐ Consistency of the supply to the industry ☐ Field attachment to relevant plumbing industries ☐ Focus more in practical training and OJT ☐ Longer duration of attachments in the industry for plumbers	☐ Proper training with proper facilities ☐ Proper usage of tools & equipment ☐ While doing training, students should be provided with quality tools and equipment ☐ Latest tools and technology has to be exposed to trainees before they are exposed to job market ☐ Sensor to detect pipe leakage	☐ Technical courses should be introduced in the schools

4.12 Feedback from the graduates to increase the quality of plumbing program

☐ Detailed course on PPR pipe ☐ Need more skilling and trainings on the use of more advanced technologies ☐ Need to change theoretical topics and lessons	☐ Increase the duration in the field ☐ In depth theory ☐ More practical training ☐ More field attachments ☐ Need to send in relevant OJT field	☐ Call external experts to teach in the institute ☐ Additional trainings and exchange programs abroad ☐ Need to engage students in workshops and seminars to enhance their skills and

☐ Teach more on construction of sewage pipes ☐ Teach more on external pipeline construction ☐ Basic electrical course should be provided ☐ DI-Joining ☐ Different types of pipes (PPR) for training in institute ☐ Seminars in water treatment ☐ Welding skills should be provided to the plumber	☐ Enough and advanced equipments should be provided during trainings and practical sessions ☐ Field attachment with experienced and reputable firms ☐ More training duration ☐ OJT duration to be maximized ☐ More of practicals on masonry and pipeline construction ☐ Need for more field attachments for experience and confidence ☐ Sewerage and Treatment practical duration should be increased ☐ Water testing practically in labs ☐ Need for a focal person to look into and also attachments related to plumbing	knowledge on the new technologies ☐ Requirement of more trained/professional trainers ☐ Advance training from foreign plumbing professionals ☐ Additional trainings and exchange programs abroad ☐ In need of more professional tutors with experience in the field ☐ Qualified experts from outside the country should be called for teaching ☐ Need for additional instructors ☐ More professional teachers are needed

☐ Demands more opportunities/job provisions from government sectors ☐ Enrollment of students should be above class 12 ☐ Increase job opportunities for plumbing graduates ☐ Best rankers to get default government jobs ☐ Encourage performance based incentives ☐ Gender discrimination should be avoided (males are prioritized) ☐ Mismatch of jobs should be decreased (NC 3 gets NC 2 jobs) ☐ Job related skills are required ☐ Need to increase the salary of plumbers (basic salary is very low) ☐ Need more job opportunities ☐ Income for the jobs should be increased and there is shortage of jobs in the market	☐ Basic knowledge on advanced tools and equipments ☐ Adequate tools available for training ☐ Adequate/advanced equipments provided during learning ☐ Advanced tools for learning ☐ Focus more on modernized plumbing materials and equipments ☐ Need trainings and workshops on advanced plumbing tools and techniques ☐ Replace old tools with new tools ☐ Requirement of enough equipments for the trainees in the institute	☐ Advancement of plumbing graduates doing diploma ☐ Institute Diploma courses for the plumbing students ☐ Multi training, skill upgrades, Diploma to be efficient plumber ☐ Need Diploma courses in institutes ☐ Scholarship programs should be introduced ☐ Short skilling programs ☐ Require degree programme for graduates ☐ Provide tertiary education eg. Degree ☐ Institutes should have refresher course at least once a year to discuss challenges and way forward
☐ Architectural drawings need to be addressed and focused ☐ Detailed drawing interpretation in terms of civil ☐ Drawing and estimation classes should be prioritized	☐ Additional trainings and exchange programs abroad ☐ On the Job trainings abroad	☐ Need more funds to provide and accustom students with new technologies ☐ Plumbers' skills must be tested through a general examination with 4 to 5 years after their graduation ☐ Need for dress code

PART 5 RECOMMENDATIONS

5.1 Curriculum Review

The TTTRC will be reviewing and updating the curriculum for the plumbing course at both NC 2 and NC 3 levels. While additional industry consultation will be carried out as part of the review process, the findings within this report will be used during the review process to add an additional list of learning outcomes, competencies, soft skills, and to review the existing tools and equipment used during the training delivery process. The following tables provide recommendations based on the feedback from the industries and plumbing professionals on the existing curriculum. The subsequent section provides recommendations of the new learning outcomes to be added in the existing curriculum.

Competency area (NC 2)	**Learning outcomes**	**List of competencies**	**Recommendation during curriculum review**
Carryout installation of internal domestic water supply system and sanitary fixtures	1. Install water pipes and Chrome Plated(CP)fittings	1.1 Cut Pipe 1.2 Ream Pipe 1.3 Thread Pipe manually 1.4 Thread pipe mechanically 1.5 Perform GI Pipe Joint 1.6 Perform CPVC pipe joint 1.7 Perform PPR pipe joint 1.8 Perform HDPE pipe joint 1.9 Prepare Layout 1.10 Cut Channel 1.11 Lay Pipe 1.12 Fix Clamp 1.13 Conduct Leak Test 1.14 Insulate Pipe	All competencies are relevant and to be retained in the curriculum
	2. Carryout basic masonry works	2.1 Prepare mortar 2.2 Construct wall 2.3 Perform plastering 2.4 Perform basic RCC work	All competencies are relevant and to be retained in the curriculum
	3. Install water storage Tanks	3.1 Prepare bedding 3.2 Fix tank components 3.3 Mount storage tank 3.4 Check leakages	All competencies are relevant and to be retained in the curriculum
	4. Install water pump	4.1 Prepare layout 4.2 Construct pump base 4.3 Fix pump and its accessories 4.4 Test pump	All competencies are relevant and to be retained in the curriculum
	5.Maintain internal domestic water supply system	5.1 Locate fault 5.2 Prepare estimate and costing of maintenance	All competencies are relevant and to be retained in the curriculum

		5.3 Clear pipe blockage 5.4 Repair/Replace defective pipes and fittings(CP fittings) 5.5 Service pump 5.6 Service storage tank	
Carry out installation of sanitary fixtures and sewerage pipelines	1. Install sanitary fixtures	1.1 Prepare layout 1.2 Fix fixture bracket 1.3 Install wash basin 1.4 Install European type water closet pan 1.5 Fix Cistern 1.6 Install Asian/Indian type water closet pan 1.7 Fix geyser 1.8 Fix Urinal 1.9 Install Bath tub 1.10 Fix bathroom accessories 1.11 Install kitchen sink 1.12 Install bidet 1.13 Install urinal with automatic cistern 1.14 Install Jacuzzi bathtub 1.15 Install shower (cubical/rectangular) 1.16 Apply adhesive to the fixtures 1.17 Check fixtures installation	All competencies are relevant and to be retained in the curriculum
	2. Install sewerage pipelines	2.1 Excavate trench 2.2 Perform bedding 2.3 Join PVC/HDPE pipes 2.4 Lay pipe 2.5 Construct chamber 2.6 Check leakage 2.7 Backfill the trenches 2.8 Fix Stacks	All competencies are relevant and to be retained in the curriculum

Competency area (NC 3)	**Learning Outcome**	**List of competencies**	**Recommendation during curriculum review**
Carry out installation of external pipelines and valves	1. Install water pipelines and fittings	1.1 Excavate trench 1.2 Perform bedding 1.3 Join GI pipe 1.4 Join HDPE pipe 1.5 Join DI pipe 1.6 Fix valves 1.7 Fix water meter 1.8 Conduct leak test	All competencies are relevant and to be retained in the curriculum

	2. Maintain external pipelines and fittings	2.1 Clear blockage 2.2 Repair defective pipes and fittings	All competencies are relevant and to be retained in the curriculum
Maintain treatment plant	1. Maintain intake	1.1 Clean intake	All competencies are relevant and to be retained in the curriculum
	2. Maintain water treatment plant	2.1 Backwash filter 2.2 Clean sand filter 2.3 Disinfect water 2.4 Perform chlorine test 2.5 Perform pH test	All competencies are relevant and to be retained in the curriculum
	3. Maintain sewerage treatment plant	3.1 Remove sludge 3.2 Perform BOD test 3.3 Perform suspended solid test 3.4 Perform COD test 3.5 Perform coliform test	All competencies are relevant and to be retained in the curriculum

Recommendation of additional learning outcomes to be added in the curriculum during curriculum review process:

1. Installation of sensor equipped sanitary fixtures	**2. Masonry Skills** Basic construction skills; Basic knowledge on construction technology (machinery); Cutting of Granite/Marble slabs for wash basin installation; Plastering walls; Tile works; Laying and repair and maintenance of tiles	**3. Basic wiring and electrical knowledge** Basic knowledge in wiring; Basic electrical skills; Plumbing Electrical appliances (geyser and water pump connection,wiring, single phase, 3 phase geyser) ** could be provided as a short-course*
4. Pipes and Fittings Kitec pipes and fittings; Composite pipes and fittings; Copper pipes and fittings; SS pipes and fittings for hot water supply, DI pipes and fittings; UPVC pipes and fittings; PE pipes and fittings; DWV pipes and fittings	**5. Plumbing tools, equipment and machine care and maintenance** Operating core machine; Operating Electro fusion welding machine with electrofusion couplers (HDPE); Repairing and maintenance of sensor equipped fixtures (electronic skills); Repairing of tools, equipment and machine.	**6. Advance Drawing, layout, and interpretation** Architectural and structure drawings interpretation; Engineer drawing (building fixtures/design); Building map drawings; Swimming pool layout; Civil drawing & design interpretation; Layout of plumbing system for buildings; Drawing theory class (DWG drawing and interpretation); Reading satellite points
7. Central Heating System Floor heating system; heat pump (central heating system); bore well pump	**8. Leak testing, joints and waterproofing** Portable leak testing; Bud fusion joint; Waterproofing	**9. Water filtration system**

10. Welding and carpentry skills Basic civil, mechanical and carpentry skills; Basic welding for modification of GI fittings; basic electronic skills	**11. Sewerage and water treatment** External drainage system; Sewerage layout; Artificial Sewerage treatment; Water treatment and sewage treatment - water testing; Safety tank (pond) training; Practical training needed for sewerage and water treatment in institutes	**12. Green technology** Water-efficient fixtures; Basic training for solar water heating system; Green kitchen (solar technology)
13. Rain-gutter fixing/pipe fixing	**14. Irrigation system**	

5.2 Soft Skills Review

The following tables provide recommendations on the soft skills currently provided by the institutes during the training. The subsequent section provides recommendations of the new soft skills to be added in the existing training delivery.

Soft Skills	**Recommendation during NCS or curriculum review**
Team work	All soft skills are relevant and to be retained in the NCS and curriculum
Communication skills	
Planning (work)	
Workplace housekeeping	
Time management	
Negotiation	
Problem solving	
Basic ICT skills	
Basic research skills	
Social Skills	
Driglam Namzha	
Self presentation and personal hygiene	
Waste management	

Recommendation of additional soft skills to be added during the NCS and curriculum review:

1. Work attitude Appreciation for the jobs that they do; Readiness to make hands dirty; Positive attitude; Integrity; Accountability; Adaptability; Cooperation; Credibility; Dedication; Flexibility; Growth mindset; Hardworking; Interest and motivation; Patience; Sincerity **2. Innovation/Creativity** Creativity; Innovation **3. Critical thinking** **4. Leadership skills** Confidence **5. Physical strength** Dexterity; Physical endurance	**1. Writing** Report writing; Grammar and writing skills **2. Estimation and Calculation** Knowledge on basic mathematics; making bills; Estimating and costing skills **3. Work Ethics** Workmanship skills **4. Administrative skills** General contractor training; Organizing & maintaining records, files and database, preparing records & reports; Business management skills; Planning and management; stock entry; Decision making **5. Customer service** Customer handling **6. Entrepreneurship skills** **7. Health & safety regulations** Safety measures; Enforcing safety **8. ICT skills** Digital skills **9. Interview Skills**

5.3 Tools and Equipments Review

The following tables provide recommendations on the relevancy of different tools and equipment currently used by the institutes during the training delivery process. The subsequent section provides recommendations of the new tools and equipment to be used during the training delivery.

SN	Hand tools	Recommendation
1	Ratchet die	All hand tools are relevant and to be retained in the curriculum/NCS and in training delivery process
2	Bench Vice	
3	Tongue groove plier	
4	Locking plier	

5	GI Pipe cutter	
6	Pipe wrench	
7	Adjustable wrench	
8	Screw driver	
9	Pipe vise with tripod stand	
10	Measuring tape	
11	Hacksaw frame	
12	Flat file	
13	Round File	
14	Chisel (Flat)	
15	Yarning Chisel	
16	Hammer	
17	Adjustable wrench	
18	CPVC pipe cutter	
19	CPVC pipe reamer	
20	GI Pipe Reamer	
21	Spirit level	

SN	Equipment	Recommendation
1	Electrical drilling machine	All equipment are relevant and to be retained in the curriculum/NCS and training delivery process
2	PP-R welding machine	
3	Pedestal Drilling Machine	
4	Pressure Testing Machine	
5	Portable Threading Machine	
6	Tiles Cutter	
7	HDPE Bud welding machine	
8	Universal threading machine	
9	Angle grinder machine	
10	Pipe bender machine	

Recommendation for additional hand tools and equipment to be used during the training delivery process and review of NCS and curriculum:

Tools:	**Equipment:**
☐ Basic masonry tools like trowel ☐ Cordless Screw drilling ☐ Crowbar ☐ Digital plumbing level ☐ Electric soldering	☐ Advanced and portable pressure checking ☐ Block clearing machine ☐ Concrete Breaker/ Hammer drill/Demolition Jack Hammer/ Wall Chisel machine (Wall chaser) ☐ Cordless drill machine

☐ Face Shield ☐ Hand Auger bit ☐ Hole-saw cutter ☐ Inspection camera ☐ Knife ☐ Laser leveling instrument ☐ Laser measuring light ☐ Leakage detector ☐ Multi-meter ☐ Tool set based on material (SS, Pex, DI, GI, Copper, PVC, UPVC, CPVC and others) ☐ Pump plier ☐ Socket wrench ☐ Strap wrench	☐ Core Cutting Machine (drilling) ☐ Coring machine ☐ DWC pipe butt joint machine ☐ Electrical budding machine ☐ Electrical screw machine ☐ Electrofusion welding machine ☐ Floor laser machine ☐ Flow meter with sensor ☐ Heating gun machine ☐ Pipe pressure testing with inbuilt pump in compressed air ☐ Pipe welding machine for SS pipe ☐ Water leakage detector machine ☐ Water level machine

5.4 National Competency Standards Review

During the report drafting stage, the TVET-QC was in process of reviewing the NCS for the plumbing course at both NC 2 and NC 3 levels. However, with request from the DWPSD, the final stage of the review process was kept on hold. The TVET-QC will incorporate additional requirements in terms of unit, element, soft skills, and tools and equipment to be used during the training delivery process, as detailed out in section 5.1, 5.2, and 5.3 of this report, which is not repeated in this section. The NCS review for the plumbing course at both NC 2 and NC 3 level should incorporate recommendations provided in this report. The following two tables provide recommendations based on the feedback from the industries and plumbing professionals on the existing elements within the NCS for NC 2 and NC 3 level.

Unit (NC 2)	**Element**	**Remarks**
Carryout installation of internal domestic water supply system and sanitary fixtures	1. Install water pipes and Chrome Plated(CP) fittings	Relevant (in the curriculum)
	2. Lay soil and waste pipe and fittings	Relevant (in the curriculum)
	3.Install sanitary fixtures and fitting	Relevant (in the curriculum)
	4.Install water based floor radiant heating system	Relevant (to be included in the curriculum)
	5.Install water tanks and pumps	Relevant (in the curriculum)

	6.Repair plumbing system	Relevant (in the curriculum)
Carryout installation of external water supply system	1. Lay external pipelines and valves	Relevant (in the curriculum)
	2. Repair plumbing system	Relevant (in the curriculum)
	3. Conduct operation and maintenance of water intake and treatment plant	Relevant (in the curriculum)

Unit (NC 3)	**Element**	**Remarks**
Carryout installation of main sewer system	1. Install sewer lines	Relevant (in the curriculum)
	2. Install chambers and manholes	Relevant (to be included in the curriculum)
	3. Conduct operation and maintenance of sewerage treatment plant	Relevant (in the curriculum)
Carryout installation of advanced sanitary and bathroom	1. Install advanced sanitary fixtures	Relevant (in the curriculum)
	2. Install cubicle shower	Relevant (in the curriculum)
	3. Install advanced sanitary fixture with sensors	Relevant (to be included in the curriculum)

5.5 Capacity Development of Trainers

The two institutes currently have a total of six plumbing instructors, four in TTI-C and two in JWPTI. All instructors are TOT certified, with two instructors having bachelors degree qualification and four with diploma qualification. With the update of NCS and curriculum to incorporate all the new elements and learning outcomes, the two training institutes will have to provide additional skills and competencies to the learners. The review of the plumbing course will have to be complemented by capacity development of existing instructors to provide training in the additional learning areas. As per the assessment of capacities of the existing instructors, their capacity will have to be built in the following areas. The occupational skills development program implemented by TTTRC can be a means to address this.

- Sensor fittings and fixtures
- Central heating system
- Radiant floor heating system
- Rain water harvesting
- Repair and maintenance of plumbing tools and equipment
- Practical on Pex and SS pipes

- Artificial sewerage treatment

5.6 Other Recommendations

5.6.1 Training materials

The training materials currently used for the delivery of the two NC levels courses at the two institutes are: PPR pipes and fittings for water supply, GI Pipes and Fittings for water supply, PVC Pipe and fitting for water/soil, CPVC pipes and fittings for water supply, Pex pipes and fittings for water supply, and HDPE Pipe and fitting for both water and waste/soil. Based on the study, the two institutes are recommended to use these additional training materials for the training delivery: Copper pipes and fittings for water supply, SS pipes and fittings for hot water supply, and HDPE Pipe and fitting for both water and waste/soil, DI pipes, and UPVC pipes.

5.6.2 Gender and wage study

During the survey, there were also indications of wage discrepancies between the male and female graduates. At the NC 2 level, the average monthly earning was Nu. 18,958, where male graduates were earning Nu. 21,744 and female graduates were earning Nu. 16,171 on average. At the NC 3 level, the average monthly earning was Nu. 23,017, where male graduates were earning Nu. 26,156 and female graduates were earning Nu. 20,551 on average. During the focus group discussion with the industries and plumbing professionals, this discrepancy was discussed. However, to understand the wage discrepancies among the two genders, a separate study is recommended, which can be carried out by WPID, DWPSD.

5.6.3 Alignment of NCS and Curriculum

A closer look at the NCS and the curriculum shows inconsistency between the ‘elements’ and ‘learning outcomes’ at both NC 2 and NC 3 level. In the curriculum, at the NC 2 level, the content is on the internal water system. The external water system is covered in the NC 3 level curriculum. However, in the NCS, both internal and external water systems are at the NC 2 level. Furthermore, the NCS for NC 3 includes sewerage system and advanced sanitary fixtures which are not in the curriculum. Therefore, going forward, there is a need to align the ‘elements’ and ‘learning outcomes’ between the NCS and curriculum for both NC 2 and NC 3 levels. This has to be led by TTTRC and TVET-QC.

5.6.4 Procurement of training materials, tools and equipment

The centralization of the procurement system within the Government has had implications on the cost of tools, equipment, and materials purchased by the two training institutes. Since the two institutes are located outside Thimphu Dzongkhag, the procurement is carried out by Dzongkhag administration. This has led to a drastic increase in the cost of training materials, tools, and equipment procured on a regular basis. Therefore, there is a need to reassess the current procurement practices to adopt one where quality and relevant tools, equipment and training materials can be procured at the most cost effective market rates.

5.6.5 Adequate supply of plumbers in the labour market

Despite the critical need for plumbers in the labour market, the two institutes are churning out less than 50 graduates in a year. The annual intake for the plumbing course is less than 50 slots. Bhutan currently imports a very high number of foreign workers in the 'plumbers' category under the guise of other occupations. Furthermore, there are a high number of practicing plumbers in the labour market without any vocational qualification and training. Plumbing occupation is one of the critical jobs in the construction sector. As the sector grows and gains dominance, this occupation will continue to be very important for the labour market. Therefore, while the training quality and relevancy is enhanced through NCS and curriculum review, there is a need to increase the intake capacity of trainees in the plumbing course in the two institutes.

ANNEXURE 1 SURVEY QUESTION FOR PLUMBING FIRMS AND INDUSTRIES

Questionnaire for the Plumbing Firm/Business

Name of the firm		**Number of employees**	
Location Dzongkhag		**Number of Female employees**	
Year of establishment		**Number of Plumbing employees**	
Ownership type		**Economic activity**	

PART 1 LEARNING CONTENT

1.1 Carryout installation of internal domestic water supply system

	Learning topics	List of competencies	How would you assess the skill requirement by a plumbing professional in these different areas of competencies?
1	Install water pipes and fittings	*1.1 Cut Pipe*	◯Needed ◯Not needed
		1.2 Ream Pipe	◯Needed ◯Not needed
		1.3 Thread Pipe manually	◯Needed ◯Not needed
		1.4 Thread pipe mechanically	◯Needed ◯Not needed
		1.5 Perform GI Pipe Joint	◯Needed ◯Not needed
		1.6 Perform CPVC pipe joint	◯Needed ◯Not needed
		1.7 Perform PPR pipe joint	◯Needed ◯Not needed
		1.8 Perform HDPE pipe joint	◯Needed ◯Not needed
		1.9 Prepare Layout	◯Needed ◯Not needed
		1.10 Cut Channel	◯Needed ◯Not needed
		1.11 Lay Pipe	◯Needed ◯Not needed
		1.12 Fix Clamp	◯Needed ◯Not needed
		1.13 Conduct Leak Test	◯Needed ◯Not needed
		1.14 Insulate pipe	◯Needed ◯Not needed
2	Carryout basic masonry works	*2.1 Prepare mortar*	◯Needed ◯Not needed
		2.2 Construct wall	◯Needed ◯Not needed
		2.3 Perform plastering	◯Needed ◯Not needed
		2.4 Perform basic RCC work	◯Needed ◯Not needed
3	Install water storage Tanks	*3.1 Prepare bedding*	◯Needed ◯Not needed
		3.2 Fix tank components	◯Needed ◯Not needed
		3.3 Mount storage tank	◯Needed ◯Not needed
		3.4 Check leakages	◯Needed ◯Not needed
4	Install water pump	*4.1 Prepare layout*	◯Needed ◯Not needed
		4.2 Construct pump base	◯Needed ◯Not needed
		4.3 Fix pump and its accessories	◯Needed ◯Not needed
		4.4 Test pump	◯Needed ◯Not needed
5	Maintain internal domestic water supply system	*5.1 Locate fault*	◯Needed ◯Not needed
		5.2 Prepare estimate and costing of maintenance	◯Needed ◯Not needed
		5.3 Clear pipe blockage	◯Needed ◯Not needed

		5.4 Repair/Replace defective pipes and fittings(CP fittings)	◯Needed ⓘNot needed
		5.5 Service pump	◯Needed ⓘNot needed
		5.6 Service storage tank	◯Needed ⓘNot needed

1.2 Carry out installation of sanitary fixtures and sewerage pipelines

	Learning topics	**List of competencies**	**How would you assess the skill requirement by a plumbing professional in these different areas of competencies?**
	Install sanitary fixtures	*1.1 Prepare layout*	◯Needed ⓘNot needed
		1.2 Fix fixture bracket	◯Needed ⓘNot needed
		1.3 Install wash basin	◯Needed ⓘNot needed
		1.4 Install European type water closet pan	◯Needed ⓘNot needed
		1.5 Fix Cistern	◯Needed ⓘNot needed
		1.6 Install Asian/Indian type water closet pan	◯Needed ⓘNot needed
		1.7 Fix geyser	◯Needed ⓘNot needed
		1.8 Fix Urinal	◯Needed ⓘNot needed
		1.9 Install Bath tub	◯Needed ⓘNot needed
		1.10 Fix bathroom accessories	◯Needed ⓘNot needed
		1.11 Install kitchen sink	◯Needed ⓘNot needed
		1.12 Install bidet	◯Needed ⓘNot needed
		1.13 Install urinal with automatic cistern	◯Needed ⓘNot needed
		1.14 Install Jacuzzi bathtub	◯Needed ⓘNot needed
		1.15 Install shower (cubical/rectangular)	◯Needed ⓘNot needed
		1.16 Apply adhesive to the fixtures	◯Needed ⓘNot needed
		1.17 Check fixtures installation	◯Needed ⓘNot needed
	Install sewerage pipelines	*2.1 Excavate trench*	◯Needed ⓘNot needed
		2.2 Perform bedding	◯Needed ⓘNot needed
		2.3 Join PVC/HDPE pipes	◯Needed ⓘNot needed
		2.4 Lay pipe	◯Needed ⓘNot needed
		2.5 Construct chamber	◯Needed ⓘNot needed
		2.6 Check leakage	◯Needed ⓘNot needed
		2.7 Backfill the trenches	◯Needed ⓘNot needed
		2.8 Fix Stacks	◯Needed ⓘNot needed

1.3 Carry out installation of external pipelines and valves

	Learning Topics	**List of competencies**	**How would you assess the skill requirement by a plumbing professional in these different areas of competencies?**
1	Install water pipelines and fittings	*1.1 Excavate trench*	◯Needed ⓘNot needed
		1.2 Perform bedding	◯Needed ⓘNot needed
		1.3 Join GI pipe	◯Needed ⓘNot needed
		1.4 Join HDPE pipe	◯Needed ⓘNot needed
		1.5 Join DI pipe	◯Needed ⓘNot needed
		1.6 Fix valves	◯Needed ⓘNot needed

		1.7 Backfill the trenches	◯Needed ⓘNot needed
		1.8 Fix water meter	◯Needed ⓘNot needed
		1.9 Conduct leak test	◯Needed ⓘNot needed
2	Maintain external pipelines and fittings	*2.1 Locate faults*	◯Needed ⓘNot needed
		2.2 Prepare estimate and cost of maintenance	◯Needed ⓘNot needed
		2.3 Clear blockage	◯Needed ⓘNot needed
		2.4 Repair defective pipes and fittings	◯Needed ⓘNot needed

1.4 What additional or new skills and competencies are required by a plumbing professional, which were not listed above?

1	
2	
3	
4	
5	

PART 2 SOFT SKILLS

2.1	**Topics**	**How would you assess the requirement of the following soft skills needed by a plumbing professional working with your firm?**
1	Team work	◯Required ⓘNot required
2	Communication skills	◯Required ⓘNot required
3	Planning (work)	◯Required ⓘNot required
4	Workplace housekeeping	◯Required ⓘNot required
5	Time management	◯Required ⓘNot required
6	Negotiation	◯Required ⓘNot required
7	Problem solving	◯Required ⓘNot required
8	Basic ICT skills	◯Required ⓘNot required
9	Basic research skills	◯Required ⓘNot required
10	Social Skills	◯Required ⓘNot required
11	Driglam Namzha	◯Required ⓘNot required
12	Self presentation and personal hygiene	◯Required ⓘNot required
13	Waste management	◯Required ⓘNot required

2.2 What additional soft skills are required by a plumbing professional, which are not listed above?

1	
2	
3	

PART 3 TOOLS AND EQUIPMENT

3.1 Does your firm provide the following hand tools to a plumbing professional working with you?

SN	Hand Tools	Tick your answer
1	Ratchet die	◯Yes ◯No
2	Bench Vice	◯Yes ◯No
3	Tongue groove plier	◯Yes ◯No
4	Locking plier	◯Yes ◯No
5	GI Pipe cutter	◯Yes ◯No
6	Pipe wrench	◯Yes ◯No
7	Adjustable wrench	◯Yes ◯No
8	Screw driver	◯Yes ◯No
9	Pipe vise with tripod stand	◯Yes ◯No
10	Measuring tape	◯Yes ◯No
11	Hacksaw frame	◯Yes ◯No
12	Flat file	◯Yes ◯No
13	Round File	◯Yes ◯No
14	Chisel (Flat)	◯Yes ◯No
15	Yarning Chisel	◯Yes ◯No
16	Hammer	◯Yes ◯No
17	Adjustable wrench	◯Yes ◯No
18	CPVC pipe cutter	◯Yes ◯No
19	CPVC pipe reamer	◯Yes ◯No
20	GI Pipe Reamer	◯Yes ◯No
21	Spirit level	◯Yes ◯No

3.2 Does your firm provide the following equipment to a plumbing professional working with you?

SN	Equipment	Tick your answer
1	Electrical drilling machine	◯Yes ◯No
2	PP-R welding machine	◯Yes ◯No
3	Pedestal Drilling Machine	◯Yes ◯No
4	Pressure Testing Machine	◯Yes ◯No
5	Portable Threading Machine	◯Yes ◯No
6	Tiles Cutter	◯Yes ◯No
7	HDPE Bud welding machine	◯Yes ◯No
8	Universal threading machine	◯Yes ◯No
9	Angle grinder machine	◯Yes ◯No
10	Pipe bender machine	◯Yes ◯No

3.3 What new/additional hand tools and equipment (which are not listed above) are used by a plumbing professional working in your firm?

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PART 4 OTHERS

4.1 What are some of the technological developments in the plumbing field?

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4.2 What are some of the new areas of opportunities or developments in the plumbing field?

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4.3 In your view, what can be done to increase the quality of plumbing graduates in the country?

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ANNEXURE 2 SURVEY QUESTIONS FOR NC 2 PLUMBING GRADUATES

Questionnaire for the NC2 Plumbing Graduates

Name		**CID no.**		**Year of Graduation**	
Gender		**Current Dzongkhag**		**Name of the Institute**	
Date of birth		**Monthly income**	Nu. _____	**Mobile number**	

PART 1 LEARNING OUTCOME

1.1 Carryout installation of internal domestic water supply system

	Learning topics	**List of competencies**	**How would you rate your current <u>skill level</u> in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**
			Highly skilled	**Moderately skilled**	**Low skilled**	**1= not at all 2=sometimes 3 = frequently**
1	Install water pipes and fittings	*1.1 Cut Pipe*	◯	◯	◯	
		1.2 Ream Pipe	◯	◯	◯	
		1.3 Thread Pipe manually	◯	◯	◯	
		1.4 Thread pipe mechanically	◯	◯	◯	
		1.5 Perform GI Pipe Joint	◯	◯	◯	
		1.6 Perform CPVC pipe joint	◯	◯	◯	
		1.7 Perform PPR pipe joint	◯	◯	◯	
		1.8 Perform HDPE pipe joint	◯	◯	◯	
		1.9 Prepare Layout	◯	◯	◯	
		1.10 Cut Channel	◯	◯	◯	
		1.11 Lay Pipe	◯	◯	◯	
		1.12 Fix Clamp	◯	◯	◯	
		1.13 Conduct Leak Test	◯	◯	◯	
		1.14 Insulate pipe	◯	◯	◯	
2	Carryout basic masonry works	*2.1 Prepare mortar*	◯	◯	◯	
		2.2 Construct wall	◯	◯	◯	
		2.3 Perform plastering	◯	◯	◯	

		2.4 Perform basic RCC work	◯	◯	◯	
3	Install water storage Tanks	*3.1 Prepare bedding*	◯	◯	◯	
		3.2 Fix tank components	◯	◯	◯	
		3.3 Mount storage tank	◯	◯	◯	
		3.4 Check leakages	◯	◯	◯	
4	Install water pump	*4.1 Prepare layout*	◯	◯	◯	
		4.2 Construct pump base	◯	◯	◯	
		4.3 Fix pump and its accessories	◯	◯	◯	
		4.4 Test pump	◯	◯	◯	
5	Maintain internal domestic water supply system	*5.1 Locate fault*	◯	◯	◯	
		5.2 Prepare estimate and costing of maintenance	◯	◯	◯	
		5.3 Clear pipe blockage	◯	◯	◯	
		5.4 Repair/Replace defective pipes and fittings(CP fittings)	◯	◯	◯	
		5.5 Service pump	◯	◯	◯	
		5.6 Service storage tank	◯	◯	◯	

1.2 Carry out installation of sanitary fixtures and sewerage pipelines

	Learning topics	**List of competencies**	**How would you rate your current <u>skill level</u> in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**
			Highly skilled	**Moderately skilled**	**Low skilled**	**1= not at all 2=sometimes 3 = frequently**
	Install sanitary fixtures	*1.1 Prepare layout*	◯	◯	◯	
		1.2 Fix fixture bracket	◯	◯	◯	
		1.3 Install wash basin	◯	◯	◯	
		1.4 Install European type water closet pan	◯	◯	◯	
		1.5 Fix Cistern	◯	◯	◯	
		1.6 Install Asian/Indian type water closet pan	◯	◯	◯	
		1.7 Fix geyser	◯	◯	◯	
		1.8 Fix Urinal	◯	◯	◯	
		1.9 Install Bath tub	◯	◯	◯	
		1.10 Fix bathroom accessories	◯	◯	◯	
		1.11 Install kitchen sink	◯	◯	◯	
		1.12 Install bidet	◯	◯	◯	
		1.13 Install urinal with automatic cistern	◯	◯	◯	

		1.14 Install Jacuzzi bathtub	◯	◯	◯	
		1.15 Install shower (cubical/rectangular)	◯	◯	◯	
		1.16 Apply adhesive to the fixtures	◯	◯	◯	
		1.17 Check fixtures installation	◯	◯	◯	
	Install sewerage pipelines	*2.1 Excavate trench*	◯	◯	◯	
		2.2 Perform bedding	◯	◯	◯	
		2.3 Join PVC/HDPE pipes	◯	◯	◯	
		2.4 Lay pipe	◯	◯	◯	
		2.5 Construct chamber	◯	◯	◯	
		2.6 Check leakage	◯	◯	◯	
		2.7 Backfill the trenches	◯	◯	◯	
		2.8 Fix Stacks	◯	◯	◯	

1.3 What additional or new skills and competencies are required as a plumbing professional, which were not taught during the training in the institute?

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PART 2 SOFT SKILLS

2.1	**Topics**	**How would you assess the soft skills you learned from the training in the institute? Use the following scale to score** **1 = very poor** **2 = poor** **3 = average** **4 = good** **5 = very good**	**Is this soft skill needed as a plumbing professional?**
1	Team work		◯Yes ◯No
2	Communication skills		◯Yes ◯No
3	Planning (work)		◯Yes ◯No
4	Workplace housekeeping		◯Yes ◯No
5	Time management		◯Yes ◯No
6	Negotiation		◯Yes ◯No
7	Problem solving		◯Yes ◯No
8	Basic ICT skills		◯Yes ◯No

9	Basic research skills		◯Yes ◯No
10	Social Skills		◯Yes ◯No
11	Driglam Namzha		◯Yes ◯No
12	Self presentation and personal hygiene		◯Yes ◯No
13	Waste management		◯Yes ◯No
			◯Yes ◯No

2.2 What additional soft skills are required as a plumbing professional, which were not taught during the training in the institute?

1	
2	
3	

PART 3 TOOLS AND EQUIPMENT

3.1 As a plumbing professional, do you use the following hand tools?

SN	Hand tools	Tick your answer
1	Ratchet die	◯Yes ◯No
2	Bench Vice	◯Yes ◯No
3	Tongue groove plier	◯Yes ◯No
4	Locking plier	◯Yes ◯No
5	GI Pipe cutter	◯Yes ◯No
6	Pipe wrench	◯Yes ◯No
7	Adjustable wrench	◯Yes ◯No
8	Screw driver	◯Yes ◯No
9	Pipe vise with tripod stand	◯Yes ◯No
10	Measuring tape	◯Yes ◯No
11	Hacksaw frame	◯Yes ◯No
12	Flat file	◯Yes ◯No
13	Round File	◯Yes ◯No
14	Chisel (Flat)	◯Yes ◯No
15	Yarning Chisel	◯Yes ◯No
16	Hammer	◯Yes ◯No
17	Adjustable wrench	◯Yes ◯No
18	CPVC pipe cutter	◯Yes ◯No
19	CPVC pipe reamer	◯Yes ◯No
20	GI Pipe Reamer	◯Yes ◯No
21	Spirit level	◯Yes ◯No

3.2 As a plumbing professional, do you use the following equipment?

SN	Equipment	Tick your answer

1	Electrical drilling machine	◯Yes ◯No
2	PP-R welding machine	◯Yes ◯No
3	Pedestal Drilling Machine	◯Yes ◯No
4	Pressure Testing Machine	◯Yes ◯No
5	Portable Threading Machine	◯Yes ◯No
6	Tiles Cutter	◯Yes ◯No
7	HDPE Bud welding machine	◯Yes ◯No
8	Universal threading machine	◯Yes ◯No
9	Angle grinder machine	◯Yes ◯No
10	Pipe bender machine	◯Yes ◯No

3.3	**What new/additional hand tools and equipment (which are not listed above) are needed as a plumbing professional?**
1	
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3.4	**In your view, what can be done to increase the quality of plumbing graduates in the country?**
1	
2	
3	

ANNEXURE 3 SURVEY QUESTIONS FOR NC 3 PLUMBING GRADUATES

Questionnaire for the NC3 Plumbing Graduates

Name		**CID no.**		**Year of Graduation**	
Gender		**Current Dzongkhag**		**Name of the Institute**	
Date of birth		**Monthly income**	Nu. _____	**Mobile number**	

PART 1 LEARNING OUTCOME

1.1 NC 2

	Content during NC level 2	**List of Learning topics**	**How would you rate your current skill level in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**
			Highly skilled	**Moderately skilled**	**Low skilled**	**1= not at all 2=sometimes 3 = frequently**
1	Carryout installation of internal domestic water supply system	Install water pipes and fittings	○	○	○	
		Carryout basic masonry works	○	○	○	
		Install water storage Tanks	○	○	○	
		Install water pump	○	○	○	
		Maintain internal domestic water supply system	○	○	○	
	Carry out installation of sanitary fixtures and sewerage pipelines	Install sanitary fixtures	○	○	○	
		Install sewerage pipelines	○	○	○	

1.2 Carry out installation of external pipelines and valves

	Learning Topics	**List of competencies**	**How would you rate your current skill level in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**
			Highly skilled	**Moderately skilled**	**Low skilled**	**1= not at all 2=sometimes 3 = frequently**
1	Install water pipelines and fittings	*1.1 Excavate trench*	○	○	○	
		1.2 Perform bedding	○	○	○	
		1.3 Join GI pipe	○	○	○	

		1.4 Join HDPE pipe	◯	◯	◯	
		1.5 Join DI pipe	◯	◯	◯	
		1.6 Fix valves	◯	◯	◯	
		1.7 Backfill the trenches	◯	◯	◯	
		1.8 Fix water meter	◯	◯	◯	
		1.9 Conduct leak test	◯	◯	◯	
2	Maintain external pipelines and fittings	*2.1 Locate faults*	◯	◯	◯	
		2.2 Prepare estimate and cost of maintenance	◯	◯	◯	
		2.3 Clear blockage	◯	◯	◯	
		2.4 Repair defective pipes and fittings	◯	◯	◯	

1.3 Maintain treatment plant

	Learning Topics	**List of competencies**	**How would you rate your current <u>skill level</u> in different areas of competencies?**			**How frequently do you use this skill as a plumbing professional?**
			Highly skilled	**Moderately skilled**	**Low skilled**	**1= not at all 2=sometimes 3 = frequently**
1	Maintain intake	*1.1 Clean intake*	◯	◯	◯	
2	Maintain water treatment plant	*2.1 Backwash filter*	◯	◯	◯	
		2.2 Clean sand filter	◯	◯	◯	
		2.3 Disinfect water	◯	◯	◯	
		2.4 Perform chlorine test	◯	◯	◯	
		2.5 Perform pH test	◯	◯	◯	
3	Maintain sewerage treatment plant	*3.1 Screen sewage*	◯	◯	◯	
		3.2 Measure flow rate	◯	◯	◯	
		3.3 Clean treatment pond	◯	◯	◯	
		3.4 Measure sludge depth	◯	◯	◯	
		3.5 Remove sludge	◯	◯	◯	
		3.6 Perform BOD test	◯	◯	◯	
		3.7 Perform suspended solid test	◯	◯	◯	
		3.8 Perform COD test	◯	◯	◯	
		3.9 Perform coliform test	◯	◯	◯	

1.3 What additional or new skills and competencies are required as a plumbing professional, which were not taught during the training in the institute?

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PART 2 SOFT SKILLS

2.1	**Topics**	**How would you assess the soft skills you learned from the training in the institute? Use the following scale to score** **1 = very poor** **2 = poor** **3 = average** **4 = good** **5 = very good**	**Is this soft skill needed as a plumbing professional?**
1	Team work		◯Yes ◯No
2	Communication skills		◯Yes ◯No
3	Planning (work)		◯Yes ◯No
4	Workplace housekeeping		◯Yes ◯No
5	Time management		◯Yes ◯No
6	Negotiation		◯Yes ◯No
7	Problem solving		◯Yes ◯No
8	Basic ICT skills		◯Yes ◯No
9	Basic research skills		◯Yes ◯No
10	Social Skills		◯Yes ◯No
11	Driglam Namzha		◯Yes ◯No
12	Self presentation and personal hygiene		◯Yes ◯No
13	Waste management		◯Yes ◯No

2.2 What additional soft skills are required as a plumbing professional, which were not taught during the training in the institute?

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PART 3 TOOLS AND EQUIPMENT

3.1 As a plumbing professional, do you use the following hand tools?

SN	**Hand tools**	**Tick your answer**
1	Ratchet die	◯Yes ◯No
2	Bench Vice	◯Yes ◯No

3	Tongue groove plier	◯Yes ◯No
4	Locking plier	◯Yes ◯No
5	GI Pipe cutter	◯Yes ◯No
6	Pipe wrench	◯Yes ◯No
7	Adjustable wrench	◯Yes ◯No
8	Screw driver	◯Yes ◯No
9	Pipe vise with tripod stand	◯Yes ◯No
10	Measuring tape	◯Yes ◯No
11	Hacksaw frame	◯Yes ◯No
12	Flat file	◯Yes ◯No
13	Round File	◯Yes ◯No
14	Chisel (Flat)	◯Yes ◯No
15	Yarning Chisel	◯Yes ◯No
16	Hammer	◯Yes ◯No
17	Adjustable wrench	◯Yes ◯No
18	CPVC pipe cutter	◯Yes ◯No
19	CPVC pipe reamer	◯Yes ◯No
20	GI Pipe Reamer	◯Yes ◯No
21	Spirit level	◯Yes ◯No

3.2 As a plumbing professional, do you use the following equipment?

SN	Equipment	Tick your answer
1	Electrical drilling machine	◯Yes ◯No
2	PP-R welding machine	◯Yes ◯No
3	Pedestal Drilling Machine	◯Yes ◯No
4	Pressure Testing Machine	◯Yes ◯No
5	Portable Threading Machine	◯Yes ◯No
6	Tiles Cutter	◯Yes ◯No
7	HDPE Bud welding machine	◯Yes ◯No
8	Universal threading machine	◯Yes ◯No
9	Angle grinder machine	◯Yes ◯No
10	Pipe bender machine	◯Yes ◯No

3.3 What new/additional hand tools and equipment (which are not listed above) are needed as a plumbing professional?

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3.4	**In your view, what can be done to increase the quality of plumbing graduates in the country?**
1	
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