

The Plumbing Profession As A Business Opportunity And Employment Prospect For Civil Engineering Graduates

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Abstract – The current reality is that the employers of labour no longer have adequate space to accommodate the teeming population of tertiary institution graduates. For a few job vacancies that exist, employers look beyond academic qualification. They want graduates who have skills and entrepreneurship orientation that will help their firms to remain profitable and competitive. This paper is an entrepreneurship education that provides graduates/undergraduates of civil engineering in particular and other related disciplines in general, with the necessary skills to appreciate and embrace plumbing as a profession. The aim is to expand the scope of opportunities available to graduates for employability and self-employment after graduation. The paper covers the scope of plumbing, plumbing tools, fittings and fixtures, safety in plumbing, estimates, installation and maintenance work, a step into the plumbing profession, and characteristics of successful plumbers.

Keywords – Entrepreneurship, Plumbing, Self-Employment, Civil Engineering, Graduate.

1. Introduction

In the current era of dwindling white-collar jobs and lays-offs across the world [1, 2], plumbing offers a great business and employment opportunities [3], especially for graduates of civil engineering. Plumbers are required in private homes, in commercial establishments, in factories and in corporate organizations. This is because many of us have a network of plumbing pipes and connections in our homes, houses or offices and we do face plumbing issues every now and then. A plumbing problem (e.g. a disruption of water supply, a leaky kitchen pipe, a blocked lavatory, a damaged water closet, and so on) can be distressing and usually calls for an urgent attention. Plumbing in general encompasses a network of a fluid-conveying pipes/conduit system, including interconnected devices for flow control, flow temperature manipulation, storage and dispensing of fluids. In this respect, oil and gas pipelines, refrigeration/air conditioning and ventilation pipelines, water treatment systems, drainage and sewage systems, storage tanks, valves, other flow control devices are also parts of a plumbing system.

The movement of fluids, especially water, across pipelines is essential for modern live. Plumbing in the form of water supply or sanitary system is a very important requirement of every contemporary building. Water supply and sanitary works could take about 8 per cent of the total construction cost of a building. Indeed, the fundamental requirement for water supply and sanitation for healthy living makes plumbing a very important aspect of building industry, such that specialist in the field of plumbing are often consulted during preparation of schemes and structural designs.

Fixing of a plumbing system is a specialized skill that requires the services of trained technician. It is in this respect that plumbing is also a definition of a skill or a trade for fixing a fluid-conveying pipe system. However, in developing countries such as Nigeria, there is often a loose or absent regulation on such seemingly common activity like plumbing. The consequence is that the plumbing profession in Nigeria is more or less dominated by people many of whom do not have even a basic education.

Multiple plumbing unit failures are a major cause of increased service outages in water utilities [4]. In this modern era, plumbing system is a major component of technological-driven aesthetic, hospitality, and competitive investments. Hence, plumbing requires people with the right education and professional skills for minimizing preventable system failures. A good and functional plumbing system conserves resources, reduces costs, reduces health risks and brings comfort to users.

Plumbers do much more than repair toilets, taps, basins, and plumbing fittings and fixtures in homes and offices. They play a major role in protecting the environment by providing safe, fresh water and sanitation through proper management, care, reuse and conservation of safe drinking water supplies [5]. In addition, plumbers provide comfort for modern living, e.g. maintaining pipelines in the energy and HVAC (heating, ventilation and cooling) systems. This is why the plumber is one of the most sought after professionals across the world [6]. This paper is part of entrepreneurship education that intends to expose civil engineering graduates in Nigeria and other developing countries to plumbing as a business opportunity and for employability enhancement.

This paper aims to equip the readers with necessary skills or reinforce their knowledge towards practicing or appreciating plumbing as a profession. It is envisaged that at the end a resolute reader should have acquired the skills to do the following:

- I. Explain why plumbers or plumbing professionals will continue to be in high demand
- II. List some basic plumbing tools and their functions
- III. Properly name some common plumbing fittings and fixtures
- IV. Explain safety requirements in plumbing
- V. Perform simple estimates for installation and maintenance work
- VI. Understand how to become a plumbing professional
- VII. List six characteristics of a successful plumber

2. Who is a plumber?

According to the World Plumbing Council [7], the World Health Organization describes plumbers as the most important front line health workers around the world. This is plausible because plumbers perform work that meets essential needs of our daily lives. A plumber is a qualified tradesman or a technician who specializes in installing and maintaining plumbing systems to meet customer/users' satisfaction. This means that a plumber is not just anyone who can manipulate tools and join pipes. He is a trained professional with requisite minimum academic qualification, such as Trade Test, City and Guilds, National Diploma, etc. When we talk of "plumbers" in this paper, we mean "professional plumbers".

Despite the current economic crunch in Nigeria, with its ubiquitous unemployment effects in all sectors, the demand for plumbers remains relatively high. This is because plumbing systems go along with building demand. According to a report quoting the Nigerian Vice President, Sen. Kashim Shettima [8], Nigeria requires about 28million additional housing units to meet her housing needs. As the quest for constructing new houses rises, the demand for hiring plumbers soars.

For graduates that have HND or a higher qualification, plumbing skills can enhance your chances of grabbing high positions in plumbing-related jobs, such as facility manager, pipeline engineers, estate engineers, water treatment engineers, etc. One needs only

to check the monthly advertorials for a few job vacancies in Nigeria to confirm that the demand for plumbers takes a prominent position.

For graduates who may wish to seek greener pasture in industrialized countries (like Europe, America, some parts of Asia, etc.), plumbing is surely a high-priced skill that you can proudly bring to the table of many employers. The U.S. Bureau of Labor Statistics [9] projects plumbing job to be growing at 2%, as fast as the average of all occupations in the United States. According to the Bureau, in the U.S., the median pay of plumbers is as much as \$61,550 per annum (NGN 97,866,962) or about \$29.59 per hour (NGN 47,049). According to MML Plumbing [10], the average annual salary of a plumber in UK is over £40,000 (NGN 82,383,160). Wow!

One of the interesting aspects of the plumbing profession is that fresh engineering graduates (especially civil engineering) can quickly learn the arts and tricks of the trade, and become their own masters, i.e. become self-employed or employers of labour. This nevertheless requires patience, prudence and perseverance, like in any other serious business endeavour.

Mindful that this paper is about doing plumbing as a business, the scope scales down the theoretical or the technical details of plumbing. It rather concisely presents the ingredients that make plumbing a profitable professional business, especially for civil engineering graduates.

3. Basic Plumbing Tools

Fig. 1 shows the pictures of common plumbing tools

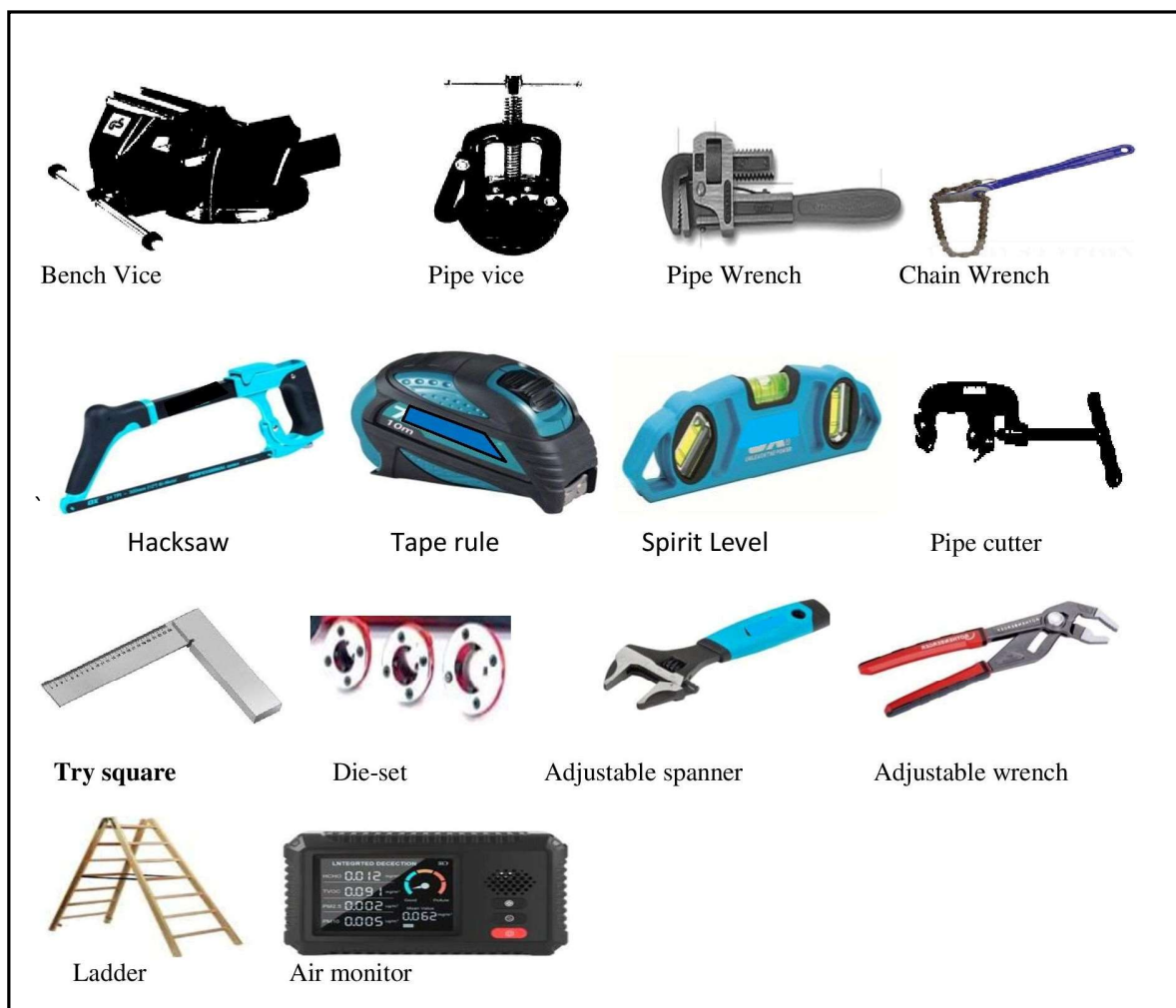


Figure 1 Common plumbing tools

Table 1 describes the functions of common plumbing tools

Table 1 Functions of common plumbing tools

S/No	Name of tool	Function
1	Bench vice	Used for holding flat or rectangular work pieces for cutting and other operations
2	Pipe vice	Used for holding pipe for cutting and other operations
3	Pipe wrench	Used for holding pipe especially during loosening and tightening operations.

4	Chain wrench	Used for fixing and turning large diameter pipes
5	Hacksaw	Used for cutting pipe and other work piece
6	Tape rule (or tape measure)	used to measure distance or size
7	Try square	Used for making perfectly square shaped cuts, marks, etc. on woods, pipes, and walls
8	Spirit level (plumber's level)	Used for checking elevations and measuring horizontal levels and slopes.
9	Pipe cutter	Used for cutting pipes
10	Die-set	Used for cutting threads on pipes
11	Adjustable spanner	Used for tightening or loosening connectors
12	Adjustable wrench	Used for gripping and turning pipes with ½" to 2" diameters.
13	ladder	For climbing or gaining access
14	Air monitor	Used to detect oxygen and carbon dioxide levels in a space

4. Plumbing fittings and Fixtures

4.1 Plumbing fittings

Fittings are connecting units used when installing pipes to go around corners, to join other pipes, to reduce the diameter of the pipes, and to control flow. Fig. 2 shows some of the common plumbing fittings.

The fitting system for PVC and steel pipes is similar. Steel pipes only use steel fittings. However, PVC pipes use both PVC and steel fittings, because the threads are the same size. For PVC pipes, many fittings can be connected by gluing plain adaptors with "PVC solvent cement."



Figure 2 Common plumbing fittings

4. 2 Common plumbing fixtures

A plumbing fixture is a unit that is connected (fixed) to a plumbing system in a convenient place in a building for using water for specific functions. Common plumbing fixtures include washbasin, bathtubs, sinks, showers, water closets and so on. Fig. 3 shows some common plumbing fixtures.



Figure 3 Common plumbing fixtures

5. Safety requirements for plumbers

Apart from installation and maintenance of water supply and sanitary systems, the plumber's job may also involve servicing waste disposal and heating systems. Plumbers also carry materials, tools and equipment. They cut pipes and other work pieces, assemble materials, tools and equipment. These are risky jobs. A plumber should therefore be aware of hazards in the work place, and take care to avoid exposure by observing the safety rules. Hazards can be addressed in the following areas as follows:

5.1 Chemical and material exposure

- Be acquainted with potential hazards at your new job sites
- Ensure you know the hazards associated with chemicals you use such as solder, adhesives, and solvents.
- Check the chemical properties of materials and associated health hazards, and ensure you use the required personnel protective equipment (PPE).
- Avoid direct contact with sewage by wearing appropriate PPEs such as hand gloves, safety shoes and coveralls.
- Clean equipment after use and wash your hands, face and feet.

5.2 Confined spaces

- Be conversant with emergency procedures, obtain work permit and wear the required PPE.
- Avoid oxygen deficient environment and be aware that sewage decomposition, can release hydrogen sulfide to unsafe levels.
- Use air monitors to assure your safety. For confined space O₂ level should not be less than 19.5 %, and the CO₂ level should be at most 0.54 (5,000 ppm) for 8 hours work [11]

5.3 Slippery environment

- Wear shoes with slip-resistant soles.
- Always keep your work area clean and clear of debris and equipment
- Walk cautiously, dragging your feet when necessary

5.4 Electric shock

- Avoid use of damaged cable
- Ensure that tools are properly grounded, that power connections use 3-pin plugs
- Be careful with metal pipes; if you perceive a little shock on touching a metal pipe, stop work immediately.
- Avoid naked wires, and watch out for live wire connections to wet environment

5.5 Use of tools

- Ensure the tools and equipment you use have required safety features.
- Avoid working with blunt tools.
- Do not cut materials toward your face or body to avoid cuts and punctures.

- Wear goggles when cutting or grinding to avoid eye injuries from flying particles.

5.6 Working Posture

- Keep your back straight and not in awkward positions, especially when performing repetitive manual tasks to avoid a musculoskeletal disorder.
- Use proper lifting techniques/devices and keep your back straight while working.
- Rotate tasks or take a quick break every 30 minutes.

5.7 Working at high heights

- Use a ladder for as short duration only, and ensure that the ladder is properly positioned and held by someone while using it.
- Fixed scaffolding is preferable when working at a higher height.
- Always use your helmet when working at higher heights

6. Estimates for plumbing installation and maintenance work

The ability to prepare reasonable bills or to demand appropriate charges for good quality work is necessary for the survival and growth of a plumbing professional. Appropriate charges are bills that reasonably match the nature and quality of the work, and the wherewithal of the customer. The key words are “reasonable” and “appropriate”, not “cheap” or “expensive.” Cheap estimates usually do not produce reliable work, and may not be profitable. Very high estimates/charges may be unrealistic, and may make your customers to grudge or to run away.

A good approach to prepare bills/charges is to do so technically and objectively - i.e. scientifically.

In this section, we shall consider a hypothetical case of a work requiring preparation of an estimate (bill of quantities) for a client. Refer to fig. 4.

Hypothetical Example

Suppose that Mr. Emeka has installed an overhead water supply tank (fig. 4) for his house, and asked you (a graduate professional plumber) to give him a quotation for supplying water from the tank to, the kitchen, shower, toilet, and the garden. How do you go about this?

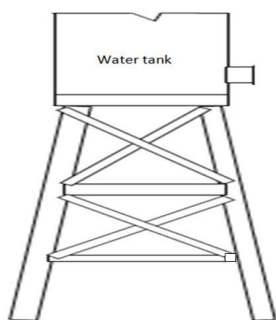


Figure 4 Installed overhead water tank

First step is to go to the site with measuring tools and writing materials.

Second step is to make a sketch, based on site information and measurements (fig. 5), or a list of materials or both in any way you can. The list should also contain a list/description of materials. The advantage of a sketch is that it can serve as a visual guide and can be easily converted to a working drawing by adding the right dimensions). There are various standardized notations for drawing plumbing systems.

Third step is to do a market survey of materials and labour required.

Finally, the fourth step is to prepare the bill of quantities (quotation) as in table 2.

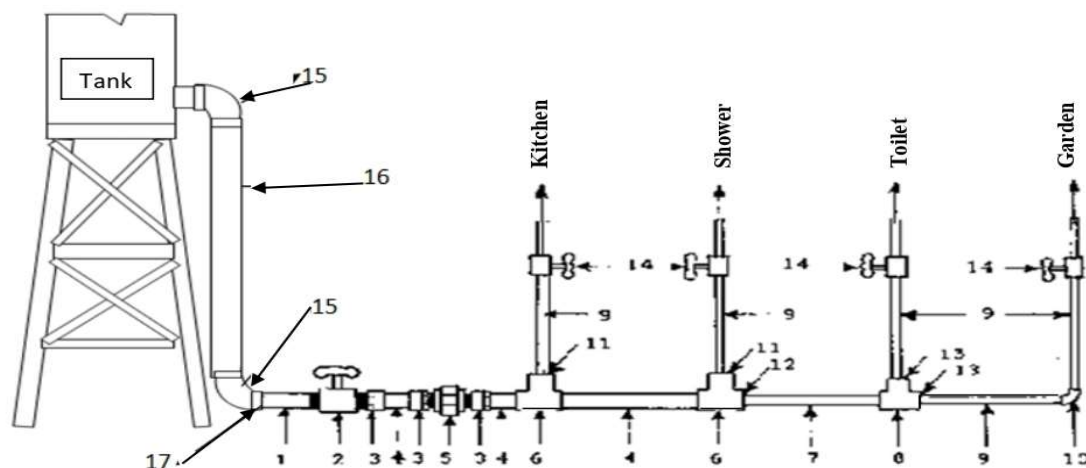


Figure 5 A sketch for a proposed plumbing work for Mr. Emeka

Description of direct materials

1--1" PVC pipe two end threaded, 2 -- 1" Gate valve, 3 -- 1" PVC connector male thread, female glued, 4 --1" PVC pipe, 5 --1" galv. Union, 6 -- 1" PVC Tee-joint, 7 --3/4" PVC pipe, 8 -- 3/4" PVC Tee-joint, 9 -- 1/2" PVC pipe, 10 -- 1/2" PVC Elbow 90°. Female, 11-- 1" - 1/2" Bush, 12-- 1" - 3/4" Bush, 13 -- 3/4" - 1/2" Bush, 14 -- 1/2" control gate valves, 15 -- 2" PVC Elbow 90°, 16 -- 2" PVC pipe, 17 -- 2" - 1" Bush.

Table 2 Bill of quantities for Emeka's Plumbing work

S/No	Description	Quantity	Unit cost (N)	Amount (N)
1	1" PVC pipe two end threaded	1No	3800	3800
2	1" Gate valve	1No	750	750
3	1" PVC connector male thread, female glued	3No	500	1500
4	1" PVC pipe,	2 Lengths	2800	5600
5	1" galv. Union	1No	1800	1800

6	1" PVC Tee-joint	2No	100	200
7	¾" PVC pipe	2 Lengths	1900	3800
8	¾" PVC Tee-joint	1No	80	80
9	½" PVC pipe	4 Lengths	1100	6600
10	½" PVC Elbow 90°	1no	750	750
11	1" - ½" Bush	2No	300	600
12	1" - ¾" Bush	1 No	200	200
13	¾" - ½" Bush	1No	300	300
14	½" control gate valves	4No	250	1000
15	2" PVC Elbow 90°	2No	550	1100
16	2" PVC pipe	2 Lengths	3800	7600
17	2" - 1" Bush	1No	350	350
18	thread tape	2Nos	250	500
Sub Total (direct material and, if not accommodated in the workmanship, direct labour)				36530
Workmanship				12300
19	Total			48830

Calculation of workmanship

The workmanship should take into consideration the following:

- The quantity and cost of direct labour to be hired (man-hours) if any. This item may also be separated and written after the direct materials.
- The cost of indirect labour (contract staff or experts to be hired), if any
- The risk involved in the job (does it involve high height, confined space, swamp, etc?). A higher risk attracts higher workmanship.
- Other indirect costs (e.g. materials or special tools to be used or hired - ladder, scaffold, welding equipment, transportation costs, etc.)
- Of course the Plumber's pay - what you feel is good for you (this may depend on the duration of the job), but should be competitive and not scare your customer

Workmanship may also be calculated as the percentage of the direct material cost, especially when this (total material cost) is considered reasonable. Typically, 10% to 30% is applied. When stating your workmanship bear in mind that it may be subject to a bargain and that the client might want you to reduce (cut) your initial quotation.

Nigerian clients seemingly like to cut the workmanship, even when it is honestly frugal. So you may add a margin for a bargain, but do not overdo it. However, avoid the practice of over-padding the material cost, it is not ethical and may damage your reputation. Instead, you may include transportation or holding cost, or any other incidental cost and be clear to explain it, if called upon.

In the above example, the workmanship was put at approximately 20% of direct material cost plus cost of hired labour

How workmanship in the above example was calculated

Direct material cost = ₦36,530

20% of direct material cost = $0.2 \times ₦36,530 = ₦7,306$

Hired labour: Number of "man" = 2

Number of days = 1

Total man – days = $2 \times 1 = 2$

Cost/man – day = ₦2,500.00

Total cost for hired plumbers = $₦2,500 \times 2 = ₦5,000.00$

Workmanship = $₦5,000.00 + ₦7,306 = ₦12,306 \cong ₦12,300$

There are no hard and fast rules about workmanship. It is whatever you may consider profitable. Note that you are never under an obligation to discuss with anyone how you determine your workmanship. However, you may voluntarily explain it, if you think that will prove a positive (convincing) point for you. The procedure for determining the bill for installation work may be applied to major repair work. For minor repairs, workmanship may be as simple as any bill you consider reasonable in line with prevailing rates within the locality or the client's capacity to pay.

7. How to Become a Plumbing Professional

Plumbing is a path to a stable and a dependable income – something that eludes many today. With National Diploma (ND) in civil engineering, you have the requisite paper qualification to enter the plumbing profession, either as an employee or an employer (*on your own*, as we say in Nigeria). To practice plumbing is however another kettle of fish.

You must learn the tricks of the trade and sharpen your skills. Do not panic. It is actually not easy but may be quite simple. Consider the benefits and say once more YES I CAN! There are four approaches to it.

You can start as an apprentice plumber. You do this by working with an experienced (qualified) plumber. In the developed countries, you need to obtain a plumbing license after your apprenticeship. This may require success in a written exam, or a demonstration of practical skills or both. Luckily, it is not quite so over here in Nigeria. All you may need is to show or prove your skill. Your certificate is adequate.

The snag is that plumbers who know their onions are becoming fewer and fewer, especially in Nigeria. However if you search closely you may find one. Another obstacle is to find one who would agree to take you as an apprentice or agree to be your partner (collaborate) with you. Things are hard you know. The folks might think you would shorten their ration or even take their job.

You have to be patient. Apprenticeship typically may take between two or more years for you to be proficient, depending on how intensely you pursue technical plumbing training alongside work.

There is a trick around it and this is the second approach. You do not totally reveal that you are a novice plumber to anyone. After all, you have the paper (ND in engineering) qualification. Give yourself the position of a plumbing sales engineer-self acclaim. But mean it. Look for a good and a manageable plumber-if possible more than one (preferably the old folks in the trade who are still agile). Agree with such that you will be bringing plumbing jobs for him to do. Then go and search for plumbing jobs. Meet builders, architects, developers, engineers, property owners and people constructing new houses and properly introduce yourself. For instance, say to the prospective client (after greeting) "my name is "X," "I and my group are professional plumbers and we would like to be of good services to you if the need arises." Then offer your contacts such as phone number, email, business card. If you are called, go with your plumber, allow him take measurements and prepare preliminary bills. Adjust the bills and discuss with client.

If a deal is struck, go with plumber to buy the materials even if the client is going with you. Then assist the plumber during the work. Be down to earth, ask questions and learn the practical aspects as quickly as you can. Do not be overzealous, start by holding pipes and tools for him when necessary and watch closely. Create the impression that you are helping to make the job faster but only do hands-on on the skills you think you have reasonably mastered. At the end, make your plumber happy by paying him what was agreed even when the job turns out to be simple.

The third approach is to enroll in a practical plumbing school. A technical college or polytechnic nearby that offers certificate course in practical plumbing is an opportunity for you to enroll. This may take more than 12 months. Do not worry. Time flies, even more so for an idle person.

The fourth is for those who already have practical plumbing skills. It is to go ahead immediately into the plumbing trade. Acquire the basic tools and look for clients. Hit the ground running: for as they say, "Time waits for no one."

Do not forget the theoretical aspect. Read about plumbing and related fields (pipe designs, sanitary systems, water supply systems, etc.). *Google* it out.

Remember knowing /acquiring the basic practical plumbing skills does not necessarily mean you would be doing the job yourself. You can be the employer of plumbers: and no one can mess you around because you know the tricks of the trade. For those who wish to be "on their own", it may be advantageous (though not a necessity before starting) to register a business name, or even write a business plan. Having a registered business name or a business plan may enhance your chances for obtaining loans from banks and other formal institutions.

8. Characteristics of Successful Plumbers

The characteristics outlined below are the key attitudes a plumber needs to imbibe to survive and prosper.

I. Technical Knowledge

- Ability to apply training and learning to the situations in the field
- Understanding different units and systems
- Ability to install, troubleshoot, and repair system components

II. Problem-Solving

- Ability to deal with surprises in a variety of settings

- Capacity to know when to stop, assess the situation, and develop a viable plan to overcome the obstacle and proceed in a way that accomplishes the goals and achieves client's/customer's satisfaction

III. Communication

- Ability to explain the details of work and work plans to clients, other trades people, and other stakeholders in the language they will understand

IV. Honesty and Integrity

- Ability to conduct oneself in a trust and worthy manner
- Ability to honour promises and always align word with action

V. Customer Service

- Ability to answer questions, listen to concerns and address issues, and provide timely and professional service to customers

VI. Safety and Compliance

- Awareness of the codes and laws that govern plumbing systems and the client's work environment
- Ability to perform a job safely and without causing any damage to self, others or the plumbing system

VII. Punctuality

- Being at the right place of work at the right time at all times
- Recognizing punctuality as one of the fundamental traits of a professional

VIII. Physical Fitness

- Keeping the body and the brain in healthy status
- Doing appropriate exercises and eating healthy food
- Visiting physicians for health checks when necessary and taking medications seriously

IX. Continual Learning

- Striving to be abreast of the rapidly changing plumbing industry and the latest advancement in technology, especially in the area of plumbing
- Being more friendly with the internet for research more than for fun

X. Aesthetic sense

- The ability to see and appreciate beauty
- The ability to create balance, harmony, and order in presentations of your work
- The ability to reject what is unpleasant or unnecessary
- The ability to learn from all things beautiful

XI. The can-do attitude

- Conditioning the brain to be positive about success
- Confronting fear and inertia (object at rest prefers to be at rest) by doing

9. Conclusion

This paper exposes the readers to plumbing as a profession in high demand, as an avenue for self or hired employment to qualified graduates. The paper dwells on practical aspects of plumbing to motivate teaming job seekers to plumbing and to help practitioners of plumbing to succeed. This paper is part of entrepreneurship education by the authors to lots of civil engineering and other related-graduates looking for employment in the current era of dwindling white-collar jobs and high rate of job lay-offs.

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