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A Survey of Computer-Aided Engineering Skills Required for Job Security of Machinist in Industrial Revolution 4.0 in Nigeria

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Abstract: *The study looked at the computer-aided engineering skills that Nigerian machinists need to keep their jobs in the 4.0 industrial change. In particular, the study looked into the code and CNC machine skills that Nigerian machinists need to keep their jobs in the 4.0 industrial change. While two research questions were asked to guide the study, two alternative theories were also made and tested at the.05 level of significance to help guide the study. A poll method was used for the study. Two hundred and seventy-seven (277) people took part in the study. There were sixty-three (63) mechanical engineering professors and two hundred and fourteen (214) industrial-based machine-shop supervisors from thirty-seven (37) companies in the Trans-Amadi Layout of Port Harcourt in Rivers State. Using purposeful sampling, 113 people from the whole community were chosen as responders. They were made up of 42 professors and 71 managers of industrial machine shops. The test, called "Computer-Aided Engineering Skills for Job Security (CAEJOS)," was looked at by three experts to make sure it was valid in both face and content. It also had a reliability coefficient of .68, which was found using Cronbach Alpha. For the study, mean and standard deviation were used to look at the data, and a benchmark mean value of 3.0 was used to make decisions. The study found that machinists in Nigeria need to know how to use a computer- numerically controlled machine and how to code in order to keep their jobs in the industry change 4.0. Based on what the study found, the expert suggested that The federal government of Nigeria should quickly get educational schools the right CNC tools so that students can learn the skills they need for jobs in the business (catch them young!).*

Keywords: Skills, CNC, Job Security, Machinist and Industry Revolution 4.0

Introduction

People can learn new skills and apply them in new situations by building on the ones they already have and the things they have done in the past. A person gets better at it over time until they can do the necessary skill without thinking about it (Nneoma, 2017, quoted in Victor & Olarewaju, 2022). Onyebuenyi and Mbah (2018) say that a person's skill is the aware and intended use of actual information that they have gained through experience, training, and doing the job. According to Okonkwo et al. (2022), Bakare (2006) said that people could learn new skills through practice and teaching on programs that help people learn and improve their skills. Getting better at a skill means using it in different settings. This is called skill development. Kalu (2015), quoted in Victor and Olarewaju (2022), says that it is the chance to learn. Getting better at skills is the most important thing for building a good job. There are different ways to learn new skills, such as by experimenting on your own in a certain area, by searching for new ways to do things and practicing over and over again, or by doing the same things over and over again without thinking about them (Urieto, 2009). Victor and Olarewaju (2022), citing Oke (2019), say that someone has learned a skill when they can do it without thinking about how to do it or breaking it down into standard steps..

Also, each job requires a different set of skills and ways to learn them. Being able to do something well is an example of skill (Ochogba & Amaechi, 2018). But skill acquisition is the process of learning a skill from someone with more experience, an organization, or any other source so that the trainee can use the skill after learning it. As mentioned by Okonkwo et al. (2022) and Aliozor (2004), skill acquisition is the process by which people are supposed to learn how to do a certain job and keep practicing it until they are good at it and can do it when they need to. Fadairo (2010) went on to say that having a skill means showing that you have a habit of doing, thinking, or acting in a certain way that has become so normal to you through practice or repeating that it happens without you having to think about it. Getting skills means getting really good at something. To become an expert in a field like mechanical engineering technology means to do great work and become a sought-after master in that field..

Mechanical Engineering Technology teaches students about the tools, materials, and ideas behind mechanical technology. It is the field of mechanical engineering technology that studies tools that use force and movement. Of all the different types of building, this is one of the oldest and most general. Training in mechanical technology is good for both teens and adults, and it helps them learn the skills they need to do well in their chosen job. Mechanical engineering technology is a field that teaches people the skills they need to do their jobs well and efficiently (Onyije & Saue, 2022). To be a mechanical engineer, you need to know about physics, dynamics, thermodynamics, materials science, architecture, electrical engineering, and structure analysis. The researcher thinks that

mechanical engineering technology is the use of scientific and engineering concepts together to plan, create, build, and fix machines and systems that are powered by mechanical forces. To go along with these basic ideas and machines, mechanical engineers and scientists also use tools like Computer-Aided Engineering (CAE).

Computer-Aided Engineering (CAE) is a group of programs that use computer technologies to help with things like analyzing CAD modeling, making a model of a product and studying how it works in real life, and also making the structure better and more efficient. In CªE devices, a CAD system is used to make a three-dimensional model of the item. Computer-aided engineering (CAE) is a type of industrial technology. These technologies are meant to be used in the most important areas for making tools, which makes them stand out among other uses (Sudzilovsky, 2009). By saving, collecting, and sharing engineers' and designers' experience, CAE technologies make it possible for methods and technologies to be shared across industries and fields. Because of this, engineering computer analysis should be done as early as possible in the process of developing and building goods (Sabonnadiere, 2012). For modern industry to work, it needs new technologies, high-quality tools, and skilled workers. The engineer can "play" with the structure's parameters and properties to get the best parameters and properties for the product that was created (Ushakov, 2012). Without Computer Numerical Controlled (CNC) tools and other CAE systems, it is not possible to make complex science-based goods like ships, planes, tanks, industrial equipment, and more.

One of the most common types of Computer-Aided Engineering (CAE) machine tools is the Computer Numerical Controlled (CNC) machine. Morrar et al. (2017) say that a computer numerically controlled (CNC) machine is mostly used for cutting shaft or disk parts with an internal and external cylindrical surface, any cone angle with an internal and external conical surface, complex rotary internal and external surfaces, and cylindrical, tapered threads, and other cutting. It can also be used to make grooves and holes, among other things. Agrawal et al. (2022) said that Computer Numerical Controlled (CNC) machines are computer-controlled automated machine tools that are mostly used for processing rotary workpieces. They can follow pre-programmed instructions to do a wide range of processing tasks accurately, which is very important in the field of precision turning. The manufacturing industry is still one of the most important in many countries. As industrial production grows and technology is always being improved, it has become one of the "mother machines" of industry. The grinding process improves the machine tool's accuracy, stability, and dependability so that it can process parts with high precision and good surface quality. But for these tools to work, someone called a maker has to follow a set of instructions.

Machinists run machines and use blueprints, lists of requirements, and their own measurements to figure out sizes, limits, and types of fit. Accurate readings are very important for machinists' jobs. This person said that the machinists needed to know about the qualities of metals and non-metallic materials. People who are machinists may work in fields that make, fix, or use tools. Some examples are businesses that make tools, equipment, parts for cars, and parts for spacecraft. Machinists make precise parts that are used in every part of the industrial process. CNC tools can be programmed to make parts using computer-aided design (CAD) and/or computer-aided manufacturing (CAM) software in Industry 4.0, also known as the fourth (4th) industrial revolution. Toolpath testing software that works on its own can help find and avoid crashes between tools and machines. Machinists need to know how to use computer-aided engineering (CAD) in order to stay relevant and keep their jobs in today's work environment.

Nowadays, job security is just as important to the country as job happiness standards. Onyebuenyi and Mbah (2018) said that job stability means being sure of a job. It includes all the good things that can happen with a job while it's happening. Akpan (2013) thought of job security as the expectation of staying in the same job. It has to do with how employees feel about losing their job or losing desirable aspects of their job, like not being able to move up or having good working conditions. It also has to do with how they feel about long-term career opportunities in today's technological world (industry revolution 4.0).

The industrial revolution is going to happen because of how quickly solutions are being designed. An industrial revolution is a change in the way things are made, how people live, how the economy works, and how technology is used, caused by the fast development of new clever science solutions (Dombrowski & Wagner, 2014). The industrial revolution changed the way people worked, lived, and made money. The industrial revolution began in 1780 with the invention and use of the steam engine. The next big step forward was the production of electricity in 1890, and the most recent step forward was the creation of nanotechnologies in 1990. Kagermann et al. (2015) say that Industry 4.0 is linked to smart workplaces, smart goods, and smart services that are all part of an internet of things and services, which is also known as the industrial internet. Qin et al. (2016) said that the 4th Industrial Revolution (IR) is a new age of industrial revolutions with fast changes in technology, society, and the economy. "Industry 4.0," which is the next generation of the industry, gives manufacturers more freedom in how they make things, as well as better quality, higher output, and mass customization (Ulewicz & Novy, 2017). So, it helps businesses deal with the difficulties of making more customized goods quickly and better (Ulewicz et al., 2016).

The fourth (4th) industrial revolution, also known as Industry 4.0, is a trend that can directly change the organization and policies of industries. An important part of Industry 4.0 is smart production. Industry 4.0 is a German strategy plan that aims to make workplaces smarter by using cyber-physical systems (CPSs), the Internet of Things (IoT), and cloud computing to improve and change manufacturing technologies (Zhong et al., 2017; Lasi, et al., 2014). To put it another way, Zhong et al. (2017) said that Industry 4.0 is made up of smart manufacturing systems that get new information from all over the important fields. This makes them flexible, smart, and able to be changed to fit the needs of a global market that is always changing. It is important for all related businesses and the whole production supply chain to be able to share information with each other.

Statement of the Problem

Industry 4.0, which is driven by technology, is becoming more complicated. This is one of the main reasons why workers are being laid off and businesses are cutting back, which is causing youth unemployment to rise in Nigeria (Wordu, et al., 2022). It's clear that mechanical engineers and machinists in Nigeria are still using the same skills that were needed in the 2nd Industrial Revolution (Industry 2.0), which started in the late 1800s and was based on using electricity to make a lot of things. This led to the 4th Industrial Revolution (Industry 4.0), which is now happening. To back up what was said above, Saue (2024) said that this has always left a gap between the training received and the skills that graduates are expected to need in the future, as stated in the NBTE 2001 program. To make machinists more employable and protect their jobs, they will have to learn computer-aided engineering skills in addition to their standard ones. So, a poll was done to find out what computer-aided engineering skills machinists in Nigeria need to keep their jobs in the 4.0 industrial change..

Purpose of the Study

The study's goal was to find out what computer-aided engineering skills Nigerian machinists need to keep their jobs in the era of Industry 4.0. In particular, the study sought to:

1. Look into the CNC cutting skills that machinists in Nigeria need to have in order to keep their jobs in the 4.0 industrial change.

2. Find out what code skills machinists in Nigeria need to keep their jobs in the 4.0 industrial change.

Research Questions

The study was based on two (2) research questions.

1. What CNC skills do machinists need to have in order to keep their jobs in Nigeria during the 4.0 industrial revolution?

2. What kind of code skills do CNC machinists in Nigeria need to keep their jobs in the 4.0 industrial revolution?

Hypotheses

The following two (2) alternate hypotheses were formulated at .05 level of significance.

H_1: There is a significant difference between the mean responses of lecturers and industrial supervisors on CNC machining skills required for job security in Nigeria

H_2: There is a significant difference between the mean responses of lecturers and industrial supervisors on coding skills required for job security in Nigeria.

Methodology

Research Design: A descriptive survey.

Population of the Study: Two hundred and seventy-seven (277) people took part in the study. There were sixty-three (63) mechanical engineering lecturers and two hundred and fourteen (214) industrial-based machine-shop supervisors from thirty-seven (37) companies in Port Harcourt, Rivers State's Trans-Amadi Industrial Layout.

Sample and Sampling Techniques: A purposeful random method was used to choose 113 respondents from the whole population. These respondents were made up of 42 lecturers and 71 industrial-based machine-shop supervisors.

Instrument: The form used to collect data had a 4-point rating scale that went from "Highly Required" (HR = 4) to "Required" (R = 3), "Not Required" (NR = 2), and "Highly Not Required" (HNR = 1). "Computer-Aided Engineering Skills for Job Security (CAEJOS)" was written on the test.

Validity of Instrument: The instrument was checked for face and content validity by three experts: two (2) from the University of Lagos and one (1) Yaba College of Technology, Yaba Lagos. These experts were split in half and came from the Department of Mechanical Engineering..

Reliability of the Instrument: Fifteen (15) machinists and ten (10) lecturers in Lagos State, Nigeria, who were not part of the study group tried out the tool first. So, Cronbach Alpha was used to figure out a value for stability.68 on the bass pipe.

Data Analysis: Mean and standard deviation were used to look at the data that was collected for the study. The t-test was used to test the theories at the.05 level of significance. A criterion mean value of 3.0 was used to draw the lines for making decisions.

Results

Research Question 1: What CNC machining skill is required of machinists for job security in industry revolution 4.0 in Nigeria?

Table 1: Mean and standard deviation of lecturers and industrial supervisors on CNC machining skills required for job security in Nigeria

		Lecturers N=42			Industrial Supervisors N=71		
S/N	**Items**	$\bar{X}_1$	**SD**	**Rmk**	$\bar{X}_2$	**SD₂**	**Rmk**
1.	Identify configurations and applications of CNC	3.39	0.8	R	3.23	.83	R
2.	Select appropriate cutters	3.42	.62	R	3.40	.82	R
3.	Vertical and horizontal milling	3.56	.73	R	3.42	.62	R
4.	Perform lathe operations (drilling, tapping, and boring canned cycles).	3.11	.99	R	3.16	.94	R
5.	Programme CNC machine and inputting design specifications	3.07	.83	R	2.95	.87	R
6.	Operated and set up CNC machines to produce precision parts	2.95	.99	R	3.09	.86	R
7.	Ability to use of micrometer	3.27	.87	R	3.22	.85	R
8.	Identify major machine accessories chip conveyors, rotary tables and indexers, pallet changers, and live tooling.	2.70	1.05	R	2.86	1.02	R
9.	Identify machine controls like Siemens, Haas, Fanuc, etc.	2.97	.95	R	3.04	.94	R
10.	Utilize and monitor cutter feeds, speeds, and chip load for efficient programming for both roughing and finishing	3.23	.83	R	3.31	.79	R
11.	Adjust machine settings to optimize production	3.19	.86	R	3.21	.72	R
12.	Carry out troubleshooting on CNC machines	3.32	.77	R	3.10	.55	R
13.	CNC maintenance skill	3.23	.83	R	3.17	.89	R
14.	Reading and interpretation of blueprints.	3.19	.95	R	3.18	.65	R
15.	Carry out milling operations (horizontal and vertical).	3.22	.85	R	3.21	.72	R
	Average Mean	**3.18**	**.86**	**R**	**3.17**	**.80**	**R**

Source: *Author (2025)* *Key: R = Required*

The lecturers had a grand mean of 3.18 and a standard deviation of.86, as shown in Table 1. The workplace supervisors had a grand mean of 3.17 and a standard deviation of.80 on the other hand. Based on what the lecturers and industrial supervisors said about the study's results, machinists in Nigeria need to know how to use computer-Numerical Controlled (CNC) machines in order to keep their jobs in the industry change 4.0. This is also clear from how close their standard deviations are to each other.

Research Question 2: What coding skill is required of machinists for job security in industry revolution 4.0 in Nigeria?

Table 2: Mean and standard deviation of lecturers and industrial supervisors on CNC machining skills required for job security in Nigeria

	Items	Lecturers N=42			Industrial Supervisors N=71		
S/N	**Ability to carry out coding to/for …**	$\bar{X}_1$	**SD₁**	**Rmk**	$\bar{X}_2$	**SD₂**	**Rmk**
1.	Give modal and non-modal commands	3.41	.89	R	3.51	.83	R
2.	Work offset selection	3.19	.72	R	3.18	.99	R
3.	Spindle speed	3.32	.97	R	3.09	.90	R
4.	Absolute and incremental positioning	3.48	.94	R	2.81	1.03	R
5.	Rapid motion	3.76	.90	R	3.59	.88	R
6.	Linear and circular interpolation	3.89	.98	R	2.93	.99	R
7.	Coolant regulation	2.75	.98	R	3.05	.83	R
8.	Optional and force stops	3.10	1.02	R	3.02	1.01	R
9.	Program end	3.16	.68	R	3.17	.74	R
10.	Tool change	2.59	1.14	R	3.28	.94	R
	Average Mean	**3.26**	**.92**	**R**	**3.16**	**.91**	**R**

Source: *Author (2025)* *Key: R = Required*

The lecturers had a grand mean of 3.26 and a standard deviation of.92, while the workplace supervisors had a grand mean of 3.16 and a standard deviation of.91. According to what the lecturers and industrial supervisors said, machinists in Nigeria need to know how to code in order to keep their jobs in the industry change 4.0. This is also clear from how close their standard deviations are to each other.

Test of Hypotheses

Hypothesis 1

There is a significant difference between the mean responses of lecturers and industrial supervisors on CNC machining skills required for job security in Nigeria

Table 3: t-test analysis of lecturers and industrial supervisors on CNC machining skills required for job security in Nigeria

Category of Respondents	N	$\bar{X}$	SD	df	P	t-cal	t-crit	Decision
Lecturers	42	3.18	.86					
				111	.05	.061	1.98	Accept
Industrial Supervisors	71	3.17	.80					

Source: *Author (2025)*

Table 3 shows that the grand mean for lecturers is 3.18 and the grand standard deviation is.86. On the other hand, the grand mean for industry managers is 3.17 and the grand standard deviation is.80. Also, the estimated value in the table was .061, which is less than the value in the table, which was 1.98 at the .05 level of significance. So, the alternative theory that there was a significant difference between the average answers of lecturers and industry supervisors about the CNC cutting skills that Nigerians need to keep their jobs was thrown out. This means that machinists in Nigeria need to know how to use CNC machines in order to keep their jobs, and there is no difference between what teachers and industry-based supervisors had said.

Hypothesis 2

The average answers of teachers and industrial managers on whether or not machinists need to know how to code in order to keep their jobs in the 4.0 industrial change in Nigeria are very different.

Table 4: t-test analysis of lecturers and industrial supervisors on coding skill required of machinists for job security in industry revolution 4.0 in Nigeria.

Category of Respondents	N	$\bar{X}$	SD	df	P	t-cal	t-crit	Decision
Lecturers	42	3.26	.92					
				111	.05	.560	1.98	Accept
Industrial Supervisors	71	3.16	.91					

Source: *Author (2025)*

Table 4 shows that the grand mean for lecturers is 3.26 and the grand standard deviation is.92. On the other hand, the grand mean for industry supervisors is 3.16 and the grand standard deviation is .91. On top of that, the estimated value of .560 is less than the table value of.98 at the.05 level of importance. So, the alternative theory that there was a significant difference between the average answers of lecturers and workplace supervisors about the coding skills that Nigerian machinists need to keep their jobs was thrown out. This means that machinists in Nigeria need to know how to code in order to keep their jobs, and there is no difference between what lecturers and industry-based supervisors had said.

Discussion of Findings

The professors had a grand mean of 3.18 and a standard deviation of .86, as shown in Table 1. The workplace supervisors had a grand mean of 3.17 and a standard deviation of .80 on the other hand. Based on what the lecturers and industrial supervisor said about the study's results, machinists in Nigeria need to know how to use Computer-Numerical Controlled (CNC) machines in order to keep their jobs in the industry change 4.0. Table 3 shows that the grand mean for lecturers is 3.18 and the grand standard deviation is .86. On the other hand, the grand mean for industry-based supervisors is 3.17 and the grand standard deviation is .80. Also, the estimated value in the table was .061, which is less than the value in the table, which was 1.98 at the .05 level of significance. So, the alternative theory was found to be false. This is shown in Table 2. The lecturers had a grand mean of 3.26 and a standard deviation of .92, while the workplace supervisors had a grand mean of 3.16 and a standard deviation of.91. According to what the lecturers and industrial supervisors said, machinists in Nigeria need to know how to code in order to keep their jobs in the industry change 4.0. Table 4 shows that the grand mean for lecturers is 3.26 and the grand standard deviation is .92. On the other hand, the grand mean for industry supervisors is 3.16 and the grand standard deviation is .91. So, the alternative theory was found to be false. In other words, machinists in Nigeria need to know how to code in order to keep their jobs, and the answers from lecturers and industry-based supervisors are the same. The results are in line with what Saleh et al. (2021) said about adaptive control technology of a Computer Numerical Controlled (CNC) lathe. This is the control technology that changes the processing parameters and strategies on its own by monitoring and analyzing the processing status in real time during the CNC lathe machining process. Its goal is to make cutting more efficient, guarantee quality, and cut down on the need for human help.

Conclusion

The study looked at the computer-aided engineering skills that Nigerian machinists need to keep their jobs in the 4.0 industrial change. Researchers in Rivers State, Nigeria, used a detailed research method and a questionnaire to find out what teachers and managers of machine shops work really think. The study found that machinists in Nigeria needed to know how to use computer-controlled machines and how to code in order to keep their jobs in the industrial revolution 4.0. The big mean and standard deviation of the responses in Tables 1 and 2 above showed that there was no difference between the answers of lecturers and industry-based supervisors when it came to the CNC machining and coding skills that machinists in Nigeria need to keep their jobs in the 4.0 industrial revolution.

Recommendations

The research recommends that:

1. The federal government of Nigeria should quickly get educational colleges the right CNC tools so that students can learn the skills they need for jobs in the industry (catch them young!).

2. Nigeria's Federal Ministry of Science and Technology should move right away to train young people in CNC cutting and programming so they can get jobs right away in the country's businesses. This can be done through a variety of trade skills training sites.

3. The Nigerian federal government should tell all educational institutions that they need to use some of their rebuilding funds to teach professors and technicians how to use the CNC code and cutting system.

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