

## UTILIZATION OF AUTOMATION TOOLS - BASED SUPPLY CHAIN MANAGEMENT FOR ACHIEVING TECHNICAL SKILL DEVELOPMENT IN TVET TRAINING INSTITUTIONS IN RIVERS STATE

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### Abstract

*This study determined respondents' perception on utilization of automation tools - based Supply Chain Management for achieving technical skill development in TVET training institutions. The study which was conducted in TVET training institutions in Rivers State, adopted descriptive research design. The total population was 152 subjects consisting of 36 technical college teachers, 42 technicians and 74 final students in the four (4) Rivers State owned technical colleges. The entire population was censused and used for the study. The instrument for data collection was a structured questionnaire titled "Utilization of Automation Tools - Based Supply Chain Management for Achieving Technical Skill Development Questionnaire (UATSCMATSDQ)". The instrument was validated by 3 experts from the department of Industrial Technology Education, Rivers State University, Port Harcourt. Comments and observations made by them were adequately utilized making the instrument appropriate for the study. Pearson Alpha was used to determine the reliability coefficient of the instrument which yielded 0.71. The instrument consisted of 21-items answerable on a four-point scale rating of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with numerical value of 4,3,2,1 respectively assigned. 152 copies of the instrument were administered on the respondents and all the 152 copies were retrieved after completion by the researcher and four (4) Research Assistants. Data collected was analyzed using mean statistics. Result showed among others that utilization of PLC-based SMC enhances technical skill development. Provision of PLC-based SMC in TVET institutions among others was recommended.*

Key Word: Automation tools, Supply Chain Management, TVET Institutions, Technical Skills

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### Introduction

Efficient and accurate supply chain is essential for the growth and performance of students in any academic institution especially where instructions are directed towards acquisition of scientific knowledge and practical skills. Technical and Vocational Education and Training (TVET) as an aspect of educational process emphasizes the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding, and knowledge relating to occupations in

various sectors of economic and social life (UNESCO, 2015). According to International Labour Organization (ILO, 2021), TVET utilizes formal, non-formal, and informal learning to provide knowledge and skills for employment, inclusion, and sustainable development. The aims of TVET is to equip learners with knowledge, competencies and skills needed for career in labour market. National Policy on Education of the Federal Republic of Nigeria (NPE, FRN, 2013) stressed the aims of TVET to include provision of trained manpower, imparting skills and scientific knowledge on learners, provision of technical and vocational skills necessary for industrial, commercial and economic development of the society as well as training individuals to be self-reliant and employers of labour. TVET training institutions encompasses Technical Colleges, Vocational Enterprise Institutions (VEIs) and National Vocation Qualification Framework (NVQF) (FRN, 2013).

For optimal achievement of the goals of TVET in this dynamic technology driven era, the need to ensure quality assurance in instructional facilities and delivery through prompt provision of quality instructional materials, equipment, and services as well as the efficient management of these resources to support practical learning and skill acquisition remains indispensable. Integration of efficient and reliable Supply Chain Management (SCM) in TVET institutions could be essential in facilitating goal achievement. SCM is the integration of business processes from suppliers to end users to provide products, services, and information that add value for customers and stakeholders (Ojadi, Akinlabi & Egbuta, 2021). It is the streamlining of inter-organizational processes and relationships to enhance performance competitiveness and relevance in the labour market. Mabanga (2018) defined SCM as the strategic coordination of procurement, logistics, and inventory systems to ensure the timely and cost-effective delivery of educational resources and services that support instruction. It involves the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities (Oloruntoba & Gray, 2006). Supply chain management in TVET therefore is a strategic coordination involving the total system approach of prompt supply and satisfactory management of the entire flow of information, instructional facilities, materials, control, instructional delivery and other required services for the purpose of achieving the goals of TVET satisfactorily.

Enhanced supply chain management in TVET could improve training and instructional efficiency to support sustainable manpower development and national growth. Manpower development is the systematic training of individuals in technical colleges to meet industrial and technological needs (Umar & Maigida, 2021). According to Oviawe and Uwameiye (2022) manpower development is a competency-based approach to preparing learners for the dynamic demands of the labor market. Rutledge, Kehr and Griffin (2021) describe manpower development as a dynamic process of aligning TVET outcomes with global workforce standards. Application of new technologies, collaborations and effective supply and management of instructional resources could be priorities in achieving competency in manpower development in TVET.

Utilization of automation tools in enhancing supply chain management in TVET could be progressive. According to Dalsaniya and Patel (2022) automation tools are software systems that combine robotic process automation and artificial intelligence to perform tasks with very low human intervention. Tyson and Zysman (2022) opined that automation tools are technologies powered by artificial intelligence that effectively replaces humans in physical and cognitive responsibilities. The utilization of automation tools - based Supply Chain Management (SCM) within Technical and Vocational Education and Training (TVET) refers to the integration of advanced technologies that enable the automatic execution of SCM processes with minimal human intervention. This approach aims to enhance instructional delivery, foster student engagement, improve academic performance and retention, and ultimately cultivate a skilled and competitive workforce capable of thriving in the global labour market while contributing to national development. The integration of automation tools could be imperative in achieving this.

Programmable Logic Controllers (PLCs) - based SCM could enhance instructional processes in TVET. PLCs are industrial automation training programmable softwares that help student learn practical instruction such as how to control machinery. According to Frey (2014) PLC is a digital electronic device with programmable memory used to store instructions for implementing specific functions such as control, sequencing, timing, counting and arithmetic operations. It is a system containing sensors, actuators, control logic, and software with the ability to independently carryout technical processes in industrial environments (Weyrich, 2024). It could boost practical instruction experiences and streamline technical processes.

Computer Numerical Control (CNC) machines in SCM could also enhance the achievement of competent skilled manpower development. According to Ekengwu and Emeruwa (2024) CNC is automated platforms that enable precise control of manufacturing processes through programmable software and hardware integration. This automatic tool can be utilized to teach accuracy in machines practices such as cutting, milling, and drilling in manufacturing. CNC stores and process machining instructions using imputed data. Using CNC in TVET institution could facilitate instructional processes as machining functions are controlled by motors using computer programmes instead of manual adjustments. Other automation tools include Robotic Arms (RA) which is mostly suitable for training students in manufacturing, robotic programming and assembling component using automation. 3D Printers are also automation tools that enabling students to produce complex models directly from digital files thereby. Building Management Systems (BMS) is another automation tool which when utilized, enable students to monitor and control electrical and other installations in a building at a glance. It is often used in maintenance.

Automation tools reduces errors in learning practical lessons, promotes productivity and enhance accuracy in workshop practices thereby improving instructional efficiency. Several findings including that of Ajiga, Okeleke, Folorunsho and Ezeigweneme (2024), Sheth (2023) and Elhajjar, Yacoub and Yaacoub, (2023) has shown that automation tools increase efficiency, save cost, improve data accuracy, improves maintenance and enhance practical learning. This could facilitate goal achievement, improve instruction processes and impact on skilled competency development among TVET students.

### **Statement of the Problem**

Despite the potential benefits derivable from automation tools, its utilization in enhancing SCM in TVET has been so minimal. The SCM system in TVET still rely heavily on manual operations in effecting instructional processes. This could result to errors in workshop practices, waste of time, poor data collection and poor reporting of instructional operations. Practical lessons requiring prompt supply of instructional facilities are either delayed or out rightly not available. Additionally, lack of adequate number of personnel and facilities to handle issues in the supply chain could negates the achievement of the goals of TVET. Studies such as that of Ukala and Iheukwumere (2025) has also shown that automation tools are not adequate enough in TVET institution to facilitate learning. This could retard competency in technical manpower development. It is on this basis that this study tends to determine respondents' perception on the impact of automation tools utilization in enhancing supply chain management in TVET training institutions on achieving technical manpower development.

### **Purpose of the Study**

This study is on utilization of automation tools - based supply chain management for achieving technical skill development in TVET training institutions in Rivers State. Specifically, this study determined:

1. Perception of respondents on the impact of Programmable Logic Controllers (PLCs) - based SCM for achieving technical skill development in TVET training institutions in Rivers State
2. perception of respondents on the impact of Computer Numerical Control (CNC)-based SCM for achieving technical skill development in TVET training institutions in Rivers State
3. Perceived impact of Machines 3D Printers -based SCM for achieving technical skill development in TVET training institutions in Rivers State.

## Research Question

The following research questions guided this study

1. What is the perception of respondents on the impact of Programmable Logic Controllers (PLCs)- based SCM for achieving technical skill development in TVET training institutions in Rivers State?
2. What is the perception of respondents on the impact of Computer Numerical Control (CNC) - based SCM on technical skill development in TVET training institutions in Rivers State?
3. What is the perception of respondents on the impact of Machines 3D Printers-based SCM on technical skill development in TVET training institutions in Rivers State?

## Method

This study is on utilization of automation tools - based supply chain management for achieving technical skill development in TVET training institutions. The study which was conducted in Rivers State, Nigeria adopted descriptive research design. A total population of 152 subjects consisting of 36 technical college teachers, 42 technicians and 74 final students in the four (4) Rivers State owned technical colleges in Rivers State. The technical colleges are Government Technical College, Ahoada; Government Technical College Eleogu; Government Technical College Port Harcourt and Government Technical College Tombia. The entire population was censused and used for the study due to its manageable size. A structured instrument titled “Utilization of Automation Tools - Based Supply Chain Management for Achieving Technical Skill Development Questionnaire (UATSCMATSDQ)” which was developed by the researcher was used for data collection. The instrument was validated by 3 experts from the department of Industrial Technology Education, Rivers State University, Port Harcourt. Comments and observations made by them were incorporated accordingly. Thus, the researcher believe that the instrument is suitable and appropriate for the study. Cronbach Alpha was used to determine the reliability coefficient of the instrument which yielded 0.71 developed by the researchers. The instrument consisted of 21-items answerable on a four-point scale rating of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) and a numerical value of 4,3,2,1 respectively assigned. 152 copies of the instrument was administered on the respondents. 152 copies of the instrument were retrieved after completion by the researcher and four (4) Research Assistants. Data collected was analyzed using mean statistics. Items with a mean rating of 2.50 and above were regard as Agree while items with mean rating below 2.50 were regarded as Not Agree.

## Results

### Research Question 1

What is the perception of respondents on the impact of Programmable Logic Controllers (PLCs) - based SCM on technical skill development in TVET training institutions in Rivers State?

**Table 1: Mean rating of respondents' perception on the impact of PLCs - based SCM on technical skill development in TVET training institutions in Rivers State**

| SN                | Items                                                                         | SA  | A  | D  | SD | Total      | Mean        | Decision     |
|-------------------|-------------------------------------------------------------------------------|-----|----|----|----|------------|-------------|--------------|
| 1                 | enhances problem-solving skills                                               | 110 | 27 | 8  | 5  | 152        | 3.57        | Agree        |
| 2                 | improves skills to handle real-world technical problems                       | 124 | 21 | 7  | 5  | 152        | 3.80        | Agree        |
| 3                 | skill in designing control systems for smart warehouses are enhanced          | 120 | 15 | 13 | 4  | 152        | 3.65        | Agree        |
| 4                 | Improves hands-on skills in integrating PLCs with workplace planning systems. | 133 | 10 | 5  | 4  | 152        | 3.79        | Agree        |
| 5                 | Enhances mastering of input/output skill for industrial control applications. | 108 | 24 | 11 | 9  | 152        | 3.52        | Agree        |
| 6                 | Enhances skill in troubleshoot basic ladder logic programmes                  | 131 | 7  | 1  | 3  | 152        | 3.61        | Agree        |
| 7                 | Promotes acquisition of diagnostic skills                                     | 131 | 12 | 5  | 4  | 152        | 3.77        | Agree        |
| <b>Grand Mean</b> |                                                                               |     |    |    |    | <b>152</b> | <b>3.63</b> | <b>Agree</b> |

Data analyzed in Table 1 showed that respondents agree to each of the items of the instrument. The overall grand mean of 3.63 which is greater than the cutoff point of 2.50 shows that it is the perception of respondents that Programmable Logic Controllers (PLCs) - based SCM positively impact on technical skill development in TVET training institutions in Rivers State.

## Research Question 2

What is the perception of respondents on the impact of Computer Numerical Control (CNC) -based SCM on technical skill development in TVET training institutions in Rivers State?

**Table 2: Mean ratings of respondents' perception on the impact of Computer Numerical Control (CNC) - based SCM on technical skill development in TVET training institutions in Rivers State**

| SN                | Items                                                                     | SA  | A  | D  | SD | Total      | Mean        | Decision     |
|-------------------|---------------------------------------------------------------------------|-----|----|----|----|------------|-------------|--------------|
| 8                 | enhances learners' skill in precision machining.                          | 117 | 20 | 8  | 7  | 152        | 3.63        | Agree        |
| 9                 | Enhances acquisition of automation skills in implementing technical tasks | 124 | 16 | 7  | 5  | 152        | 3.70        | Agree        |
| 10                | Improves skill in handling modern supply chain tools.                     | 130 | 7  | 13 | 2  | 152        | 3.74        | Agree        |
| 11                | Enhances innovative skill                                                 | 120 | 16 | 7  | 9  | 152        | 3.63        | Agree        |
| 12                | Improves maintenance skill                                                | 98  | 37 | 10 | 7  | 152        | 3.48        | Agree        |
| 13                | Improves skill on technical career readiness                              | 122 | 17 | 6  | 7  | 152        | 3.67        | Agree        |
| 14                | Improves manufacturing skill among learners                               | 123 | 16 | 7  | 6  | 152        | 3.68        | Agree        |
| <b>Grand Mean</b> |                                                                           |     |    |    |    | <b>152</b> | <b>3.65</b> | <b>Agree</b> |

Result of analyzed data as shown in Table 2 indicates that respondents agree to each of the items of the instrument. The overall grand mean of 3.65 which is greater than the cutoff point of 2.50 is an indication that respondents perceive that Computer Numerical Control (CNC) -based SCM positively impact on technical skill development in TVET training institutions in Rivers State.



### Research Question 3

What is the perception of respondents on the impact of 3D Printers - based SCM on technical skill development in TVET training institutions in Rivers State?

**Table 3: Mean ratings of respondents' perception on the impact of 3D Printers - based SCM on technical skill development in TVET training institutions in Rivers State**

| SN                | Items                                                                 | SA  | A  | D  | SD | Total | Mean        | Decision     |
|-------------------|-----------------------------------------------------------------------|-----|----|----|----|-------|-------------|--------------|
| 15                | enhances learners' innovation ability                                 | 120 | 16 | 7  | 9  | 152   | 3.62        | Agree        |
| 16                | improved technical modelling skills                                   | 131 | 7  | 1  | 3  | 152   | 3.62        | Agree        |
| 17                | Enhances technical drawing and design skills                          | 118 | 19 | 9  | 6  | 152   | 3.64        | Agree        |
| 18                | helps bridge the gap between theory and practice in TVET institutions | 98  | 12 | 6  | 4  | 152   | 2.92        | Agree        |
| 19                | Builds confidence in students when used for training                  | 109 | 22 | 12 | 9  | 152   | 3.51        | Agree        |
| 20                | encourages problem-solving skills                                     | 130 | 13 | 5  | 4  | 152   | 3.76        | Agree        |
| 21                | Promotes hands-on learning and practical skill development            | 99  | 30 | 13 | 10 | 152   | 3.43        | Agree        |
| <b>Grand Mean</b> |                                                                       |     |    |    |    | 152   | <b>3.50</b> | <b>Agree</b> |

Result of analyzed in Table 3 showed that respondents agree to each of the items of the instrument as each the calculated mean of each item is above the cut-off point of 2.50. The overall grand mean of 3.50 which is greater than the cutoff point of 2.50 is an indication that respondents perceive that the utilization of 3D Printers - based SCM positively impact on technical skill development in TVET training institutions in Rivers State.

### Discussion of Findings

Findings as shown in Table 1 indicated that utilization of Programmable Logic Controllers (PLCs) - based supply chain management positively impact technical skill development in TVET training institutions. This corroborates that of Frey (2014) that PLC enhances instruction in control, sequencing, timing, counting and arithmetic operations when utilized in practical lessons. Findings as shown in Table 2 also revealed that the utilization of automation tool such as Computer Numerical Control (CNC) -based Supply Chain Management positively impact technical skill development in TVET training institutions. This finding agree with that of Sheth (2023) that automation tool increases efficiency when used for practical instruction. The study is also in line with the findings of Elhajjar, Yacoub and Yaacoub (2023) that automation tools improve data accuracy, improves maintenance and enhance practical learning which promote technical skill acquisition. Findings obtained from research question 3 as shown in Table 3 is that utilization of 3D Printers - based SCM positively impact on technical skill development. This finding corroborates that of Ajiga, Okeleke, Folorunsho and Ezeigweneme (2024) that automation tools enhance instructions thereby facilitating acquisition of competencies among learners.

### Recommendations

Based on the results from the analyzed data, the researchers the following recommendations were made:

1. Automation tools such as PLC be integrated into supply chain management in TVET
2. Computer Numerical Control (CNC) -based Supply Chain Management should be provided in all TVET institutions by government and non-governmental organizations

3. Provision of 3D Printers - based SCM in TVET training institutions be encouraged providing these automation tools to the institutions
4. Provision of training for TVET staff on the utilization of automation tools be implemented by government

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