International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Bridging the Fiber Future: Competency Assessment and Skills Development for Engineering and Ict Professionals in Carcanmadcarlan

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Abstract

This study seeks to examine the competency level of Engineering and ICT professionals in Carrascal, Cantilan, Madrid, Carmen and Lanuza (CARCANMADCARLAN) in terms of fiber network management, troubleshooting and maintenance. The study sample comprises of 80 respondents which consist of 15 Engineering and 65 ICT professionals randomly selected from government and private agencies throughout CARCANMADCARLAN. The data was obtained via survey questionnaire with closed and open-ended questions. Overall, participants demonstrated a High Level of competence, with a grand mean of 3.67, reflecting their solid proficiency in key areas such as ICT device operation, network configuration, and desktop/laptop troubleshooting. The high ratings in ICT Devices and Operation (mean of 4.95) and Network Maintenance Skills (mean of 4.43) suggest that these professionals are well-equipped to manage essential technological infrastructures, ensuring operational efficiency and stability. The data also reveals notable gaps, particularly in Advanced Fiber Optic Skills, which received a low overall rating of 2.01. This suggests that while participants possess a good theoretical understanding of basic fiber optic technology, they lack the advanced technical skills necessary for tasks such as fiber optic splicing and termination. Under the desktop/laptop troubleshooting skills specifically on the component performing board level repair also shows a very low-level Mean rating of 1.75. It is therefore recommended that participants engage in more focused training in advanced board level repair and fiber optic network management to bridge this expertise gap and remain competitive in an evolving technological landscape.

Keywords: ICT, Fiber Optic Technology, Network Management, Competency Level

Introduction

In the digital age, the capacity to manage and sustain robust network infrastructures has become a cornerstone of operational efficiency and innovation in both public and private sectors. As industries increasingly transition to high-speed, fiber-optic networks, the demand for technically proficient professionals capable of supporting this shift has escalated. Fiber optic technology, with its superior speed, bandwidth, and reliability, is now considered the backbone of modern digital communication. However, its effective deployment and maintenance require specialized skills that go beyond basic ICT proficiencies, especially in areas such as splicing, termination, and network diagnostics.

Within this context, the CARCANMADCARLAN area in CARAGA region comprising the municipalities of Carrascal, Cantilan, Madrid, Carmen, and Lanuza faces a critical juncture in its digital development. Local engineering and ICT professionals, many of whom are responsible for sustaining agency-level IT systems, are expected to support the region's transition to fiber-based infrastructure. Yet, anecdotal and field observations suggest a gap between the competencies required for advanced fiber optic management and the skills currently held by practitioners. This disparity raises important concerns about the readiness of the regional ICT workforce to meet evolving technological demands.

While previous literature underscores the importance of ICT integration and technical training in building a future-ready workforce (Papadakis et al., 2023; Mubashira, 2019), most studies remain generalized and do not provide localized assessments of specific competencies in fiber network technologies. Moreover, limited empirical data is available regarding the current technical skillsets of ICT practitioners in geographically clustered yet economically strategic areas such as CARCANMADCARLAN. This presents a research gap with both theoretical and practical implications: without precise diagnostics of professional competencies, it is difficult to design and implement effective training interventions.

To address this gap, the present study aims to assess the competency levels of Engineering and ICT professionals across CARCANMADCARLAN in key technical domains including ICT operations, network maintenance, desktop/laptop troubleshooting, and both basic and advanced fiber optic technologies. The study utilizes a descriptive survey design, employing quantitative methods to evaluate specific skill areas based on weighted mean analysis and a structured Likert scale instrument. Eighty professionals were sampled from various government and private institutions to ensure a representative assessment across multiple sectors.

The findings of this research will contribute to a more nuanced understanding of regional training needs and provide empirical grounding for the development of targeted upskilling programs. Furthermore, the study supports ongoing national and institutional efforts to strengthen digital infrastructure by ensuring that human capital is aligned with technological advancement. By identifying both existing proficiencies and critical gaps, this research serves as a strategic resource for educators, policymakers, and organizational leaders working to future-proof the ICT workforce in CARCANMADCARLAN and similar regional settings.

Review of Related Literature

The sustained growth of the fiber optic industry is largely dependent on the availability of skilled professionals capable of designing, installing, maintaining, and optimizing high-performance network infrastructures. As organizations transition to fiber-based technologies to meet increasing bandwidth and latency demands, the required technical skillsets have evolved, pushing beyond traditional ICT knowledge into specialized domains such as fiber splicing, optical signal diagnostics, and intelligent system integration.

A growing body of literature has explored the essential competencies needed by fiber optic technicians in contemporary network environments. Mubashira (2019) emphasized the importance of a solid ICT foundation, arguing that technicians must be well-versed in computer systems and networking fundamentals to contribute meaningfully to a knowledge-based society. Reinforcing this, Papadakis et al. (2023) highlighted the need for integrated ICT learning in technical training programs, noting its role in strengthening analytical, problem-solving, and troubleshooting abilities key competencies in fiber optic system deployment and maintenance.

Recent advancements in intelligent maintenance systems have introduced new dimensions to technical requirements. Vera et al. (2024), for instance, demonstrated how machine learning algorithms could be leveraged to analyze optical fiber signals for fault detection, significantly improving the speed and accuracy of maintenance activities. These technologies demand an upskilled workforce that can interpret data, interface with automated systems, and perform complex diagnostics. Beyond technical capabilities, communication and coordination are pivotal in sustaining large-scale fiber optic infrastructure. Ngugi et al. (2023) stressed the importance of clear communication protocols and collaborative strategies, especially as network systems grow in size and complexity. Similarly, Valeagh et al. (2022) pointed out that network administrators are increasingly required to handle both technical tasks and time-sensitive operational decisions, often under resource-constrained conditions. Their study emphasized the need for targeted training in system troubleshooting, infrastructure scalability, and tool utilization to maximize efficiency and minimize downtime.

Expanding on the theme of network complexity, Maksymyuk et al. (2020) examined the architectural and operational challenges associated with evolving spectrum management in next-generation networks. Their study advocated for a comprehensive reevaluation of network management frameworks to support shared infrastructure models, which has direct implications for technician training and cross-functional coordination. The insights align with the goals of the present study to assess existing competencies and training needs to support effective network transformation in CARCANMADCARLAN. Other research has focused on security and system sustainability. Niklekaj (2023) explored threats in computer networks and the role of user education in safeguarding infrastructure. He emphasized the necessity of continuous threat awareness and security protocol training. Khairnar et al. (2024) further added that intelligent computer networks often face challenges related to system complexity, interoperability, and rapid obsolescence, making regular upskilling essential. Moreover, Muchamad (2024) presented a sustainability-oriented perspective, arguing that technical skill enhancement directly correlates with environmentally responsible innovations in network operations.

Despite these insights, few studies offer region-specific data on technical competencies, particularly in transitional regions like CARCANMADCARLAN. The present research addresses this gap by evaluating the actual skill levels of local engineering and ICT professionals, particularly in the context of advanced fiber optic technologies and network troubleshooting. By building on the literature and responding to localized needs, this study contributes to the growing discourse on workforce readiness, infrastructure modernization, and digital sustainability.

Significance of the study

The significance of a fiber optic assessment study lies in its potential to address the skills gap in the fiber optic industry, which is hindering its growth and limiting its potential. By identifying the skills required for fiber optic technicians, assessing their competency levels, and developing effective training programs, this study can contribute to the growth of the industry and the economy as a whole. This study is very significant to the following:

ICT Professionals/Practitioners: The ICT Professional / practitioners were one of the recipients of this study. Since the study conveys different agencies and municipality in Carcanmadcarlan.

Government Agencies: Through the realization of this study, the government agencies in Carcanmadcarlan are also be benefited since such participants are employed in their agency.

Future Researcher: The study would serve as bases in making future related researches as well as triggering possible research concept that would help solve real world problems in the benefit of humanity and the government.

Objectives of the study

The objective of this fiber optic assessment study is to identify the skills required for fiber optic technicians and ICT practitioner, assess their competency levels, and develop effective training programs to address the skills gap in the industry. Specifically, the study aims to:

1. Assess the level of skills and expertise on ICT Network Infrastructure technicians, including knowledge of fiber optic, network components, installation, testing, troubleshooting, and maintenance.
2. Understand what are the professional challenges encountered by Engineering and ICT Professionals in their corresponding areas agencies.
3. Identify solution and strategy towards the challenges and threats in the Network Infrastructure Technology.

Methodology

This part illustrates the methods, components and other necessary materials that are prospected to be used in this study.

The study employs a descriptive research method. The said method was used as it shows the descriptive nature of the situation during the time of the study. It comprises of numerous approaches such as the gathering of data that best describes the present status of the aimed target of the study. The questionnaire will consist of closed-ended and open-ended questions designed to collect information on the current state of ICT infrastructure, knowledge and awareness of fiber optic technology, readiness to adopt fiber optic technology, potential benefits and challenges associated with adoption. The survey questionnaire was crafted in google forms and will be distributed to government agency staff via email. Participants will be given ample time to complete and answer the questionnaire. Results of the analysis serves as basis for the development of training programs intended to address gaps.

Data collected was analyzed using descriptive statistics standard deviation, and frequency distributions. Inferential statistics such as correlation and regression analysis will also be used to identify the relationship between different variables. The research ensures the participants' privacy and confidentiality and was maintained throughout the research process. Participants was informed about the purpose of the study, and their participation were voluntary. Consent was obtained from participants before data collection.

Data Gathering

The survey utilized a Likert scale ranging from 5 (Very High Level) to 1 (Very Low Level) to assess various aspects of the expertise level. This standardized approach ensured that the data collected was both reliable and valid. The survey was administered to a diverse group of ICT and Engineering professional in CARCANMADCARLAN. This inclusive approach aimed to capture a wide range of perspectives on the evaluation of professional's expertise level.

Table 1. Range of Weighted Mean and its Interpretation

Scale	Interpretation	Range of the Weighted Mean
5	Very High Level	4.3 – 5.0
4	High Level	3.5 - 4.2
3	Moderate Level	2.7 - 3.4
2	Low Level	1.9 - 2.6
1	Very Low Level	1.0 – 1.8

The above table shows the rating scale and the interpretation as a basis in the evaluation of the level of expertise of Engineering and ICT professionals in CARCANMADCARLAN.

Results and Discussion

This section examines the competency assessment's results and discussion, emphasizing important discoveries that show the fundamental abilities and proficiencies needed by CARCANMADCARLAN's engineering and ICT professionals to efficiently oversee network infrastructure and maintenance.

Table 2. Level of expertise of the participants with regards to ICT Devices and Operation.

Criteria	Average Mean	Description
1. Basic Hardware assembly/Disassembly	4.95	Very High Level
2. Operating System Installation/Configuration	4.93	Very High Level
3. ICT Device Operation/Maintenance	4.94	Very High Level
4. Perform BIOS Configuration	4.98	Very High Level
Category Mean	**4.95**	**Very High Level**

The results indicate a Very High Level of Expertise in Information and Communication Technology (ICT) Devices and Operation as illustrated in table 2, with a remarkable mean score of 4.95. This score suggests that participants feel exceptionally confident in their abilities, likely due to comprehensive training, significant hands-on experience, and a commitment to continuous learning. Such high expertise not only enhances individual productivity but also fosters innovation and effective problem-solving within organizations. Moreover, participants are likely to take on mentoring roles, thereby contributing to a collaborative environment that encourages knowledge sharing. The specific criteria assessed Basic Hardware assembly/Disassembly, Operating System Installation/Configuration, ICT Device Operation/Maintenance, and Perform BIOS Configuration skills collectively underscore the depth of expertise present in this group, highlighting their readiness to navigate the complexities of modern technology effectively.

Table 3. Level of expertise of the participants with regards to Network Maintenance Skills

Criteria	Average Mean	Description
1. Regular Network Monitoring	4.70	Very High Level
2. Troubleshooting Network Issues:	4.28	High Level
3. Patch Management:	4.19	High Level
4. Backup and Recovery Procedures:	4.55	Very High Level
Category Mean	**4.43**	**Very High Level**

The participants demonstrated a Very High Level of expertise in network maintenance, as shown in table 3 with a category mean of 4.43. This is supported by high ratings in key areas like regular network monitoring (4.70) and backup/recovery procedures (4.55), both rated at a very high level. The other criteria, including troubleshooting network issues and patch management, scored slightly lower but still reflect a high level of expertise. This indicates that participants are particularly proficient in maintaining and managing network systems, ensuring they can keep systems running smoothly. Studies on IT professionals confirm the critical importance of these skills in minimizing network downtime and enhancing overall system reliability (Shreya, 2023).

Table 4. Level of expertise of the participants with regards to Desktop/Laptop Troubleshooting Skills

Criteria	Average Mean	Description
1. Basic Laptop Troubleshooting	4.25	High Level
2. Desktop Parts Replacement	3.70	High Level
3. Perform Laptop Upgrade	3.55	High Level
4. Perform Board Level Repair	1.75	Very Low Level
Category Mean	**3.31**	**Moderate Level**

The expertise level in Desktop/Laptop Troubleshooting Skills was assessed as Moderate, with a category mean of 3.31. While basic troubleshooting and parts replacement were rated highly, there is a notable decline in expertise for board-level repairs, which scored 1.75 (Very Low). This suggests that participants are comfortable with routine troubleshooting tasks but may lack the deeper technical knowledge required

for advanced repairs. This aligns with research showing a gap in board-level repair skills among IT professionals, as newer devices increasingly require specialized training (Rikala et al., 2023).

Table 5. Level of expertise of the participants with regards to Basic Fiber Optic Technology

Criteria	Average Mean	Description
1. Understand Fiber Optic Concepts	4.63	Very High Level
2. Identify Fiber Optic Network Devices	3.94	High Level
3. Identify Fiber Optic Tools	3.2	Moderate Level
4. Manage Fiber Optic Network	2.8	Moderate Level
Category Mean	**3.64**	**High Level**

For Basic Fiber Optic Technology, the participants displayed a High Level of expertise, with a category mean of 3.64. While there is strong competence in understanding fiber optic concepts (4.63) and identifying network devices (3.94), there are moderate skill levels in more hands-on tasks like managing fiber optic networks and identifying specific tools. This indicates a theoretical understanding but suggests a need for further practical training in fiber optic network management. Fiber optic technology is essential in modern communication infrastructures, as highlighted by (Shreya 2023), emphasizing the need for practical skill development.

Table 6. Level of expertise of the participants with regards to Advanced Fiber Optic Skills

Criteria	Average Mean	Description
1. Fiber Optic Cable Installation	2.63	Low Level
2. Fiber Optic Device Configuration on Network	2.28	Low Level
3. Fiber Optic Splicing and Termination	1.44	Very Low Level
4. Fiber Optic Network Testing and Troubleshooting	1.69	Very Low Level
Category Mean	**2.01**	**Low Level**

In Advanced Fiber Optic Skills, participants rated themselves at a Low Level, with a category mean of 2.01. Fiber optic splicing and testing were particularly low, reflecting minimal expertise in these critical areas. This suggests that participants lack the advanced technical skills required for tasks such as fiber optic installation and network troubleshooting, which are increasingly important in high-speed data

transmission networks (Mohammed et al., 2024). Training in these areas could bridge this expertise gap and increase overall competence in fiber optic technology. Highlighting the importance of awareness of these technologies for Industry 4.0 and beyond.

Table 7. Over all Technical Expertise of Participants as an engineering / ICT Professional

Criteria	Average Mean	Description
1. ICT Devices and Operation	4.95	Very High Level
2. Network Configuration and Management	4.43	Very High Level
3. Desktop/Laptop Troubleshooting Skills	3.31	Very High Level
4. Basic Fiber Optic Technology	3.64	Moderate Level
5.Advanced Fiber Optic Skills	2.01	Low Level
GRAND MEAN	**3.67**	**High Level**

The overall expertise of the participants as ICT/Engineering professionals was rated as High, with a grand mean of 3.67. The highest expertise was shown in ICT devices and network management, while advanced fiber optic skills remained a weakness. This overall assessment reflects a solid foundation in network and system troubleshooting but highlights the need for development in fiber optic technology, a critical skill in the digital age (Faheem et al., 2024). Investing in continuous learning and innovation of its potential application, particularly in innovating fiber optic technologies with higher bandwidth and low-latency connections. Engaging in this continuous journey of learning would ensure the participants stay competitive in the evolving technological landscape.

Table 8. Challenges encountered by Engineering and ICT professional in their corresponding connected agencies in terms of managing and maintaining their network infrastructure.

Criteria	Average Mean	Description
1. Difficulty in expanding network infrastructure, limited organizational support and budgetary support.	4.00	High Level
2. Challenges in managing and mitigating cybersecurity risks such as malware, ransomware, and unauthorized network access, while ensuring compliance with security standards.	3.88	High Level
3. Challenges in balancing the need for modern, high-performing equipment while managing outdated hardware and ensuring backward compatibility during system upgrades.	3.75	High Level
4. Challenges in bandwidth limitations, network congestion, and latency to maintain efficient network performance.	3.38	Moderate Level
5.High installation, maintenance, and repair costs of fiber optic networks, coupled with the need for specialized skills and equipment.	3.13	Moderate Level

6. Difficulty in conducting ICT hardware repair specially in board related problem.	2.75	Moderate Level
7. Multiple Organizational designation allowing difficulties in time management.	3.00	Moderate Level
8. Personnel ethical concern, refusal to upgrade an outdated, unsecured database system due to a closed-minded approach to new technology results in violation of data privacy regulations.	3.50	High Level
Category Mean	**3.42**	**Moderate Level**

The survey results reveal that while some challenges, like expanding network infrastructure and managing cybersecurity risks, are pressing, there are issues that appear to be of lower urgency but still require attention. For instance, the difficulty in repairing ICT hardware, particularly with board-related problems, scored the lowest with a mean of 2.75, suggesting it is the challenges that needs critical concern for many professionals. Similarly, the high costs associated with maintaining fiber optic networks and time management challenges due to multiple organizational roles were rated moderately at 3.13 and 3.00, respectively. The overall category Mean is 3.42 indicating a moderate level; these findings indicate that while these problems are not as urgent as others, they still present ongoing hurdles that, if unaddressed, could accumulate over time and impact overall efficiency and productivity.

Findings

The research revealed that Engineering and ICT professionals across CARCANMADCARLAN demonstrate a commendable level of expertise in foundational ICT skills, particularly in device operation (Mean: 4.95) and network maintenance (Mean: 4.43), indicating a robust baseline of technical proficiency essential for supporting digital infrastructure. However, a critical finding of the study is the substantial skills gap in Advanced Fiber Optic Technologies with a notably low mean of 2.01 and board-level hardware repair (Mean: 1.75), which are increasingly vital competencies in the transition toward high-speed, fiber-based communication systems and modern hardware diagnostics. This dichotomy underscores a pressing need to recalibrate training and professional development programs to address the demands of a rapidly evolving technological landscape.

From a research and policy perspective, these findings highlight a systemic issue that warrants both academic attention and institutional intervention. The results suggest that while theoretical knowledge is reasonably established, practical and advanced technical skillsets have not kept pace with industry transformation, particularly as the region's infrastructure modernizes toward fiber connectivity and digital resilience.

Conclusion

From the abovementioned results and discussion, the researcher reached the following conclusions. The analysis of the participants' expertise as ICT and engineering professionals provides a clear understanding of their strengths and areas where further development is needed. The study evaluated their skills across various domains, including network maintenance, desktop troubleshooting, and fiber optic technologies. Although participants demonstrated remarkable proficiency in fundamental ICT tasks, like device and

network management, deficiencies were detected in more specialized domains, especially in advanced fiber optic abilities and circuit level repair. The results provide a valuable insight into the technical expertise of ICT and engineering professionals in various critical areas, highlighting both strengths and areas for development.

The participants demonstrated a High Level of competence, with a grand mean of 3.67, reflecting their solid proficiency in key areas such as ICT device operation, network configuration, and desktop/laptop troubleshooting. The high ratings in ICT Devices and Operation (mean of 4.95) and Network Maintenance Skills (mean of 4.43) suggest that these professionals are well-equipped to manage essential technological infrastructures, ensuring operational efficiency and stability. The data also reveals notable gaps, particularly in Advanced Fiber Optic Skills, which received a low overall rating of 2.01. This suggests that while participants possess a good theoretical understanding of basic fiber optic technology, they lack the advanced technical skills necessary for tasks such as fiber optic splicing and termination as well us structuring a good fiber network infrastructure. This shortfall could hinder their ability to work on modern, high-speed communication infrastructures, which are increasingly dependent on fiber optic technology. Under the desktop/laptop troubleshooting skills specifically on the component performing board level repair also shows a very low-level mean rating of 1.75. The same pattern results in identifying the challenges encountered by the participants in their corresponding agencies, these two areas of indicate critical concern. It is therefore recommended that participants engage in more focused training in advanced board level repairs and fiber optic network management to bridge this expertise gap and remain competitive in an evolving technological landscape.

Recommendation

In light of the above findings, the research community and relevant stakeholders are encouraged to:

1. Develop Targeted, Competency-Based Training Programs focused specifically on:
2. Advanced fiber optic practices, including splicing, termination, network testing, and device configuration.
3. Board-level diagnostics and repair, especially for desktop and laptop systems, which remain critical in resource-constrained environments.
4. Collaborate with Industry and Academia to establish certification tracks and laboratory-based training modules that simulate real-world network deployment scenarios. This partnership will bridge the knowledge-to-practice gap and ensure curriculum relevance to industry needs.
5. Pursue longitudinal research that monitors the impact of upskilling programs over time on job performance, network efficiency, and organizational innovation thereby contributing to scholarly discourse on professional development in ICT and engineering fields.
6. Promote policy-driven support from local government units and national agencies to allocate funding and incentives for capacity-building programs tailored to regional challenges and emerging technologies.

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