

Factors Influencing Noncompliance with Fiber Installation Guidelines by Communication Service Providers: A Case Study of Lusaka, Zambia

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Abstract Fiber optics technology has become the primary transmission medium for telecommunications. As the demand for new technology and services increase, fiber optics technology offers the promise of a flexible and scalable full-service network platform with potentially unlimited capacity. Although telecommunication companies have invested significantly in fiber optic infrastructure, there has been an increase in the number of network outages caused by frequent failures in fiber optic networks due to cable cuts. The purpose of this research was to identify, examine and contextualize compliance by communication service providers to fiber installation and maintenance standards in Zambia. The key contributor to fiber cuts according to the findings of this study was excavation by road contractors during road construction. Fifty percent (50%) of engineers interviewed were of the view that fiber cable routes are not communicated to road contractors by the local authorities, hence the contractor's inability to determine the presence of fiber cables along the construction route. The lack of procedural guidelines to approve, regulate and monitor the fiber installation and management activities by regulators and local authorities was cited by respondents as one of the factors hindering compliance. In conclusion, the analysis presented in this study revealed that lack of processes and understanding of best practices in deploying fiber cable has led to poor installations and frequent fiber failures. Therefore, this study recommends enforcing the existing policies, promote infrastructure sharing and creating awareness campaigns.

Keywords ZICTA, EIZ, Backhaul, LCC

1. Introduction

Worldwide, a rapid pace of technological innovation characterized the last decades of the twentieth century, accompanied by the equally rapid integration of new technologies into society [1]. On the other hand, Zambia, like other Sub-Saharan African countries, has been integrating ICTs in various sectors of its economy and education [2]. In 2001, Government of the Republic of Zambia (GRZ) with assistance from the Japanese International Cooperation Agency (JICA), embarked on the formulation of a National Information and Communications Technology (ICT) policy. The policy formulation process completed in 2005 and the prolonged process served to raise public awareness of the role of ICTs in fostering socioeconomic development [3].

The telecommunication industry in Zambia has seen positive and significant development following reforms in 1994 which opened the industry to new markets. The

capacity to communicate and access information in Zambia has significantly increased with the provision of internet and mobile networks in the country. Zambia continues to invest in the ICT sector to reap benefits of a digital economy through initiatives such as Smart Zambia. As a signatory to United Nations, universal access to information is key. Government also continues to invest in digital infrastructure with a view to being in tandem with digital technology to serve social, health, and agriculture among the sectors to benefit from the country's digital economy transformation agenda [4].

In 2018, Zamtel, a wholly government owned telecommunication company embarked on network modernization and deployment of additional cell towers countrywide. Private operators followed suit in modernizing their networks. MTN Zambia invested K180 million to upgrade its network in the year 2020. The backhauling of both data and voices services for all major communication service providers in Zambia is largely fiber based, particularly in Lusaka. A properly installed and resilient fiber network in Lusaka ensures high availability and reliability of connections and access to critical private and public services hosted in the capital city. Fiber cuts present negative effects on delivery of quality services and revenue

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generated by service providers hence the need comply to installation standards and best practices during fiber deployment.

Under Regulation 17 of the ICT (Type Approval) Regulations, S.I No. 6 of 2011, (the “Type Approval Regulations”) ZICTA is mandated to issue facility installation clearance that conforms to set national standards. Section 7 of the ICT Act further empowers the Authority to issue guidelines for the better carrying out of its mandate. ZICTA has since released guidelines to guide the deployment of fiber networks in Zambia. This study aims to evaluate factors that impede communication service providers from complying with the requirements. The level of compliance to these guidelines continues to be low resulting in an increase in fiber cuts and outages affecting quality of services offered to the public.

Lusaka city continues to experience persistent fiber cuts due to road construction works, poles hit by vehicles, farming activities or damage by third parties making it particularly difficult for service providers to meet key quality performance indicators [5]. Studies have attributed the high number of Fiber cuts to Fiber owners not complying to industry best practices when installing the Fiber or during excavation [6]. The findings of this study are expected to inform the regulators and key stakeholders in developing country specific guidelines and policies to maximize the benefits of investing in ICTs.

2. Policy Reforms on Fiber Communication

In view of developments in the industrialized countries, Zambia embarked on telecommunications and fiber connection reforms to increase investments and efficiency in the ICT sector. Investment and efficiency became the cornerstone of the reform process. The direction of policy reforms in Zambia was similar in principle to those outlined the USA Telecommunications Act of 1996, which endorsed long-term development trends toward a competitive marketplace, vertically integrated corporations, and a minimalist regulatory stance [7]. Under the Zambian Telecommunications Act of 1994, two major accomplishments were realized. First, the functions of the Posts and Telecommunications Corporation (PTC) were separated into the Postal Services Corporation (PSC) and the Zambia Telecommunications Company (ZAMTEL). Both are still owned and operated by the government. The two companies were corporatized, separated and distinct management teams were created which led to improved resource allocation and efficiency [8].

Secondly, the creation of the Communications Authority of Zambia (CAZ) promoted competition, facilitated investments by licensing businesses and protected consumers (Telecommunications Act of 1994). The unfortunate part about the procedural and structural

safeguards of the Telecommunications Act of 1994 and the breakup of PTC, was that they were costly for Zambia to implement and assumed the presence of a highly developed legal system that was not yet present (*ibid*).

Whereas it was not difficult to create the broad reaching Telecommunications Act of 1994, the Zambian government faced greater challenges in articulating and employing constituent parts of ICTs for development. For example, the government lacked the political will to privatize ZAMTEL, which is still monolithic. The failure to privatize ZAMTEL slowed down the emergence of marketplace competition envisaged in the Telecommunication Act of 1994. The government cited national and public interest as factors for delaying the privatization of ZAMTEL, and for blocking other operators from competing in the international gateway according to Habeenzu (2003). In the meantime, new technological innovations such as Voice over Internet Protocol (VoIP) continued to blur distinctions between new and old communication technologies. Napoli (2001) observed that the convergence of old and new technologies would only further complicate the formulation of ICT policies on fiber connection and communication.

The public interest, as used in the case of ZAMTEL, was context bound. For example, sterling (1999) observed that, for policy-making purposes and with the rise of deregulation, the public and a vigorous marketplace were basically the same. This was an economic argument based on the premise that if the telecommunications sector was vigorous and growing, widely offering more jobs and a greater selection of products and choices, public interest was achieved. According to sterling, the “public” are often uninformed and apathetic about the details of policy. This characteristic led the Zambian government to decide that it should act on the public’s behalf for their “protection” from the many perceived imbalances that would be created within the sector.

2.1. Multilateral Organizations and Domestic Policy

In the 1990s, the emerging literature on political and economic reform was arguing that it was not feasible to understand the process of reform in Africa without considering the powerful role played by the international donor community (Brautigam 2000; Milner 1997; van de Walle, 2001). The literature review indicates that much of the impetus for the telecommunications restructuring that took place in Zambia and other developing nations in the 1990s had its origins in activities occurring in developed nations. A major factor was the example set by the USA and Britain to deregulate their telecommunications sectors. Busakorn (2002) argued that, in addition to the attraction of following the deregulation moves of the western powers, specific pressures from the World Bank, International Monetary Fund and World Trade Organization had significant impact on the way telecommunications industries in many developing countries were being transformed. These pressures, that Busakorn observed, are linked to an eclectic

theory proposed by Dunning (1981) and to the Berg report (1981).

The eclectic theory advises that developing nations create effective regulatory institutions; legal institutions that can handle large and complicated cases; and establish a competitive environment that will force incumbents to admit newcomers. Achieving these milestones according to Dunning will ensure that businesses have specific advantages. For example, firms are guaranteed safety and are allowed to keep their profits. Also guaranteed are certain location specific advantages such as assuring that the country is stable and free from political and social upheavals [9]. The “Berg report” named after its main author Elliot Berg, a development economist employed by the World Bank, was perceived to be applicable to occurrences in developing nations. The report drew insights from rational choice theory to evaluate developmental records of governments in sub-Saharan Africa. Its recommendations centered on the need for a greatly reduced role for the state in managing the economy and much greater reliance on the market as a means of accelerating economic activity, particularly the agriculture sector [10]. The World Bank and other bilateral lenders implemented aspects of the report as part of the SAPs.

2.2. ICTs and Social Context

According to Green (2001), all changes in communication and fiber connection patterns have complex social and cultural ramifications and eventuate from complex social and technological forces. The complexity of technology in the era of ICT and fiber convergence is particularly problematic for policymakers in developing countries such as Zambia, as they appear to be a step behind the trends of ICT and fiber diffusion. The cornucopia of ICTs and fiber connection is scary to some policymakers and exciting to others. Green (2001) further opines that the role of policy and regulation is to attempt to minimize the undesired changes, such as increasing digital divide and knowledge gaps, while getting the most out of the ICTs and fiber connections. Other theories are relevant in the debate about effects of the ICTs and fiber communications. For example, communication scholars Tichenor, Donohue and Olien (1970) were able to show through the Knowledge Gap Theory that educated people were likely to gain more information and apply it than less educated people. They also posit that the assimilation of information will keep increasing in educated people and minimally increase in the uneducated. According to Green (2001), the conclusions from that study by Tichenor et al. in the 1970s are still applicable today as evidenced in Internet users, where the knowledge gap inevitably creates a class difference dividing people of the world into the information-rich and information-poor.

Green (2001) concludes that access to technology does not necessarily lead to its use, and information does not necessarily fuel self-empowering activity. This finding is significant because it debunks the popularly held views that ICTs and fiber communications are neutral, instantly

beneficial, and subsequently lead to an increase in knowledge.

Despite the easy access to ICT and fiber services in many countries, they may still be unaffordable to ordinary people. The cost of ICT and fiber services is a challenge in developing countries, as people tend to have little disposable income. Green further observes that citizens of developing countries whose current poverty has its genesis in the exploitation carried out by former colonial powers, resist to adopting ICTs and fiber communication that come from former colonial nations. Therefore, social determinism, which Hamelink (1999) successfully linked to the de-localization influence of Multilateral Organizations, is summarized as follows: Whether the potential to support social development will be realized depends much more on the institutional environment of the technology than on its technical features per se. Therefore, analysis of the relation between ICTs, fiber connection and social development must give ample attention to their policy context, it is increasingly the international policy context that takes precedence over all others, influencing even the effectiveness of action at the local level. If, for example, local communities want to retain an autonomous space for cultural policymaking, their strategies must extend beyond local boundaries, since their chances of success will be affected by such global policies as World Trade Organization’s (WTO) decisions on trade in services or intellectual property rights [11].

The analysis by Green (2000) and Hamelink (1999) creates awareness of the context in which developing nations create ICT and fiber communications policy. The MOs de-localize this context by creating an environment within their structures through which developing nations adopt ICT and fiber communications policy.

2.3. New Technologies for Development

The link between technology and development has been established through showing positive relationships between telecommunications infrastructure growth and socioeconomic growth. Bjorn Wellenius of the World Bank describes how “telecommunications constitute the core and provides the infrastructure for the information economy. Telecommunications facilitates market entry, improves customer service, reduces costs and increases productivity [12].

Information and communication technologies and fiber connection used in development have unique characteristics that, to some, are quite arcane. Moore (1998) describes how fixed line systems, for instance, have distance-sensitive cost structures, but low marginal cost on dense routes; how wireless systems are spectrally efficient and innovative at frequency reuse for local networks but not efficient in distance communication; and how satellites provide high quality service over large geographic areas but are less effective for on demand access.

Jensen (2003) noted that Zambia was the first country outside of South Africa to obtain a full Internet Protocol (IP)

link. This occurred in the mid-1990s. The initiative grew roots at the University of Zambia, which was the pioneering organization. The Internet has now empowered millions of Africans with the ability to share and retrieve knowledge [13].

The literature is awash with differing perspectives on the use of ICTs and fiber connections for improvement of developing societies. The common denominator, however, is the admission by scholars that ICTs and fiber connection have significant effects on all societies. Since the 1980s, when development experts began to place telecommunications at the forefront of development strategies, the prevailing assumption has been that ICTs and fiber connection can accelerate economic growth in developing countries [14]. The term “leapfrogging” was often used to underscore the potential of telecommunications. According to Singh (1999), leapfrogging means telecommunications can “help less developed countries ‘skip’ some stages of development; help them accelerate development; and skip technological barriers or product cycles.” Since the 1980s, ICTs and fiber connection have increased in capacity and interoperability. Therefore, the term ‘skip forward’ epitomizes the desired outcomes envisioned by policymakers in different countries during the 1990s when they embarked on telecommunications policy reforms.

2.4. Technology Determinism

Many of the studies of information and communication technology and fiber communications all over the world have been marked by a structural approach that tends to place telecommunications in an independent role as an unequivocal driver of positive change (Wilson, 1998; Wolcott, Press, McHenry, Goodman, & Foster, 2001; Gebreab 2002; Jensen, 2002). These studies are sometimes done at the expense of full appreciation for the role of society or social forces in determining the social construction of ICTs and fiber connection. Such approaches tend to concentrate on the macro-economic causes of ICT diffusion, such as GDP per capita and presuppose a straightforward, incremental roll-out of ICT applications and fiber services (Ayogu and Hodge, 2002; Beebe, Kouakou, Oyeyinka, & Rao, 2003; Cogburn and Adeya, 2001; Cohen, 2003; Janisch and Kotlowitz 1998; Lewis, 2005). Technology determinism is firmly anchored in the perception that ICTs and fiber connections open new opportunities for poor countries to advance rapidly to modernization at the levels of developed industrial societies.

Those who subscribe to this mainstream perception tend to look at ICTs and fiber communication as ends in themselves for bridging the information and development gap between developed and developing countries. Not surprisingly, such studies put emphasis on the need to build basic infrastructure in the form of reliable telephone systems, satellite and microwave communications, and Fiber optic lines. Additionally, the introduction of software and hardware is seen to address the development blockages and reverse the

trend of marginalization (Kenney, 1995; Moyo, 1996).

The emphasis on infrastructure development is easy to support with evidence since the exponential increases in mobile telephone subscribers in Zambia and other developing countries can be measured. To maintain a sustained increase in subscribers, mobile telephone companies have expanded their networks' coverage across the country, and continually introduce further value-added services aimed at satisfying subscribers. It is safe to say that the mobile telephony technology has attained maturity in Zambia. The technology determinism perspective measures maturity by the ever-increasing number of subscribers and by the levels of service and capital input by service providers. However, Mansell and Silverstone (1996) cautioned that technology itself is imbued with social processes that determine whether diffusion occurs or not.

According to Green (2001), social determinism, as opposed to technology determinism, accounts for ICT and fiber connection diffusion. The technology determinism perspective holds that the features of a particular technology determine its use, and the role of a progressive society is to adapt to, and subsequently benefit from the implementation of technology. Social determinism, advanced by Green, is premised on society's responsibility for the development and deployment of particular technologies. In terms of political economy, technological determinism is aligned with the modernization paradigm, while social determinism is linked to the dependency paradigm because of the focus is on roll out and quantities in case of modernization, and the awareness of power relations in the case of the dependency paradigm.

Mackenzie and Wajcman's (1985, 1999) research was perhaps the most instructive to underscore the dichotomy between technology, fiber connection and social determinism. Their collection of case studies of different technologies supported their argument that social circumstance was the vital ingredient in determining which technologies were adopted, and which were not. Their definition of social circumstance included economics, politics, and the existing infrastructure. Mackenzie and Wajcman pointed out that it was wrong to see any given technology as something as inevitable as the law of gravity. For example, the duo claimed that there is no necessity that required computers to exist or that once they existed – that they must be connected to the Wide World Web (WWW). Mackenzie and Wajcman concluded that the reasons things developed as they did were not technological reasons but social reasons.

Kopytoff (2001) utilized a similar “biographical” approach to consider why a personal computer was bought, for whom and with what ends in mind. This trajectory of intended use may well be at odds with the pattern of use that developed, or that failed to develop. Such discussion about the social and technological determinism was instructive to the policy process in Zambia because as much as policymakers desired rapid diffusion of ICTs and fiber connection as a means to participate in the global economy,

measurement of both diffusion and participation may be affected by determinants outside the scope of the current ICT and fiber network policy in Zambia.

3. Fiber-Optic Transmission

According to Flournoy (2004), fiber optics is the transmitting of information as light (photonics) along flexible glass fibers. A single fiber glass strand has the potential to transmit several gigabits per second of information between head ends and designated points within the service area without frequent repeaters. This capacity allows for a 10-strand Fiber cable to simultaneously deliver nearly 500 high-definition television programs.

Ajoy, Ghatak and Thyagarajan (1998) advanced that optical fibers are less expensive in the long run because they have higher carried capacity, they experience less signal degradation and, unlike electrical signals in copper wires, light signals from one fiber do not interfere with those of other fibers in the same cable. This means that Fiber enables clearer phone conversations and television reception.

A further advantage of Fiber optics and fiber connection over copper is that signals in optical fibers degrade less, therefore, lower-power transmitters are required instead of the high-voltage electrical transmitters needed for copper wires. This, coupled with the fact that these flexible glass cables are virtually useless to copper wire vandals, will save the operators and consumers money.

3.1. Network Availability

Fixed networks are enabling infrastructure driving economic growth. It is clear, to grow fiber networks is the answer as consumers and businesses desire speed, resilience, and reliable services. Optic network technology (OTN) is the most preferred mode of transmission in networks as it provides large bandwidth for customers without interference [15]. Regardless of these gains, Fiber networks are characterized by cuts caused by road constructions, or third parties damaging the installation leading to low service availability, quality of services and loss of revenue for service providers (*ibid*). Adherence to standards during deployment of fiber networks and fiber connection is key for efficient, environmentally friendly, and sustainable networks.

3.2. Fiber Installation Standards

Two methods are commonly used to deploy fiber connection networks namely underground and aerial. In underground deployment, the fiber is buried in the ground, it is expected the fiber is buried at a minimum recommended depth. For aerial, the fiber is suspended and anchored on wooden or concrete poles of recommended height and thickness to meet strength requirements. The choice of the deployment model depends on the cost, design, existing structures on the route or soil type. In all cases, the design is to ensure reliability of the network.

Mubiana, (2019) argues that lack of standards and legislations specific to fiber installations and connection is a cause of increased fiber cuts in Lusaka. Service availability is affected due to poor fiber installation largely due to noncompliance to existing ZICTA installation guidelines.

Compliance to standards during fiber deployment and connection ensures reliable services. Noncompliance on a large scale undermines the acceptance of regulations or even provokes their complete failure [16].

4. Methodology

In this research, a mixed method approach was used. Both qualitative and quantitative methods were used to establish and evaluate factors impeding communication service providers from complying with fiber installation standards in Lusaka district. The qualitative approach was mainly used to describe subjective assessments, analyses and interpretation of attitudes and opinions of the respondents as expressed verbatim from interviews [17]. The quantitative methods helped in generating numerical data, which is statistically manipulated to meet required objectives through descriptive statistics and inferential statistics using binary models. This is because there is need to outlay some information statistically to bring out the statistical aspects of the study clearly. Using a combination of qualitative and quantitative data allowed triangulation by ensuring that the limitations of one type of data are balanced by the strengths of another.

Quantitative data was collected using questionnaires and qualitative data was obtained from open-ended questions as indicated in the structured questionnaire. A total of 252 questionnaires were administered using drop and pick method. Only 95% (240) of the participants responded. This response rate is considered reliable enough to allow for generalization of findings from the target population. In addition to arriving at the conclusions of the study, as according to Saldivar (2012), a response return rate of more than 75% for paper-based surveys is enough for the study to continue.

According to Durrheim (2004), a group of individuals with common attributes in a field under inquiry form a population. The population for this study consisted of Engineers registered with the Engineering Institution of Zambia (EIZ) and working in the telecommunication industry in Lusaka District of Lusaka Province in Zambia. The target population was expected to provide sufficient information to draw meaningful conclusion on the topic. The study area was purposefully selected as major communication service providers in Zambia have their headquarters based in Lusaka and having extensive metro fiber networks deployed within Lusaka. The area is also within reach to suit the researcher's budget and time resources. Respondents were purposively sampled based on relevance to the study, knowledge, diverse perspectives and expertise in fiber deployment and maintenance. This sampling technique aimed to glean knowledge from fiber

experts in Zambia's telecommunication industry. The study sampled a total of 252 engineers from networks departments of CSPs working under network planning, field maintenance, network optimization, network deployment, network quality and performance, supervisors, managers, and senior managers.

In this study, confidentiality was paramount considering topic bordering on compliance; with noncompliance leading to potential penalties. The questionnaire used did not ask the participant for their name or the company for which they work for. Further, the research was conducted through EIZ allowing participants to objectively express themselves without the fear of exposing their employers.

Microsoft excel was used to enter quantitative data while coding, cleaning and analysis was done in Stata 13. The type of analysis involved univariate and bivariate analysis. Univariate analysis was used to describe the characteristics of the study participants and variable outputs. Bivariate analysis was used to test for association between the independent and dependent variables. Univariate analysis is the simplest form of data analysis where the data being analysed contains only one variable. Since it's a single variable it doesn't deal with causes or relationships. The main purpose of univariate analysis is to describe the data

and find patterns that exist within it.

5. Findings

5.1. Presentation and Findings

A total of 252 questionnaires were administered. Only 95% (240) of the sample was achieved. This response rate is considered reliable enough to allow for generalization of findings from the target population. In addition to arriving at the conclusions of the study, as according to Saldivar (2012), a response return rate of more than 75% for paper-based surveys is enough for the study to continue. Simple Random Sampling was employed in the selection of respondents.

Figure 1 below shows findings from an assessment of fiber installations in Lusaka city. The findings were cross-referenced with ZICTA fiber installation guidelines. Several installations were not compliant to the guidelines.

Figure 2 below shows the distribution of respondents by level of seniority. Most respondents were technicians 49%. Field engineers, senior engineers and managers contributed 26%, 15% and 7% respectively to the overall sample. Largely, field engineers and technicians are directly involved in hands-on fiber installation activities in the field.

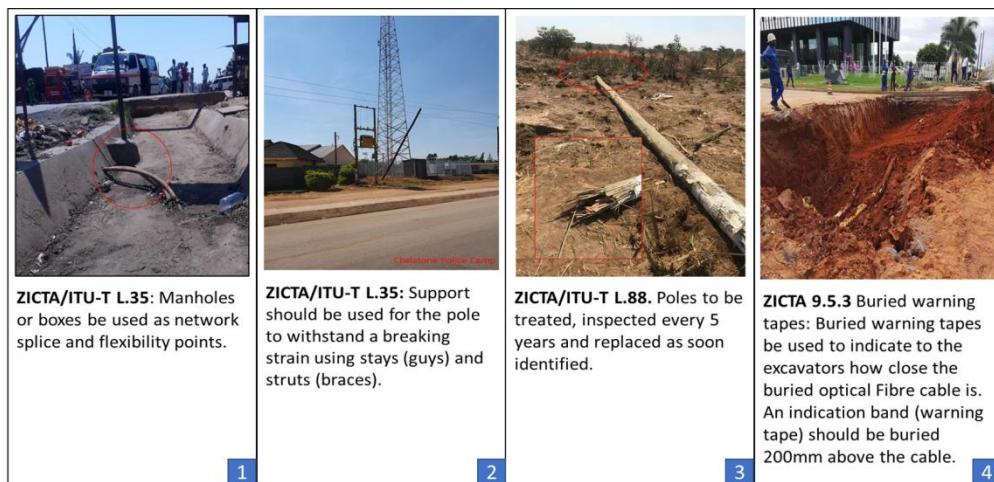


Figure 1. Field compliance assessment

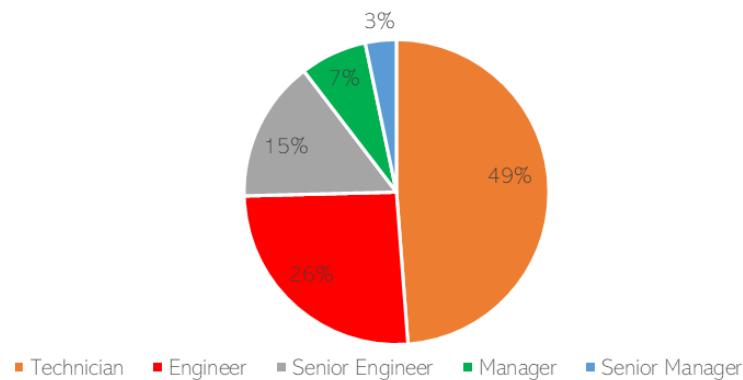


Figure 2. Level of seniority

Figure 3 below shows that ninety two percent (92%) of the respondents were Male while 8% were Female. A clear indication that the field of engineering is male dominated. Some studies have suggested the low participation of females in engineering courses in part reflects gender gaps in understanding interest in the profession as well as perceptions of identity and self-efficacy. Among the young people included in Engineering Brand Monitor survey, they indicated that perceptions of and aspirations to the engineering profession were significantly lower among females than men. The notable low number of female engineers can be attributed to two factors namely, the enormous decline in switchboard operators over the years and the second is the rise of predominantly men positions e.g., installation and repair of wired connections such as fiber.

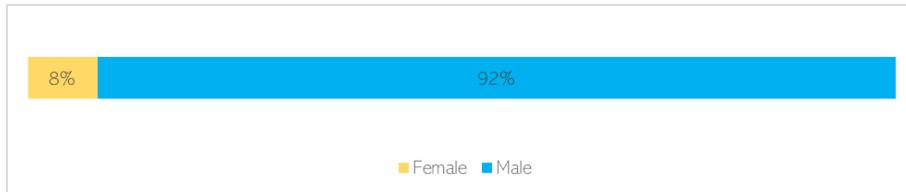


Figure 3. Distribution of Respondents by Sex

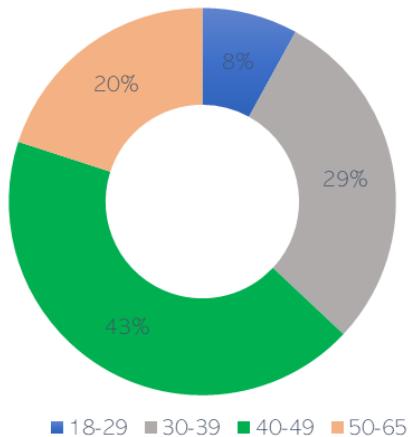


Figure 4. Distribution of Respondents by Age

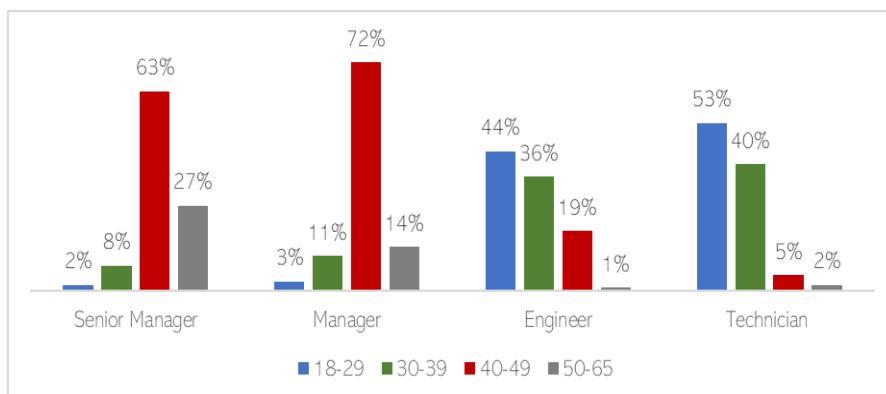


Figure 5. Age category by level of seniority

Figure 4 below shows the distribution of the respondents by their age 43% of the surveyed respondents were aged between 40 and 49 years. The average age was 38 years, with the minimum being 24 years while the maximum was 62 years. The telecommunication sector has become substantially more skilled. With average age of 38 years, most workers are much older and generally have more work experience.

Figure 5 below shows an analysis with regards to age categorized by level of seniority. Findings are summarized in Figure 5. Most technicians and engineers are aged between 18 and 29 years. While the most of senior managers and managers are aged between 40 and 49 years. This is a clear indication that age is an evaluating factor for higher work positions in the communication industry.

Figure 6 below shows share of respondents by years of employment. The highest proportion of respondents had worked between 3 to 4 years. This shows that despite the telecommunication sector having a high labour turn over when employees become mature to handle work on their own, the industry has managed to return employees at this level.

Figure 7 below shows the main area of work for the majority (36.7%) of the respondents was field level maintenance. This can be attributed to communication service providers adopting lean organization structures and adopting outsourcing model for functions such as fiber

installation and maintenance and power functions. Technical departments of CSPs largely concentrate their efforts in functions such as network planning, design, and quality.

Figure 8 below shows level of knowledge on fiber installation and management among respondents. 40% of the respondents had good knowledge of the overhead fiber deployment. In relation to underground fiber deployment, 40% of the interviewees revealed average knowledge of underground fiber deployment. On fiber management, the majority (56%) of the interviewees reported that they had average knowledge of the tools and documentation to manage fiber network.

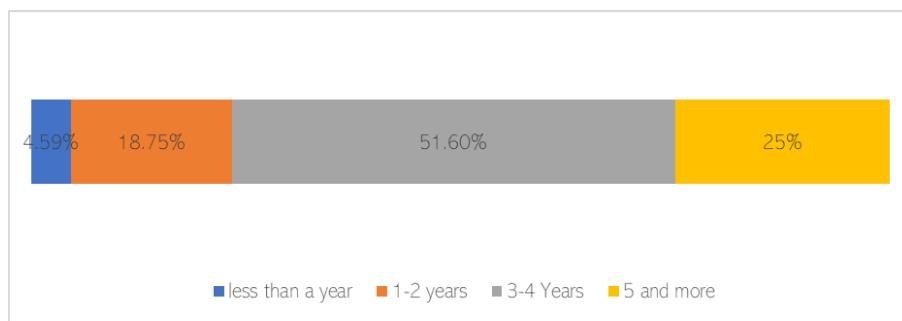


Figure 6. Years of employment

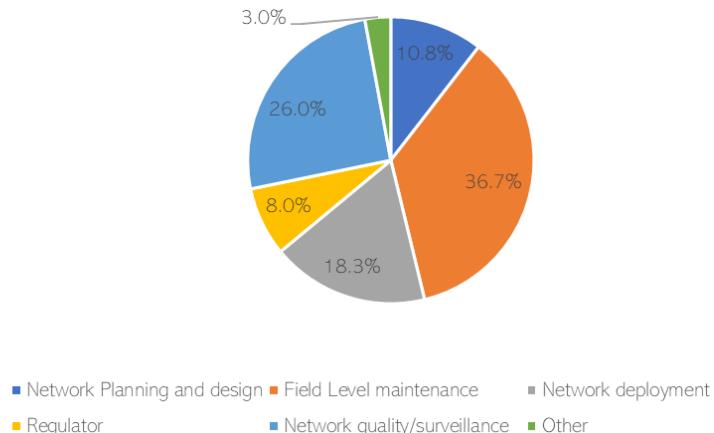


Figure 7. Main area of work

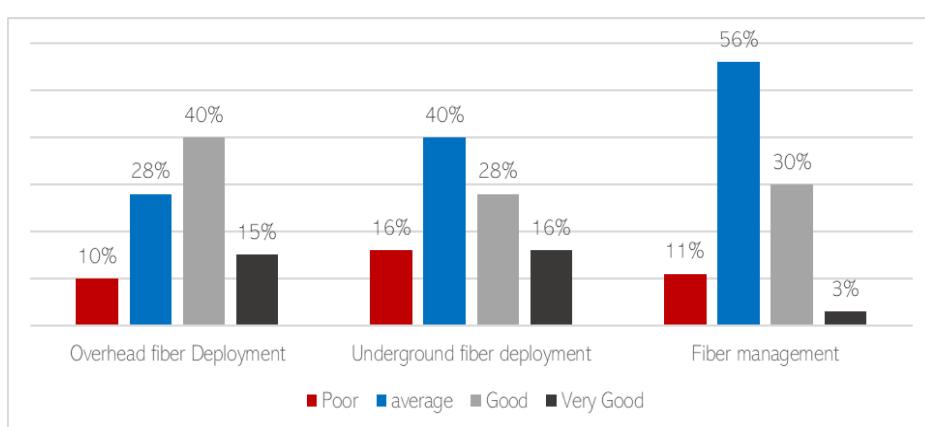


Figure 8. Knowledge about fiber installation and management

Table 1 below shows results from the chi-square analysis. It showed a statistically significant association between years of work and level of knowledge on fiber installation and management ($P=0.03$). The results from the study pointed out that those respondents who had more than five years of work experience were more likely to have very good knowledge of fiber installation and management as compared to those who had less than three years of working experience.

Table 2 shows a response to the question, “does fiber deployment pose a risk to the public?” The highest proportion (50%) of respondents indicated that fiber

deployment does not pose a risk to the public.

Most respondents across all positions (senior manager to technician) strongly agreed to the fact that fiber deployment does not pose a risk a to the public as shown in **figure 9**.

Figure 10 below shows the level of collaboration between telecommunication service providers and other key stakeholders such as RDA, city council etc. The highest proportion (60%) revealed that the level of collaboration is poor. The interviewees reported that the key stakeholders such as ZICTA and City council are uncoordinated and have not been enforcing the industry standards that define best practises in fiber optic installations and maintenance.

Table 1. Relationship years of work and level of knowledge on optic fiber installation

Variables	Hypothesis	Decision rule	P- value	Conclusion
Years of employment and level of knowledge on fiber installation and management	The two variables are associated	Accept hypothesis if p-value less than 0.05	0.03	There is an association

Table 2. Does fiber deployment pose a risk to the public

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Fiber deployment causes a risk to the public	-	80%	8%	8%	4%

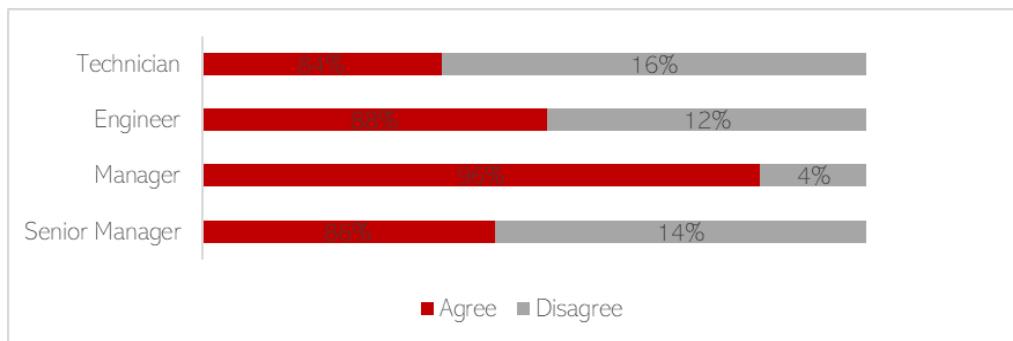


Figure 9. Fiber deployment does not pose a risk to the public - response by level of seniority

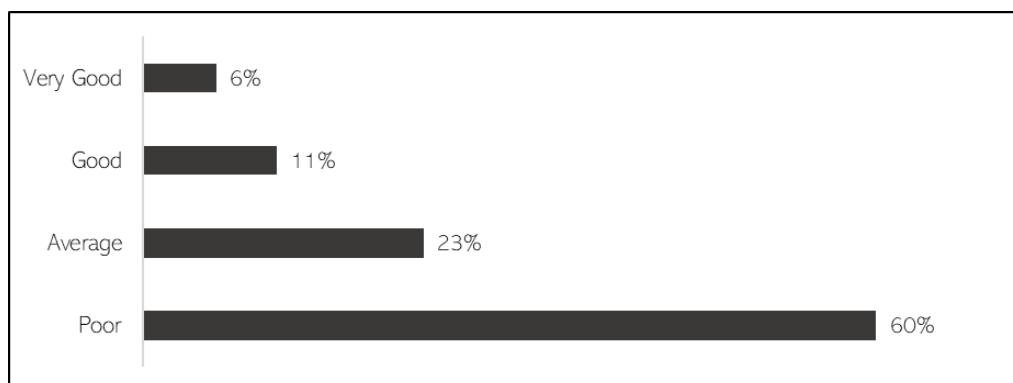


Figure 10. Level of collaboration between mobile providers and key stakeholders

Figure 11 presents an analysis of the level of collaboration across work positions. Results shows that majority of respondents across all the positions indicated that the level of collaboration between communication providers and key stakeholders was poor. Qualitative analysis showed that collaboration between stakeholders, communication providers, local government, ZICTA and experts, can significantly contribute to pushing for the optimal outcome of communication industry. However, all stakeholders should adhere to the industry rules and regulation. It is important for all stakeholders to understand the type of relationships that should be forged to promote sustainable development.

Figure 12 shows respondent's views with regards to the

best practises in fiber installation and management, most of the respondent (52%) indicated that a significant number of fiber optics cable projects have been deployed without the best industrial practices.

Results in **figure 12** shows that majority of respondents who indicated that communication service providers do not comply to industry best practises on fiber deployments were technicians (88%) and field engineers (79%) as shown in **figure 13**. The field engineers and technicians are involved in deployment and maintenance of the fiber plants. For most communication providers, engineers and technician are responsible for installation and managing fiber optic, thus, they have hands-on information on the industry's level of adherence on fiber deployment.

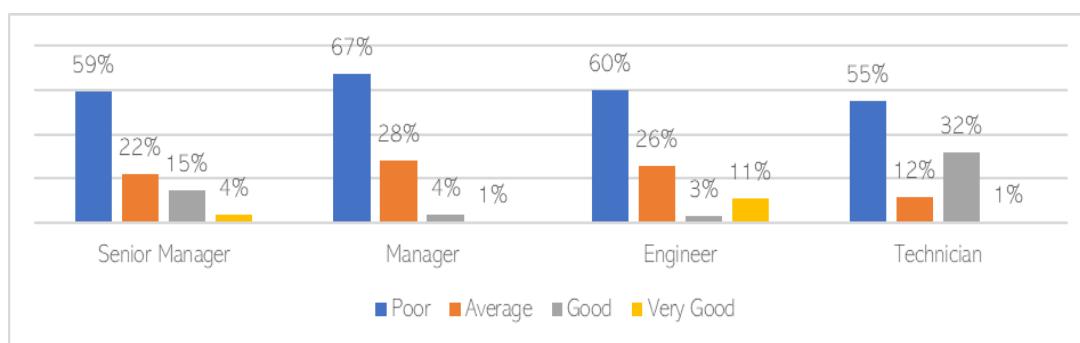


Figure 11. Level of collaboration between mobile providers and key stakeholders

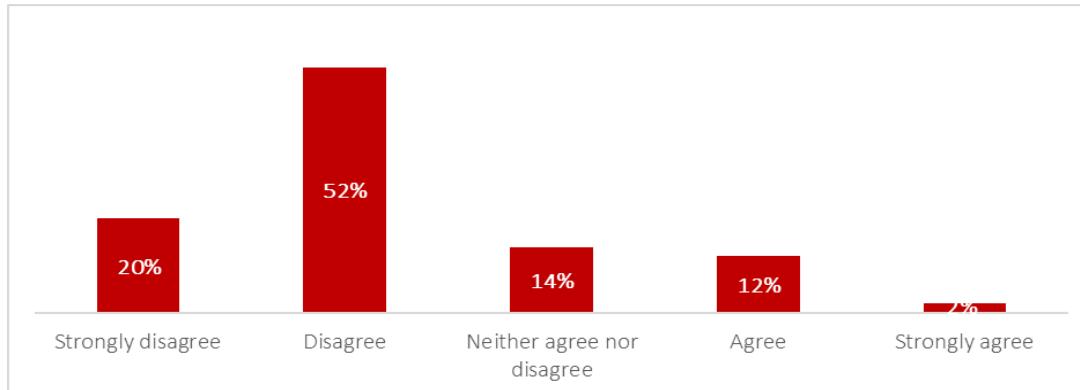


Figure 12. Respondents view of best practices in fiber deployment

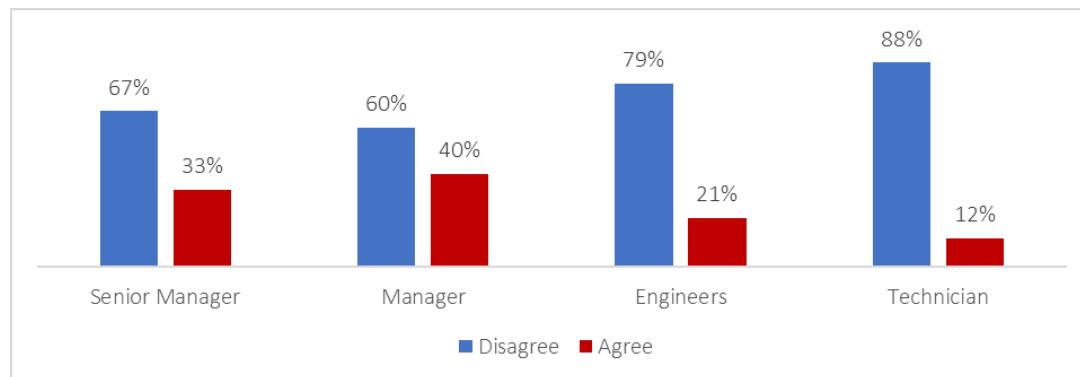


Figure 13. View of best practices in fiber deployment by level of seniority

Figure 14 shows that the key contributor to fiber cuts is excavation by road contractors during road construction has significantly caused fiber optics cable cuts. An attempt was made at analyzing the reasons behind the high rates of cuts by contractors, as indicated in figure 14, engineers were of the view that fiber optics cable routes are not communicated to road contractors by the local authorities, hence their inability to determine the presence of fiber optics cable along the construction route.

Figure 15 below shows rating of the impact of fiber cuts on network availability by respondents. The highest proportion of respondents representing 42% said the impact is very high. Collectively, the responses show a high level of

negative impact when there is an outage in the optical network infrastructure. With bundling of services onto fiber links, a fiber cut has huge economical impact both to the service providers and customers.

Figure 16 shows how the respondents rated the level of understanding of the rules and regulations governing fiber installation and management by CSPs. The highest proportion (45%) of respondents revealed that mobile network providers had moderate knowledge of the rules and regulations on fiber installation and management. It was reported that in terms of the regulatory framework of fiber cable deployment, the MNOs have lapses in managing fiber optic infrastructure in Zambia.

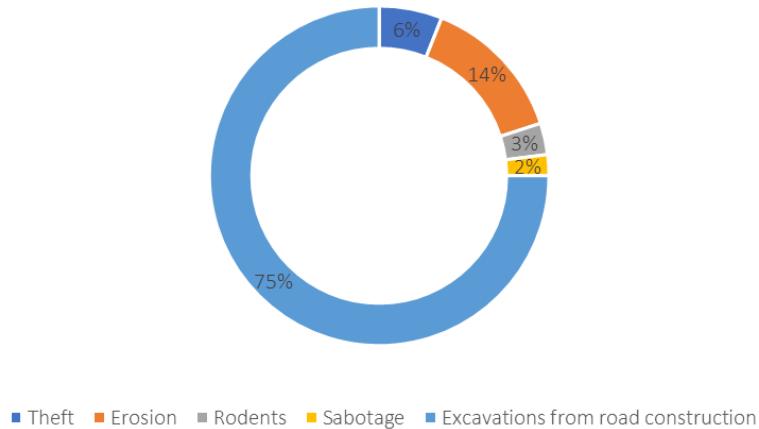


Figure 14. Causes of frequent fiber cuts

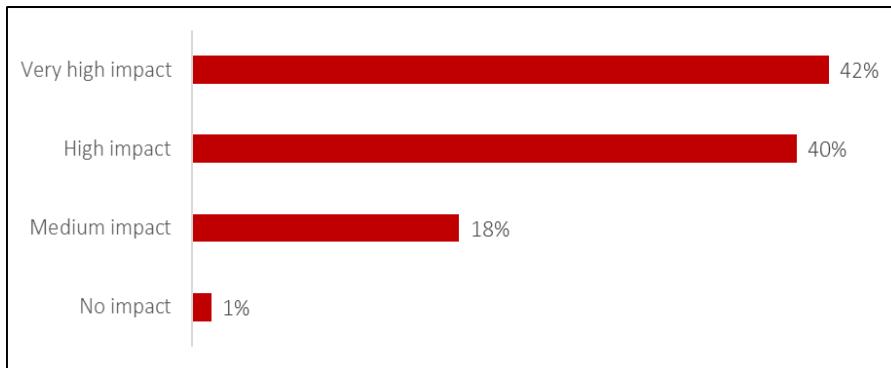


Figure 15. Rating the impact of fiber cuts on network availability

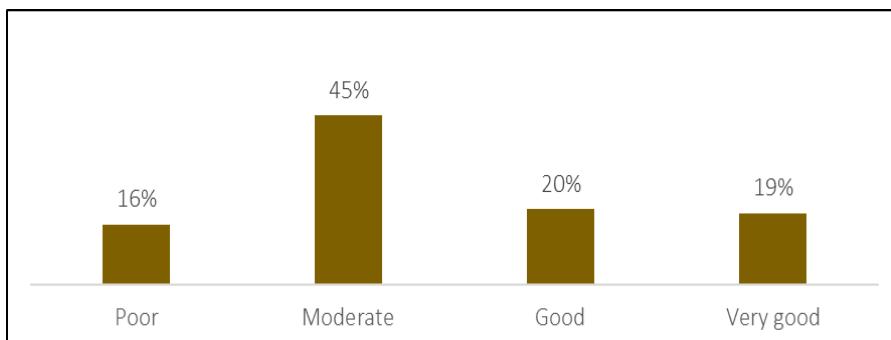
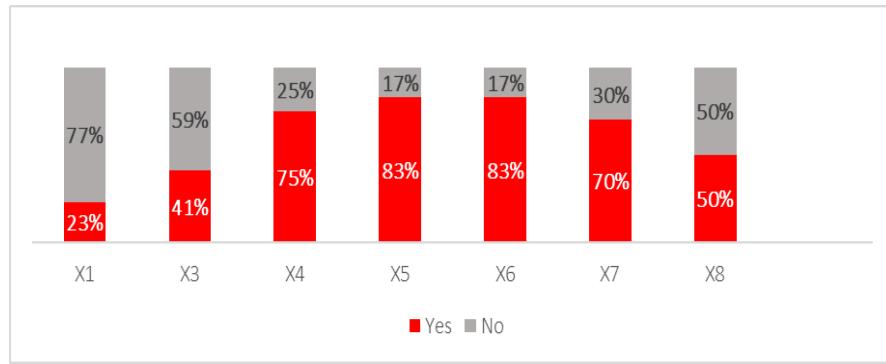


Figure 16. Rating the level of understanding of the rules and regulation

**Where:**

X_1 = Companies do not comply to fiber installation and management standards because of high costs associated with the process

X_2 = Misinformation and misunderstanding of installation guidelines are among the leading causes of noncompliance to fiber optic installation standards

X_3 = Lack of procedural guidelines to approve, regulate and monitor the fiber installation and management activities by the local authorities.

X_4 = High fees charged for processing permits and the undue delays associated with the handling of the approvals are also leading to noncompliance

X_5 = Telecommunication providers have been facing challenges with planning fiber route and adhering to the planned routes due to inaccurate location information of underground city installations such as water, sewer and fiber cables.

X_6 = Some telecommunication providers do not have sufficient financial and human resources, thus, unable to adhere to industry's standards and best practices

X_7 = Acquisition to lay optical cables along the highway is extremely exorbitant and time-consuming.

X_8 = Failure by regulatory bodies to prosecute companies not following the set standards has contributed to noncompliance.

Figure 17. Factors influencing noncompliance of fiber installation and management

Based on the findings it is clear that the main factor prohibiting communication service providers to comply with rules and regulations governing fiber installation and management are: Telecommunication service providers have been facing challenges with planning fiber routes and adhering to the planned routes due to inaccurate location information of underground city installations such as water, sewer and fiber cables; high fees charged for processing permits and the undue delays associated with the handling of the approvals are also leading to noncompliance; Lack of procedural guidelines to approve, regulate and monitor the fiber installation and management activities by the regulators and local authorities, and acquisition to lay optical cables along the highway is extremely exorbitant and time-consuming.

6. Conclusions

Key findings from this study point to the fact that most communication service providers failure to comply with rules and regulations that govern fiber installation are due to external factors such as, activities of excavation, dig-ups and road construction. The analysis presented in this study revealed that a lack of processes and understanding of best practices in deploying fiber cable is a major root cause of frequent fiber failures. Furthermore, the lack of regulatory guidelines and policies on fiber deployment and management pose a major threat to fiber optics management

in Zambia. Finally, the lack of engineers with the requisite technical expertise in fiber installation and management contributes to noncompliance. This affects the quality of work done, thereby exposing optical fiber cables to the risk of attack and damage. The regulator (ZICTA) should encourage infrastructure sharing for economical fiber deployment and easier management.

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Disclosure

This section is ONLY for those who requested disclosure. The name of the experts that reviewed your paper, in case they accepted selling disclosure to you, will appear here. Each reviewer is allowed to make their own price for that, since that is a public endorsement of your findings and may be used for varied purposes.

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