Int Journal of Social Sciences Management and Entrepreneurship 9(3): 82-95 2025

ISSN 2411-7323

www.sagepublishers.com

INTERNET OF THINGS APPLICATION AND SECTORAL RESPONSE PERFOMANCE IN TELECOMMUNICATION

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ABSTRACT

The general objective of this research was to determine the readiness of Kenya ICT sector to leverage Internet of Things for socio economic development. Therefore, the research looked at Internet of Things application and sectoral response performance in telecommunication. The study specifically aimed to; assess the response of the ICT sector in regard to IoT technology; determine the status of policy makers in response to the IoT technologies; establish the state of IoT roll out regarding the IoT coverage and to determine how adequate the human capacity to deploy the IoT is. The literature review demonstrated that a number of studies have been carried out on internet of things application and sectoral response performance in telecommunication spectrum. Hence, it's evident that a gap in literature exists on IoT application and sectoral response performance in telecommunication in Kenya. The study adopted descriptive research design and the study population was 25 key informants from different ICT sector member organization, who were purposefully selected. The data collection instruments were an interview guide containing open ended questions. A pilot study was carried out to test the validity of the instrument. Content analysis method was used to analyze data aided by content analysis software (NVivo) to summarize the responses into themes. Due to the numerous information gathered during the interviews, it has been proved that IoT application and sectoral response performance in telecommunication receive a great support by the implementation of IoT technology in Telecommunication spectrum. In particular, as stated by all the respondents, the benefits are numerous in multiple fields and moreover IoT will impact ICT sectoral response performance in telecommunication deliverables and team working. In a daily use, the new technology will increase the productivity and the efficiency of the processes, reducing the waste of resources, both in term of time and money. The study found out that impact on IoT application and sectoral response performance in telecommunication is enormous; in fact all the phases are impacted by the technology. The main driver of the impact is surely the data gathered from smart objects always reliable due to storage approaches such as cloud or server.

Keywords: Internet of Things (IoT), Sectoral Response, ICT Policy Response, Regulatory Response, IoT Roll Out, Human Capacity.

Background of the Study

Kenya envisions transitioning into a globally competitive, knowledge-based economy by the year 2030. Central to this transformation is the role of Information and Communication Technologies (ICTs), which are recognized as vital enablers of a knowledge society. ICTs promise to enhance efficiency across sectors such as education, healthcare, agriculture, and manufacturing. Among the most dynamic ICT developments are those based on mobile communications, particularly the Internet of Things (IoT). The emergence of IoT has intensified demand for frequency spectrum, pushing both state and private actors to engage actively in its adoption and integration into socio-economic systems. Consequently, the Kenyan government, through the Ministry of ICT, is expected to provide a conducive policy environment to facilitate the uptake and growth of these technologies in various sectors including transport and industry.

The Ministry of ICT is responsible for policy formulation, regulation, rollout of services, and capacity building to equip institutions and individuals with the necessary skills to adopt new technologies. IoT itself encompasses complex technologies such as artificial intelligence, machine learning, and data mining, all of which possess the potential to profoundly influence economic and social development. The government's response involves crafting and revising policy frameworks, establishing legal structures, strengthening institutions, and facilitating technological innovation. This comprehensive sectoral engagement is essential for Kenya's readiness to incorporate and benefit from these evolving technologies.

IoT platforms facilitate deeper automation, intelligent data processing, and integration of digital systems, enhancing both the reach and precision of services. As Carlo and Alexandru (2010) noted, IoT serves as a technological evolution that builds upon and extends current detection, networking, and automation capabilities. These developments leverage advancements in software, reductions in hardware costs, and increasingly technology-positive attitudes among users. According to Rojas (2012), such innovations lead to significant changes in how goods and services are delivered, and they hold considerable socio-economic and political implications. Furthermore, the evolution toward fifth-generation (5G) networks, anticipated to become commercially viable around 2020, is considered foundational for unleashing the full potential of IoT (Sicari et al., 2015).

In the emerging digital economy, businesses that can develop ecosystems around IoT—by refining raw data into actionable insights and collaborating with service partners—are able to create value-driven revenue streams (Serrano, 2015). However, the wireless infrastructure that enables these innovations operates within regulated frequency spectrums, with strict power output limits as detailed by Ovidiu and Peter (2013). Wireless technologies transmit data over electromagnetic waves, including radio, infrared, and satellite signals. The Federal Communications Commission (FCC) in the United States, for instance, governs the allocation of radio frequencies to avoid signal congestion and ensure reliability (Rose & Eldridge, 2015). Kenya follows a similar model where administrative allocation divides the spectrum into frequency bands designated for specific services. These may be assigned as either primary or secondary, with the latter obliged not to cause harmful interference to primary services (Lehr & Crowcroft, 2005).

The increasing complexity and volume of wireless communication necessitate not only legal safeguards but also institutional coordination. The IoT revolution, supported by advancements such as cloud computing and Internet Protocol Version 6 (IPv6), expands the scope and scalability of connected systems (Infocom, 2016). To manage this, regulatory bodies create frameworks to prevent frequency interference and ensure fair spectrum usage. For example, the Industrial, Scientific, and Medical (ISM) frequency bands allow unlicensed use under strict technical guidelines concerning energy output, frequency range, modulation, and protocol adherence (Busan, 2014). These administrative and technical mechanisms maintain order within the digital communications landscape.

In Kenya, the Ministry of Information, Communications, and Technology has the mandate to guide national ICT strategies. Following Executive Order No. 1/2016, the ministry was split into two departments: the State Department of Broadcasting and Telecommunications, and the State Department of ICT and Innovation. Their shared mission is to expand equitable access to ICT infrastructure and services while advancing Kenya's position as a knowledge-driven society. Core responsibilities include drafting policies and standards for the ICT and media sectors, building institutional capacity, and disseminating public information through state media such as the Kenya Broadcasting Corporation. Policy priorities currently pursued by the ministry include the application of a national service charter, upgrading ICT infrastructure, fostering digital safety, and facilitating the development of a knowledge-based society. These objectives are complemented by legal reviews, regional and international cooperation, job creation through ICT outsourcing, and the continual revision of the National ICT Policy to adapt to emerging trends.

The Communications Authority of Kenya (CAK), established under the Kenya Information and Communications Act of 1998, serves as the primary regulatory body for the communications sector. The CAK oversees a wide range of services including broadcasting, telecommunications, multimedia, e-commerce, postal and courier services. Its regulatory role encompasses licensing, spectrum and numbering resource management, approving communications equipment, safeguarding consumer rights, promoting fair competition, and managing universal access funds to ensure nationwide service reach. Additionally, the authority monitors service providers to ensure adherence to licensing conditions and legal standards. The rise of IoT has catalyzed business transformation across multiple sectors in Kenya. Telecommunications companies like Safaricom, Airtel, and Telkom Kenya are pivotal in this process, offering content, applications, and network infrastructure. These firms are evaluated based on their readiness to adapt to and integrate IoT innovations. Their efforts are crucial in enabling digital services across industries such as agriculture, tourism, and education.

Moreover, the role of academic and research institutions in supporting this transformation cannot be overstated. Institutions such as Moi University, Jomo Kenyatta University of Agriculture and Technology (JKUAT), the Kenya Education Network (KENET), and the University of Nairobi contribute to the country's knowledge economy by promoting research, innovation, and the dissemination of information. These universities engage in training future professionals and actively participate in technological development across economic and industrial sectors, aligning with Kenya's strategic objectives for national growth..

Statement of the Problem

The use of IoT places demand on policy makers, regulators, service providers and users of ICT services. The electromagnetic spectrum is the limited resource for innovative Internet access increase, and it kindle the Internet of Things. As previously mentioned, (UN, 2013a) data traffic and demand are growing at an extraordinary rate and Internet usage has become so common that the industry fears a spectrum crisis in the upcoming years. In order to meet the increasing need for network capacity, countries should ensure that electromagnetic spectrum meets the high demand and that it is used in the most efficient way. Because of its importance, effective administration of the gamut is critical to the exertions of government to increase Internet access to its population. The growth of new technologies and the changeover from fourth generation (4G) to fifth generation (5G) platform which affect the spectrum will transform the way sectors will respond in their roles and actions with regards to the new evolving technologies (smart devices) triggered by Internet of things.

Given that, the radio gamut currently available for wireless communication services (unlicensed bands) is getting strained; access points and base stations are becoming overloaded; and prices for consumers are rising. This means that theoretically everybody can be served with the limited spectrum available, but with the current spectrum management policy, some bands are very jam-packed while others such as the licensed bands and amateur radios are idle most of the time, leading to a waste of spectrum resources. The response of the Kenyan ICT sector, policy makers, Regulators, service roll out, and ICT capacity building institutions is of essence because this network will help power a huge rise in IoT technology.

Objectives of the Study

General Objective

The general objective of the study was to determine the internet of things application and sectoral response performance in telecommunication.

Specific Objectives

The study was guided by the following specific objectives;

i. To assess the effect of ICT policy response on IoT applications
ii. To determine the effect of regulatory response on the IoT applications.
iii. To establish the state of IoT roll out of the IoT applications.
iv. To determine how adequate the human capacity to deploy IoT applications.

LITERATURE REVIEW

Theoretical Review

Diffusion of Innovation Theory

This theory examines why and at what rate new ideas and technology spread. Therefore Rogers (2003) argues that diffusion is a gradual process that an innovation is communicated over a period of time among the members of a given social system. For Sila (2015), adoption is a decision of full use of an innovation as the best course of action available and rejection is a decision not to adopt an innovation. Therefore, the recognition and the beginning of acceptance of IoT technologies among participant of the social system proves that there is a process which an IoT technology is being communicated through a channel over a time among the members of a given social system. On the other hand, spectrum management is viewed as the process of frequency allocation, allotment and assignment of frequency bands and there uses are referred to as radio services which include fixed, mobile broadcasting, radio location, amateur, satellite, radio astronomy among others, (Arlen & Garry, 2014).

IoT technologies infers to sectoral responses in this study which include policy, regulators, services, infrastructure capacity building, and spectrum. The basic definition of IoT technology is seen from an argument Kevin Ashton in 1999 where he defined the aspect of IoT as connection of device to device to sense the real world. The emergence of the IoT Technologies has led to allotment, allocation and assignment of the frequency band, this includes smart devices that use internet technologies like WI-FI to communicate with each other, your laptop, and sometimes directly with cloud.

Technology Lifecycle Theory

This adoption theory explains five adopter categories or segments that are involve during the introduction of a new technology that includes service or product to show the degree to which the participant would be able to use and acknowledge the same product or service. According to Guidice (2016), IoT involves people, objects and data as major agents. Hence defined as an interconnection of smart devices and objects that have unique identifier and are able to communicate and transfer data without human or computer interaction but giving the desired goal of their purpose. It is also expected that more than billions of objects was part of the network (Sicari, Rizzardi, Gieco & porisini, 2015). However, with this rapid adoption change in technology, there are key players that must respond to these changes, and they include policy makers, the regulators, the service roll out, and the capacity building institution in response to the IoT spectrum. IoT therefore, embraces a variety of technologies, services and standards (Khan & Qurantulain, 2016).

Technology lifecycle adoption theory, acts as indicator that with the emergence of new technology there are still some key players who fall in different adopter segments hence there is need to study more on their responses because as Stain and Portugal (2004) describe, that the ultimate goal of spectrum management is to prevent users from harmful interference while allowing optimum use of the spectrum since the technologies are changing all the time. According to TDT 2018, Global Data report, the technology built is bound to changes since developers keep on upgrading their system and with the current technological firm output each firm want to have the best product and the best result, and this is all determined with the rate or the degree of their adoption. For instance, a combination of super artificial intelligence, machine language and data mining class would affect the production of a given product or services just like the third, fourth and fifth generation LTE technologies (Tam, Thatcherb & Craige, 2017).

Technology Acceptance Model Theory

Technology acceptance model is a combination of perceived usefulness and perceived ease of use that measures the extent of a new technology on a given participant level of adopting such technology. According to Lai & Zainal, (2015), Technology acceptance model has focused on the degree of the effects of perception of new technology and its usefulness and the convenience of the intentions of its adoption hence, it's advantageous when used to determine the extent of new technology adoption (Lourn & Lin 2008).

Therefore, the emergence of IoT technologies which involves the use of an artificial Intelligence system, machine learning system and data mining system aid in measuring or predicting information technology adoption given this framework and its use by the key players in this sector (Paul, John & Pierre, 2011). Nevertheless, the following sectors must be readily prepared to face the changing and new emergence of technologies since they are the key players in this ecosystem. According to Choi *et al* (2007), the emergence of new technology or new innovation is normally crucial for organizations to compete in a rapid changing market environment within a given global landscape. However, policy makers, service providers, regulators, capacity building institution, infrastructure and spectrum play vital role to an extent of deciding if a given institution has adopted a knowledge base structure of a new IoT technology and is capable to compete with other institution in market globalization, (Choi *et al.*2016).

The adoption of artificial intelligence, machine language and data mining systems, therefore, demonstrate that the link between the user intention and the user's perceived usefulness is bonded strongly, (Rajesh 2014). Hence this model of technology acceptance can only be seen when the key players: -policy makers, regulators, capacity building institution, service providers, spectrum and infrastructure accept and use the emerging technologies, (Vancatesh & Bala 2008) in the adoption of technology ecosystem.

Conceptual Framework

According to Orodho (2009) a conceptual framework describes the relationship between the research variables. However, given that IoT already exists, it elicits sectoral responses and these responses determine the readiness and or the ability of a country to leverage IoT for socio economic development. Thus, IoT infers sectoral response. The purpose of the study was to determine IoT application and sectoral response performance in telecommunication. Independent variable which is IOT adopts the technologies which comprises Artificial Intelligence, Machine Language and Data Mining, while the ''sectoral response'' which are the strategies and actions that occurs while using these applications in view of the emerging IoT is the dependent variable. The aspects of the sectoral response are policy, regulation, services and capacity building institutions

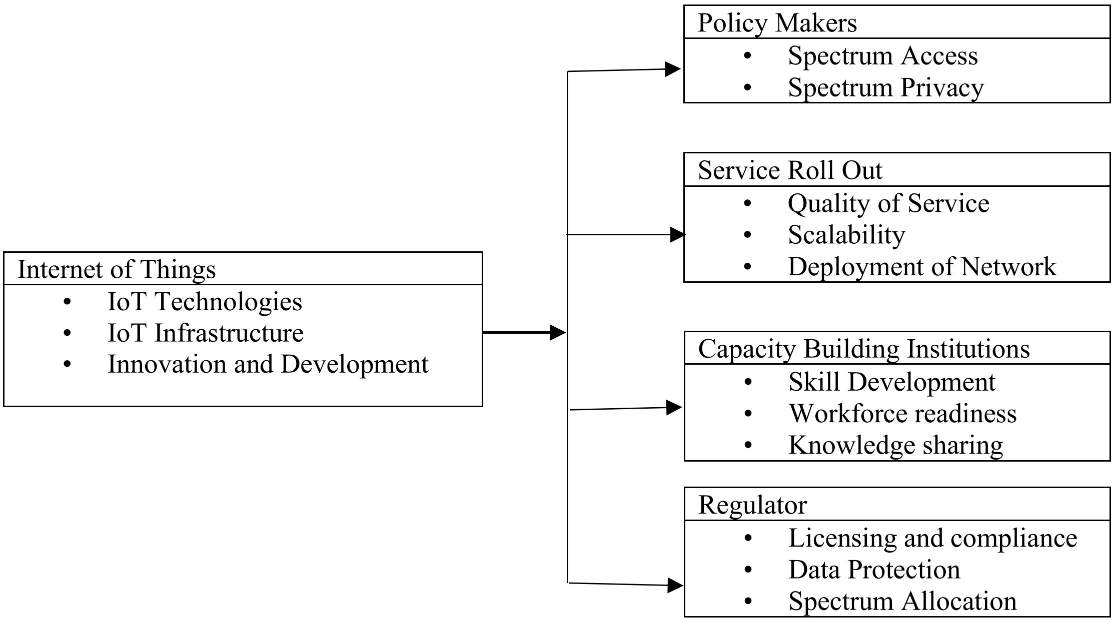

Figure 2. 1 Conceptual Framework

As shown in the conceptual framework the measures of variables are as follows; Internet of things: Adoption of IoT Technologies, Investment In IoT Infrastructure and Innovation and development. Sectoral Response: Policy, Regulation, service roll out and capacity building Institution.

Empirical Review

The empirical review of the Internet of Things (IoT) ecosystem highlights the interplay between policymakers, regulators, service providers, and capacity-building institutions, all of whom contribute significantly to its development and integration. Effective policy frameworks that support internet infrastructure, spectrum allocation, and user autonomy are critical to IoT's success. As IoT evolves, so must privacy and data security policies, which must adapt to new forms of passive data collection through smart devices. This shift requires policymakers to anticipate the socio-economic and regulatory implications of widespread connectivity (Department of Commerce, 2016). Governments globally are acknowledging IoT's transformative economic and social impact and are positioning themselves as leaders in this space (Serrano, 2015). While formal policy development typically remains with governments and intergovernmental organizations, the privatization of telecommunications has given the private sector considerable influence in shaping technological pathways (ITU, 2016). Organizations such as the International Telecommunication Union (ITU) now allow greater private sector participation in global policy dialogue. Similarly, civil society plays a role, especially in areas related to digital rights and empowerment, though with more limited access than corporate actors.

From a regulatory perspective, the fast-evolving nature of IoT suggests that detailed regulation may be premature. Instead, regulators are encouraged to facilitate collaboration with industry experts and stakeholders to develop appropriate standards (Ovidiu & Peter, 2013). National efforts to formalize standards have included the formation of expert committees focusing on various technological domains including identification systems, ultra-low power chipsets, self-organizing networks, and next-generation social software (Infocom, 2016). These committees are tasked with addressing interoperability, energy use, data traceability, privacy, and safety standards. Global engagement with international standardization bodies such as the ITU and IEEE is essential to align national policies with international benchmarks. Governance structures—comprising advisory and oversight committees and a dedicated program management unit—are essential in driving policy implementation, reviewing progress, and adapting strategies in line with technological evolution (ITU, 2016).

The rollout of IoT services has intensified global demand for wireless spectrum. The rise in mobile data consumption—nearly 12 times the volume of the entire internet traffic in 2000—has created urgency around spectrum allocation (Cisco, 2013). IoT's growth is expected to further accelerate broadband adoption, especially in regions where fixed-line infrastructure is limited. Wireless broadband offers a more cost-effective alternative due to lower capital expenditures and greater spectral efficiency, especially in low-frequency bands that support wide coverage with fewer base stations (McDonough, 2012). As such, wireless access has become not only the dominant method for internet connectivity but also a vital development enabler in low-resource environments (Uckelmann, Harrison, & Michahelles, 2011).

Institutional capacity building is central to IoT readiness, especially in countries like Kenya where smart city initiatives are driving digital transformation. The government, in partnership with universities and research institutions, is promoting innovation by funding testbeds and experimental labs to develop IoT technologies (CBS, 2016). These facilities enable experimentation with diverse devices, enhance technical understanding, and support the development of standards and ontologies relevant to IoT domains. Training programs, workshops, and boot camps further support the emergence of a skilled IoT workforce capable of producing real-world solutions. Participants in these programs are mentored through the development of proof-of-concept solutions, thereby fostering both technical and entrepreneurial skills.

Global capacity-building platforms like the ITU's Capacity Building Symposium (CBS) play a critical role in shaping ICT education strategies. The CBS-2016 event held in Nairobi brought together international experts, policymakers, educators, and industry leaders to discuss trends in ICT development and their implications for human capital (CBS, 2016). The Symposium emphasized that in light of rapid digital transformation—including the growth of IoT and big data—societies must equip citizens with new competencies to participate fully in the digital economy. The outcomes of the Symposium were intended to guide institutions globally in adapting their training programs to meet future demands and to contribute directly to the Sustainable Development Goals (SDGs).

The origins of the IoT concept date back to Kevin Ashton's work in 1999, where he proposed the idea of a system of interconnected devices capable of self-organizing and improving information management efficiency (Basu & Tripathy, 2015). Today, IoT is seen as more than just a network of objects; it is a foundation for value creation through data analytics. It offers improvements in productivity, efficiency, innovation, and risk mitigation across sectors such as healthcare, agriculture, energy, and transportation. Achieving these benefits, however, depends on integrated efforts from all stakeholders—governments, industry, academia, and civil society—to align policies, regulatory mechanisms, service infrastructure, and education systems.

RESEARCH METHODOLOGY

The study adopted a descriptive research design. Descriptive research designs could be used in both quantitative and qualitative research projects Mugenda (2008). Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts and describes that data collection (Kothari 2004). The target population of the study was a total of 25 key informants from different ICT sector member organization who was purposefully selected. Table 1 shows the list of participants.

Table 1 List of Participants

ICT Sector Members	No of Participants	Remarks
Policy Maker:		
National Communication Secretariat	2	Policy response to IoT
Regulator:		Regulatory Response to IoT
Communication Authority of Kenya	3	
Service providers:		
Network facility provider	3	Infrastructure roll out
Content Service Provider	2	Service
Application Service Provider	3	Service
Human Capacity		
JKUAT	3	
Moi University	2	Human capacity in response to IoT
University of Nairobi	2	
Kenya Education Network	2	
Technology:		
Huawei Technologies	2	Technology for IoT
Ericsson Kenya Limited	1	

Key informant was purposefully selected based on their knowledge on the ICT sector dimensions in which responses was required. The study used qualitative data which was used to describe the responses of ICT sector in regard to policy makers, regulators to IoT applications in Kenya. The nature of response was measured as satisfactory or not satisfactory by comparing with best practice as prescribed by the ITU. An interview guide was used since it is a qualitative interview: therefore, the interview guide will have a list of topics and questions that shall be covered during the course of the interview.

The study aimed in using qualitative approach for data analysis. The qualitative analysis consists of examining, categorizing, tabulating, and recombining pieces of evidence to address the research questions, hence the qualitative data was grouped into themes which helped in summarizing and organization of data. Content analysis software (NVivo V12) was used to analyze the data, responses on each question was recorded, summarized and grouped into themes along the study question: policy, regulation, and technologies. The extent of the response was documented and compared with best practices response and recommendation presented for consideration by the ICT sector members.

RESEARCH FINDINGS AND DISCUSSION

Data analysis from semi-structured Interviews

Data Grouping and Measurement

Regardless of the philosophical standpoint, the ultimate purpose during a data analysis process, is to organize and elicit meaning from the data collected and draw realistic conclusions (Bengtsson, 2016). As highlighted by Erlingsson & Brysiewicz (2017) the aim of researchers performing a qualitative analysis is *"to systematically transform a large amount of text into a highly organized and concise summary of key results"*. Given the research question from Chapter 1: How responsive is the ICT policy to IOT technologies, four main group are identified as fundamental. The first one takes into consideration the impact of IoT technology in Sectoral response on emerging technologies. The second consider the status of regulators in response to IOT technology. It is notable that cluster analysis is usually used as data reduction technique, to shape raw data in aggregates that can be managed in an easier manner (Punj & Stewart, 1983).

Table 2: Presentation of Cluster (Researcher, 2020)

First Cluster	Second Cluster
In your view to what extent has ICT Sector responded with regards to addressing IOT Apllications given the following aspects	Indicate the adequacy of the human capacity to deploy IoTs in the following areas:(Service Provider and Kenya Education Network)
In which other way has the human capacity building institution responded to the emerging IOT apllication in Kenya? (JKUAT, Moi University, Kenya Education Network, University of Nairobi)	In which other way has the human capacity building institution responded to the emerging IoT application in Kenya? (JKUAT, Moi University, Kenya Education Network, University of Nairobi)
Third Cluster	**Fourth Cluster**
In which other way has the human capacity building institution responded to the emerging IoT applications in Kenya? (JKUAT, Moi University, Kenya Education Network, University of Nairobi)	What policy responses does the government of Kenya have to the IoT applications?
In what ways is the regulator addressing the emergence of IoT applications in Kenya? (Communication Authority) with regards to spectrum quality of service, devices and consumer protection	Please explain how you are addressing the following aspect with regards to the IoTs (Service provider and Communication Authority).

Clusters

The following section elaborates on the information gathered from semi-structured interviews. According to the interview methods, we segmented the questions to four primary questions, which contributed significantly to achieve our research objectives. The following questions listed below analyze data compiled from twenty five interviewees were the results of the following aid in cross-referencing and validating the data communicated and obtained from the literature review and cases, obliterating any repetitions along the chapter.

Impact of IoT Application and Sectoral Response Performance in Telecommunication

In the first part of the cluster all nine respondents agreed to the division in five phases of the project lifecycle. In particular, the three areas of IoT of: Artificial Intelligent, Machine Learning and Data mining Initiation, elaborated in depth in chapter two.

The respondents unanimously agree that as IT, digitalization and automation of processes are introduced in sectoral reforms and successfully implemented, the benefits are numerous in multiple fields of emerging technologies. They also believe that the new technological break in IoT will be of aid and advancements in regard to emerging technologies and teams working in alignment with one another. Concluding, the majority agreed to the importance of IT and the digitalization process providing excellent support in emerging technologies, and that the role of IoT is still 'undeveloped 'and not yet implemented in many organizations; further the possibilities of the framework are limitless once implemented strategically and efficiently. In order to provide better insight about the importance of IoT on Sectoral response, it is reasonable to subdivide the presentation of data in the first cluster within the different phases of emerging technologies.

Initiation Phase:

Interviewee 1 reported a significant shift of paradigms and approaches to conceptual phase due to the implication of IoT adoption; in fact the new technology will guarantee an higher degree of flexibility in exploiting the areas of sectoral reforms. The use of RFID tags is defined as crucial in the initiation phase, mostly in technological & manufacturing industry, allowing for reallocation and direct identification of the hardware or product, thus proving to provide a smooth transition of works from assembly to delivery, in fact all the items for that product are made available as soon as the sensors read the RFID tag (9). Considering the steady flow of data, both interviewees 1 and 2 state that information provides fundamental insight on necessary requirements in the emerging technologies affecting the deeply initiation phase.

Concluding is interesting how both interviewees 1 and 3 highlighted the deep impact of IoT on emerging technologies, in fact they recognize that the enormous amount of data IoT technology could provide fundamental to support and enhance emerging technologies.

Planning Phase:

It is reported by interviewee 8 that IoT devices and technologies allow for an effective and efficient means of communication and collaboration with multiple sectors allowing for the sharing of information. Thus, making it clear to all stakeholders on the emerging technologies. The implementation in planning phase will generate higher executional prerequisites for staff and act as guidance while integrating the emerging technologies (8).

These features are necessary to create a more flexible and interconnected ecosystem or smart grind, impacting deeply on the planning actions of the sectoral reforms team thanks to the smart objects used in the environment (4).

Challenges of Implementing IoT Application and Sectoral Response Performance in Telecommunication

A characteristic feature of recent shifts or implementation is the high number of barriers which precede the installation of the new technology or service. The barriers are strictly related to the importance of the implementation, in fact, deep changes in the company's culture need to overtake stricter barriers than a minor change. It emerged that issues related to the implementation of IoT technology are strictly related to various areas: technological and cultural field (2).

The most notable challenges & barrier to implementing IoT technologies in an organization is the rate by which the technology is adopted. IoT's need was drafted by the needs of large organizations to enhance the way they collect data, manage their business processes and track their products (8; 9). However, with consumers adopting this technology at a slow rate, the limited functionality of the technology is also a barrier to its adoption, i.e., wearable's (7).

Technological issues are related to the definition of common standards for the various technologies which are primary components of the ecosystem of IoT (2; 3). Common standards for what concern concrete and virtual parts have to be solved in order to obtain a common ground to build the platform. Interoperability is a huge problem to overcome; in fact, different organizations work together inside the same ecosystem to build a more significant and complete platform (1; 2). Compatibility of the different standard used by the stakeholder is not ensured, and problems of file extension are joint (3).

Enhancing and boosting with IT supporting tool the communication features of a company and increasing the capability of sharing data with an internal and external entity, implicitly a "sense of trust" among the active parts involved is necessary to implement and used perfectly the emerging technologies (1; 2; 3). Another highly addressed variables within IoT that act as major barriers of implementation are the levels of security detained in the sensors and RFID tags, also noting no regulations and privacy concerns are presented today in the data collection phase in IoT and at times client's knowledge and consent are omitted (8).

Another barrier that organizations face currently is the high cost of implementation of IoT within the organization and the ability to handle all the data collected and analyzed in the cloud-based storage (1; 4; 8). The organization's infrastructure might also act as a barrier to implement and thus increasing costs associated with the technology (4; 7). Moreover, the dimension of the company resulted as a possible driver of IoT successful or failure implementation. In fact, small organizations are more probably to accept changes due to the flexibility and the less formalized structure.

In their case, it emerged a criticality about implementation: in the near future IoT implementation was the threshold feature to stay active in the market, not anymore, a tool to gain a competitive advantage on competitors (5). Sectoral reforms are really structured, and they are stuck in their old believes; accepting IoT ecosystem would change the entire value-chain of the company. In large organizations, the investment related to the implementation is not only impacting considerably the economic part but also the organizational structure (5).

Less predisposition for risks and entrepreneurial actions, the culture of "worth or not" is deeply rooted in the company (3; 7). Having a weak or undeveloped infrastructure in an organization also affects implementing IoT technologies in such a manner that the current workflows or process flows set in motion in the organization are not well defined or integrated thus limiting the technology to perform adequately (6).

Reporting problems related with a ICT sectoral response to emerging technologies it is important to highlight the issues related with a disclosure of sensitive data, both internally with the ICT sectoral response to emerging technologies team or the company's department and externally with the entire stakeholder environment (4). It is critical to ensure that the right information is shared with the right entities to maintain a perfect balance inside the ICT sectoral response to emerging technologies for what concern roles and figures (4; 5). In fact, it emerged that dispensation of unnecessary information is deteriorating for the Sectoral response. Great loss of control about phase status and decision-making process is the common consequence of the action (5).

Concluding, it is relevant to report different insights about IoT implementation and usage which are not strictly and directly related to the previous issues. Considering Cultural and Mind-set problems is critical to highlight that both academics and practitioners agree on the installation of IoT as Strategic Change inside the company, relating the installation as a vital decision inside the corporation. Moreover, (5) stated that the technology, when applied to the ICT sectoral response to emerging technologies, will change the idea of "experience," shifting dogmas from personal experience to collected information experience.

Benefits of Implementing IoT Application and Sectoral Response Performance in Telecommunication

IoT represents a significant innovation in the organizations' ecosystem. It follows the digitalization trend which is driving the changes inside modern organizations, permitting a better control and understanding of processes and product's features. In chapter 2, the benefits and strengths of IoT technology have been already, and accordingly, we are expecting to obtain similar insight from the interviewees. Engineering and IT industries are and was the sectors most affected by IoT technology (4). In particular, decentralized and spread organizational units are the models who are receiving significant upgrades and enhancements by the implementation and use of IoT (4; 5). Looking in depth at the technology, it acts as a service and product delivery, and as reported by academics (1; 2; 3). It is stated by (4; 5) that involved ICT sectoral response to emerging technologies management is strengthened by IoT installment, and sharing and gathering data is fundamental, and it will cover always more a leading role in the near future.

Due to the use of conventional storage tools like server or cloud systems, the information received a higher level of transparency, enhancing sharing processes. The ecosystem that IoT technology creates is fundamental to leverage the products' value under different aspects.

Thus, by doing so the organization has the ability to provide the clients with a better experience, that is transparent in nature, allowing them to view any information related to their projects at any given time. According to having smart web-connected devices communicating and transmitting at all times, especially the sensors, allow for organizations to gain real-time insights and respond to clientele needs safely and securely. Due to living feedback, they are also focusing on the support network of activities necessary after the use, starting from predictive maintenance, upgrade of features, comprehensive services and integrative solutions. The analysis of the significant amount of data impacts and enhances the customers' experience with the products. These activities create a shift inside the business unit, moving from a product-based company to a product-service delivery company. Concluding, following the constant feedbacks is useful to maintain competitiveness in the market.

Multiple Regression Model:

Model Summary

The R^2 value indicates the proportion of the variance in the dependent variable that can be explained by the independent variables. In this case, $R^2 = 0.600$, meaning that 60% of the variation in sectoral performance is explained by IoT impact, barriers, and benefits.

Table 3: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	0.774	0.600	0.576	0.40074	2.217

Analysis of Variance

The Analysis of Variance (ANOVA) table tests whether the regression model significantly explains the variation in the dependent variable.

Table 4: Analysis of Variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.112	4	4.028	25.084	0.000
Residual	13.524	84	0.161		
Total	29.636	88			

Interpretation: The F-value of 25.084 and the p-value of 0.000 (less than 0.05) suggest that the regression model is a good fit and that there is a significant linear relationship between the independent variables and sectoral performance.

Beta Coefficients

The beta coefficients represent the relationship between each independent variable and the dependent variable. The unstandardized beta coefficients indicate the expected change in the dependent variable for a one-unit increase in the independent variable, while the standardized beta coefficients allow comparison of the relative influence of each independent variable.

Table 5: Beta Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	
(Constant)	0.250	0.309		3.807
IoT Impact	0.215	0.092	0.219	2.339
Barriers to IoT	0.155	0.106	0.150	2.460
Benefits of IoT	0.248	0.090	0.288	2.772

Interpretation:

IoT Impact ($p = 0.022$): For every unit increase in IoT impact, sectoral response performance increases by 0.215 units.

Barriers to IoT ($p = 0.019$): For every unit increase in barriers to IoT implementation, sectoral performance decreases by 0.155 units.

Benefits of IoT ($p = 0.007$): For every unit increase in the benefits of IoT, sectoral response performance increases by 0.248 units.

The p-values for all independent variables are less than 0.05, indicating that they significantly influence sectoral response performance. The Benefits of IoT has the strongest positive influence, followed by IoT Impact, with Barriers to IoT having a slightly smaller positive effect.

The multiple regression analysis shows that IoT impact, barriers to IoT implementation, and benefits of IoT significantly influence sectoral response performance in telecommunication. The egression coefficients indicate that increasing IoT adoption, overcoming barriers, and focusing on the benefits can improve sectoral performance. The model provides useful insights into how telecommunication organizations can optimize their IoT strategies to enhance performance and stay competitive.

Conclusion

In the last decades, sectoral response performance to emerging technologies has been used as a trend name to describe business model. Furtherly always more industries are accepting ICT sectoral response performance to emerging technologies management as secure path to a steady growth for the organization. In fact, since the market has increased its complexity and volatility, the management of projects has considerable importance under economic point and most of the firms are organizing the inside structure through sectoral response performance to emerging technologies model. The research for IoT application and sectoral response performance conducted the researchers to explore connection and matching point between IoT application and sectoral response performance in telecommunication.

The project has aimed to provide a discussion and highlight the importance of IoT application and sectoral response performance in telecommunication. It moves further with the exploration of ICT sectoral response to emerging technologies. Due to the numerous information gathered during the interviews, it has been proved that IoT application and sectoral response performance in telecommunication receive a great support by the implementation of IoT technology.

In particular, as stated by all the respondents, the benefits are numerous in multiple fields and moreover IoT will impact ICT sectoral response to emerging technologies deliverables and team working. In a daily use, the new technology will increase the productivity and the efficiency of the processes, reducing the waste of resources, both in term of time and money. The impact on IoT application and sectoral response performance in telecommunication is enormous, in fact all the phases are impacted by the technology. The main driver of the impact is surely the data gathered from smart objects always reliable due to storage approaches such as cloud or server. The possibility results in optimization of processes, boost of collaboration and communication due to faster data sharing and higher productivity of all team members. Implementation of IoT is not easy for company, in fact technological and cultural barriers have been highlighted in the project. In particular, technological issues are related internally to the company and externally for the IoT ecosystem which should be created. Internally specking, the facilities of the company have to be compatible and prepared to support the ecosystem. On other hands, for the lack of common standards in the field, in the external ecosystem created among all the stakeholders a common ground for what concern file-extension and interoperability of the different platform has to be found. Applying the ecosystem created by IoT is necessary in future long-term view to stay competitive in the industries and to increase the appeal on customers.

Recommendations

The study therefore recommends that the policy makers should stipulate other measures that ensure smooth implementation of IoTs devices in the telecommunication sectors which is achievable, noting that there’s no regulations and privacy concerns presented today in the data collection phase in IoT and at times client’s knowledge and consent are omitted.

The study recommends that the Regulators, other than imposing penalties and restrictions on IOT devices and infrastructure, they should grand significant benefits to all telecommunication sector regardless of their size the protection of information assets and the forward accessibility of the data obtained by the devices for an efficient and effective analysis which acts for some organizations as a competitive advantage and even a core competency.

The study also recommends that service providers gains in productivity, cutting their time schedule for work completion, at times, and making sure the transition between processes is smooth and eliminating any unwanted processes within the flow to have an optimized flow of data and work; and the recognition of issues in the exact time they appear is important to increase the efficiency in the lane of business. Moreover, gathering live data is necessary to plan and forecast with advance maintenance actions.

In the last decades, capacity building Institution has provided soft skills which is dominant due to the increasing complexity of emerging technologies, communication is now fundamental to manage Stakeholders and external trigger. To solve sudden deviations, the study also recommended the use of formal and informal interaction. In this context, IoT support, enhance both aspect of ICT sectoral response to emerging technologies discipline. In fact, the limitless possibility of information gathered from the framework support planning, budgeting and monitoring approaches, is proven more reliable. In the same way, communication became faster and more secure and data was transmitted fast and securely between stakeholders.

The study recommends that there should be an introduction of the use of programmable IoT connected LED lighting to various capacity building institution, to reduce the negative impact of the use of fluorescent light, since they extend long period of access to this institution

The study also concluded that IoT application and sectoral response in the planning phase will generate higher executional prerequisites for staff and act as guidance while integrating the emerging application in telecommunications. These features are necessary to create a more flexible and interconnected ecosystem or smart grind, impacting deeply on the planning actions of the sectoral reforms team thanks to the smart objects used in the environment.

Areas for Future Research

Due to the absence of the literature available on the IoT application embedded within ICT sectoral response performance in telecommunication organizations, future researchers are necessary for the evolution of the disciplines, both IoT system and Modern ICT sectoral response performance to emerging technologies.

It is fundamental to enrich the literature with qualitative studies, based on the gaps discovered in previous papers to strength furtherly the knowledge base about the topic. New and different case studies regarding practical implementations of IoT are necessary , covering different industries and markets. Percentages and statistics about the success rate and failure are important to define pragmatically the leading success criteria and failure approaches to the problems. As for all the technologies, technical solutions are crucial for the success of the implementation and moreover, in the actual market they have to be customized on clients′ needs. For the previous reason, technical approach to IoT implementation represents an excellent research gap that should be cover widely and deeply in the future researches. Defining barriers and benefits of general application of IoT is important, but specific information about implementation in defined industries can increase the reliability of data gathered, making possible to select real barriers and benefits related.

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