Addis Ababa University
College of Natural and Computational Sciences
School of Information Science

Digital maturity assessment model for Ethio-telecom network and security sectors

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Addis Ababa, Ethiopia
June 2020

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Approval of Examination

This thesis entitled ***"Digital maturity assessment model for Ethio-telecom network and security sectors"*** has been examined and approved for the award of the degree of Master of Science in Information Science from Addis Ababa University, College of Natural and Computational Sciences, School of Information Science.

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Declaration

I declare that the work in this thesis is carried out by the author alone. Whole or part of the work has not been submitted before in order to qualify for any other academic degree. It is submitted in partial fulfillment of the requirements for the degree of Masters of Science in Information Science at the School of Graduate Studies of Addis Ababa University.

Meaza Getachew Signature_____

Dedicated

To

My mother

Abaynesh Negash, a strong and loving soul who thought me to trust in God and believe in hard work that so much could be done with little. This work is a sign of my love to you.

Abstract

Telecom companies are unfolding going through the digital era. In the process of becoming fully digital service providers, the process of maturity in all aspects is crucial. Measuring the level of development for telecom companies nowadays is necessary to keep pace with the rapidly growing digital technologies. Maturity models are important tools for the measurement of the analysis of the as-is situation of companies and the future to be goals by defining the level of growth and the expected attainable requirements. Telecom network is the heart of digital services and secure network strategies and workflows are important to deliver those services. Despite the variety of researcher undertaken on digital maturity areas, there have been no studies conducted on telecom digital maturity, specifically on domain-centric maturity assessment models in Ethiopia. Hence, in this research an assessment has been done using a mixed-method design aimed to develop a domain-specific digital maturity model; a case study research has been conducted to gather quantitative data from 117 respondents from the selected network and security divisions and another 9 respondents are interviewed for the qualitative data collection part. The analysis of both data is performed using SPSS and Nvivo 12 qualitative data analysis software. The qualitative analysis revealed that the sections have low ratings on technological dimensions mainly on analytics technology, and on strategy, leadership, and innovation aspects. On the basis of quantitative data findings, the study looks at how digital leadership can maintain the innovation process within the sections and the analysis explains that effective leadership skills focusing on the practice of knowledge sharing brings in a shift of innovation process to the next stage. The contribution of this study is in two forms, the first one is assessing the current level of maturity for network and security sectors using a generally accepted maturity model and secondly, developing domain-specific maturity model by using the outcomes gained from the assessment.

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Chapter One

1.1 Introduction

Digitization is a global mega trend that is fundamentally changing existing value chain across industries and public sectors (Collin et al., 2015). Industries across the spectrum are faced with a fundamental change: digital transformation. The telecommunications industry is no exception. The term "transformation" expresses a fundamental change within the organization, which impacts strategy and structure (Matt, Hess, & Benlian, 2015). Communications service providers are being faced with a deep transformation that is taking them from being providers of conventional communication offerings (e.g., voice, SMS) into providers of digital services (e.g. cloud services, and Internet of Things). Thus, the transformation is disruptive; it influences not only customer relationships, but internal strategies and value propositions as well (Westerman, Bonnet, & Calméjane, 2011). The entirety is being connected to the internet or is being digitized. Examples of this consist of the digitization of money. A change in customer expectations, which are being molded toward in to continually connected, personalized way of life and digitized offerings are some of the factors identified as a key driver for digital transformation (Valdez-de-Leon, 2016). Aimed primarily at modernization, and secondly, at internal efficiency and access, Digitization involves the development, operation, and maintenance of the technological environment, including the availability of technological capabilities, services, and infrastructure within and between government organizations. Based on this environment, the digital Stage entails the representation of data, documents and other information in digital formats, making such information available to staff, partners and other stakeholders within and outside a government organization in digital formats automating existing processes and services based on digitized information and its exchange through digital networks, and making the services accessible to customers in a digitized format and through digital networks. The Digitization Stage in principle does not involve redesigning, improving, or any way changing existing processes, services, or practices, but merely digitizing and automating what already exists and making the outcomes available to the same stakeholders and customers through digital networks (Janowski, 2015).

This is where digital technologies are deployed into the traditional business models to provide revenue and value producing opportunities. In this sense, taking advantage of

digitalization opens new doors for business opportunities and provides competitive advantage for companies (Tavakoli & Mohammadi 2017).

Digital interaction is constantly increasing, and digital technologies are changing the way people live, communicate, and do business. The phenomenon digitalization, or digital transformation, is gaining more attention every day while it affects every dimension of the business in almost every industry (Hanifan et al. 2014). It is the process of transforming into a digital world, where traditional operations are replaced by digital technology (Gartner 2016; Hanifan et al. 2014).

For a thriving digital transformation, companies ought to focus on two complementary activities: reshaping customer value propositions and transforming their operations using digital technologies for greater customer interaction and collaboration (Berman, 2012). Henriette , Feki , and Boughzala (2016) propose defining the digital transformation as a disruptive or incremental change process. It starts with the adoption and use of digital technologies, then evolving into an implicit holistic transformation of an organization. In recent years, an unclear number of various maturity models have been developed to conceptualize and assess digital maturity in organizations with the intention to effectively manage and guide digital transformation. Maturity is defined as a specific process to explicitly define, manage, measure, and control the evolutionary growth of an entity. (Diogo, Proença, José, & Borbinhaa, 2016). Digital maturity models assist companies to evaluate their potential to encounter digital transformation in line with pre-define dimensions. (Berghaus & Back, 2016) Digital maturity is about adapting the organization to compete effectively in an increasingly more digital environment. Maturity goes far beyond simply implementing new technology by aligning the company's strategy, workforce, culture, technology, and structure to fulfill the digital expectations of customers, employees, and partners. Digital maturity is, a continuous and ongoing process of adaptation to a changing digital landscape (kane , palmer , phillips , kiron , & buckly , 2017).

Digital technologies are changing the competitive landscape providing new ways of delivering value to customers and new service opportunities and factors associated with past successes may not be associated with future success. Digital business requires companies to act and respond faster than they ever have before and characterized by continual learning and experimentation of new skills, approaches, and capabilities (Kane et al ., 2018).

Digital success requires not only that investment be aligned closely with strategy but also that it is at sufficient scale. There are many elements of a transformation, from end-to-end journey redesign and embedding analytics into processes to open tech platforms. They require a myriad of capabilities, from artificial intelligence and agile operations to data lakes, cloud-based infrastructure, and new talent. Many of these elements have been written about extensively, and each can absorb a significant amount of executive time. What's often missing, however, is a comprehensive view of how an organization sets the right ambition, how to architect the right elements for the transformation, then how to systematically and holistically undertake the change journey (Dahlström, Ericson, Khanna, & Meffert, 2017).

1.2 Background

Telecommunications service was introduced in Ethiopia by Emperor Menelik II in 1894 when the construction of the telephone line from Harar to the capital city, Addis Ababa, was commenced. Then the interurban network continued to expand satisfactorily in all other directions from the capital. Many important centers in the Empire were interconnected by lines, thus facilitating long distance communication with the assistants or operators at intermediate stations frequently acting as verbal human repeaters between the distant calling parties. Ethiopian Telecommunications Corporation was the oldest public telecommunications operator in Africa. In those years, the technological scheme contributed to the integration of the Ethiopian society when the extensive open wire line system was laid out linking the capital with all the important administrative cities of the country.

After the end of the war against Italy, during which telecommunication network was destroyed, Ethiopia re-organized the Telephone, Telegraph and Postal services in 1941. In 1952 the Imperial Board of Telecommunications (IBTE) was established by proclamation No. 131/52 in 1952. The Board had full financial and administrative autonomy and oversaw the provision and expansion of telecommunications services in Ethiopia. The Imperial Board of Telecommunications of Ethiopia, which became the Ethiopian Telecommunications Authority in 1981, was placed in charge of both the operation and regulation of telecommunication services in the wake of the market reforms. In 1996, the Government established a separate regulatory body, the Ethiopian Telecommunication Agency (ETA) by Proclamation 49/1996, and during the same year, by regulation 10/1996, the Council of Ministers set up the Ethiopian Telecommunications Corporation (ETC). Under the supervision ETA, the principal duty of ETC is maintained. It expanded telecommunication

services in the country and provided domestic and international telephone, telex, and other communication services.

At the time, the total Exchange capacity was 780,000 lines; out of this 171 were automatic Digital exchange with 760,368 capacity of lines. The remaining lines were connected to manual exchanges. By the end of June 2004, 91 Microwave, 43 UHF, 242 DRMASS, 281 VSAT, 78 VHF and 8 HF Local Network stations have been operational. The total number of fixed telephone subscribers has reached 484,368. These subscribers had generated 2,225.14 million urban metered calls and 17.7 million outgoing minutes. The Corporation has been providing internet services since 1997. The number of subscribers has reached 12,155 by the end of June 2004 (Bogale, 2005).

As a continuation of the 2005/06 – 2009/10 five-year plan and after concentrating its efforts on education, health and agriculture, the Ethiopian government has decided to focus on the improvement of telecommunication services, considering them as a key lever in the development of Ethiopia. Ethio telecom is born, on 29th November 2010, from this ambition of supporting the steady growth of our country, within the Growth and Transformation Plan (GTP), with ambitious objectives for the year 2015. The Ethiopian government has decided to transform the telecommunication infrastructure and services to world class standard, considering them as a key lever in the development of Ethiopia. Ethio Telecom's network capacity currently stands at 62 million mobile subscribers, 3 million fixed line users with a mobile service coverage of 85%. It also boasts a vast fiber route that allows optical fiber network coverage as well as an International Gateway Capacity; 42 Gbps including 3 Terrestrial Route through Djibouti, Sudan &Kenya, and a satellite back up. Now Ethio-telecom reputed as the continent's largest mobile operator with an estimated 57 million subscribers beating MTN Nigeria according to IT Web report of November 2017. Thus, Ethio telecom is born from this ambition to bring about a paradigm shift in the development of the telecom sector to support the steady growth of the country (Baron, 2010).

1.3 Statement of the problem

The telecommunications industry has long been at the forefront of the digital age, supplying the ever-growing wired and wireless broadband networks that now span the globe. The benefits have been enormous. Billions of people now enjoy always-on connectivity and access to every kind of information imaginable. Businesses in virtually every industry now live through those networks, connecting with customers and suppliers while transforming

their internal operations. Ironically, the same telecommunications companies that have done the most to advance the dawn of the digital age have yet to build on the digitization they have championed. In fact, they continue to lag behind more digitally native companies in driving the digital transformation of their own businesses (Friedrich, Péladeau, Gröne, & Herdé, 2015).

Executing on the new, fully digital business model will require a major transformation of how telecoms deliver their products and services (Friedrich et al.,2015).

The telecom ecosystem has provided the fundamental building blocks - access, interconnectivity and applications that are enabling this digital revolution to take place. A large share of potential value stemming from digitization across global industries over the next decade is dependent on the telecom industry delivering essential infrastructure, applications, and productivity improvements in many areas (Patterson, Mittal, & Weinelt, 2017).

Now days, the mobile phone becomes more ubiquitous and pervasive. Immediacy of information, and Simplicity become more significant in day to day digital interaction. The monopoly owned telecom company in Ethiopia, Ethio-telecom, which has a total of 44 million subscribers countrywide is the one that has to meet the increasing customer need for quick connection and fast access to services.

But there are observable limitations on the company existing service deliveries such as, mobile, and broadband network connections, quality and speed of data and voice services. The major ethio-telecom services lie on the backbone of network and security sectors. But, as the core operator of its business, the company has not yet assessed the digital readiness of those sectors regarding the processes, strategies, and capabilities. So, understanding digital transformation will be necessary for the sectors to enable new business models beyond the pipe and address changing customer expectations through strengthening the sectors agility.

A maturity model provides some guidance on how organizations approach and maps out typical paths of how organizations go about their digital transformation (Berghaus and Back, 2016). There are various models that are generally developed to assess the telecom maturity. But there is a lack of domain specific assessment models to perform in depth analysis of specific touch points, to provide detailed action requirements and to scrutinizes the sectors positions and capabilities in the future. (Shahiduzzaman, 2017), explains that digital maturity

is not a static concept because the digital landscape is continuously changing. As such, an organization will need to assess maturity over time.

Assessing the level of maturity is found important to identify the gaps that exist particularly on the company network and security core functions and processes that help to better understand the enhancement areas to speed up companies' digital journey.

The attempts made in maturity modeling, specifically in digital areas are very limited. The main works related to DMM tends to be too general and high-level in their coverage to come up with the specific need of this research. Each of the maturity criterion identified have been designed to be generic in nature to adopt and apply to the specific current problem area. Due to the changing technology behavior and the competitive nature of the telecom industry, those sectors explicitly has to be focus on continuous assessment in order to identify the gaps that exist particularly on the network and security functions and processes, to better understand the enhancement areas and to meet the core digital target of the company.

Based on the above rationales, identifying, and measuring the digital potential the sectors has now will contribute in reshaping the strategies to strength and enlarge its core business activities and to build an ever-transforming company. To this end, this research will assess the digital maturity of Ethio -telecom regarding its network and security and tries to provide domain specific maturity assessment model by integrating various aspects of digitization.

1.4 Objective of the study

1.4.1 General objective

The general objective of this research is to assess the current digital maturity of ethio-telecom network and security sectors and provide domain specific digital maturity self -assessment model for those sectors.

1.4.2 Specific objective

To achieve the general objectives, the following specific objectives are formulated:

1. To understand the basic digital maturity concepts and align with the selected sectors current activity.
2. To study and select core telecom digital maturity assessment tools.
3. To study different types of telecom maturity evaluation metrics.
4. To identify and capture digital maturity needed elements regarding network and security sectors.

1.4.3 Research questions

This research attempted to answer the following research questions.

1. To what extent does Ethio-telecom network and security sectors are adapting themselves to digital transformation?
2. How can domain specific maturity assessment model be built for self-assessment purpose in those sector's?

1.5 Significance of the study

Assessing the digital maturity level of Ethio telecom has several advantages. The study helps for identifying the digital technological opportunities, capabilities, and potentials to be explored in the company. It shows how the company is responding to its core digital business capabilities. In more detail this study will have the following core benefits.

- Assessing the maturity readiness of telecom services like its core network and security sections, can be taken as a starting point for continual processing to achieve the operational excellence of telecom services.
- It recommended self -assessment model for improved digital transformation conception and a shift in organizational mind-set for other competitive telecom service providers may come.
- It can use as an input for other researchers who are interested on working in digital maturity areas.
- The study gives a good insight for Ethio telecom professionals and expertise to help them to reshape their view on process automation and strategies and operation of the Ethio telecom service.

1.6 Scope of the study

Digital maturity assessment is usually analyzed covering a company or a business sector due its behavior of studying every detail related to the various dimensions of the operations and most of digital maturity models are also suited to cover all aspects of general maturity elements. As it is a very broad area to cover all sectors of Ethio -telecom, this research paper only gives much emphasis on the backbone of ethio telecom services that are network and security sectors.

Focusing on the two sectors is found very important due to the time and financial constraint to cover all divisions and sectors of the company and the importance of focusing on the two

major sectors operation. The scope of this study is limited on the core technical bond that exists between the two and the critical requirement of both sectors and capability now a day to deliver core services and applications.

1.7 Organization of the thesis

This thesis divided in to six chapters. The first chapter covers the introduction of digitization and digital transformation, the background and statement of the problem, scope, and methodology of the study parts. In the second chapter literature review and related work on digital maturity is presented. On this chapter digital maturity model with respect to digital strategizing, ICT maturity, manufacturing maturity domain specific model and industry 4.0 maturities are presented.

In the third chapter research methodologies, methods and techniques are discussed and chapter four contains data collection, analysis and finding are discussed. In the fifth chapter digital maturity domain specific model building process takes place and the last chapter discusses about the conclusion and recommendation.

Chapter Two

2. Literature review

2.1 Maturity model Overview

Maturity model is a set of characteristics, attributes, indicators, or patterns that represent progression and achievement in a domain or discipline. The artifacts that make up the model are typically agreed upon by the domain or discipline and are validated through application and iterative recalibration. A maturity model allows an organization or industry to have its practices, processes, and methods evaluated against a clear set of artifacts that establish a benchmark. These artifacts typically represent best practice and may incorporate standards or other codes of practice that are important in a domain or discipline. By having the ability to benchmark, organizations can use maturity models to determine their current level of achievement or capability and then apply these models over time to drive improvement. Digital maturity is about adapting the organization to compete effectively in an increasingly digital environment and digital Maturity Model is an effective tool to provide guidelines for a clear path throughout the transformation journey. (Caralli, Knight, & Montgomery, 2012)

Architecturally, maturity models typically have "levels" along an evolutionary scale that defines measurable transitions from one level to another. The corresponding attributes define each level; in other words, if an organization demonstrates these attributes, it is said to have achieved both that level and the capabilities that the level represents. Having measurable transition states between the levels enables an organization to use the scaling to define its current state, determine its future, more "mature" state, and identify the attributes it must attain to reach that future state (Caralli et al., 2012).

As it is a recent phenomenon which emerged with industry 4.0 revolution, Digital transformation is a relevant process that becomes a topic of discussion in the scientific community. Along with digital transformation, digital maturity is gaining more and more popularity due to its application and use of modern technologies in organization's processes to achieve its goals efficiently. There is no single and perpetual definition of digital maturity in the scientific field. Scholars provided a number of Digital maturity definitions. Below presents the definition of different authors.

No	Definition	Author and source
1	Digital maturity is about integrating your organization's operations and human capital in digital processes and vice versa.	WalkMe pioneered the Digital Adoption Platform (DAP) for organizations to utilize the full potential of their digital assets.
2	Digital maturity-integration of organizational operations and human capital into digital processes and Vice versa-digital processes into organizational operations and human capital.	George Westerman, Didier Bonnet, and Andrew McAfee "The Nine Elements of Digital Transformation" MIT Sloan Management Review January 07, 2014
3	Digital maturity – how organizations systematically prepare to adapt consistently to ongoing digital change. Digital maturity draws on a psychological definition of "maturity" that is based upon a learned ability to respond to the environment in an appropriate manner	G.C. Kane, "Digital Maturity, Not Digital Transformation," MIT Sloan Management Review, April 4, 2017, https://sloanreview.mit.edu. The general background of this concept of maturity is based on L. Hyatt, B.Hyatt, & J. Hyatt, "Effective Leadership Through Emotional Maturity," Academic Leadership Journal 5, no. 2 (summer 2007): article 4.
4	The term "digital maturity" is closely related to digital transformation. We can say that digital maturity is the final stage of digital transformation, which companies aspire to achieve, those companies that have achieved such digital maturity, have now witnessed important improvements in the operation of the company, and have also increased customer satisfaction.	Has your company achieved digital maturity? by Alberto Dominguez | Dec 25, 2017

Table 2. 1 The Definition of Digital Maturity by Different Authors

(Aslanova & Kulichkina , 2020)

2.2 The Philosophical Grounding of Design Science Research (DSR)

The process of knowledge creation started with a substantive field of inquiry, which is called philosophy. Philosophy is primarily concerned with rigorously establishing, regulating, and improving the methods of knowledge creation in all fields of intellectual endeavor (Patington, 2002). In philosophical inquiry, the facts, the theory, the alternatives and the ideals are brought together and weighed against each other in creation of knowledge and legitimize knowledge.

The science of artificial (design science) a body of knowledge about the design of artificial (man-made) objects and phenomena –artifacts that designed to meet certain desired requirements. Design science is then knowledge in form of constructs, techniques and

methods for performing this mapping, models, theory- the know- how for creating artifacts that satisfy given sets of functional requirements. Design science research is research that creates this type of knowledge using design, analysis and reflection.

There are many varieties of philosophical approaches for "ways of knowing", which have commonly been divided into positivism, interpretivism, realism, critical theory, hermeneutics and phenomenology. Usually, the selection of research strategy and the methods for research activities depends on the research philosophical stances (Saunders, Lewis, & Thornhill, 2009) Unfortunately, such divisions did not distinguish another research paradigm that is centered toward practical problem solving which is Design Science Research (DSR). A comparison between two common philosophical approaches with DSR is tabulated in below table to illustrate the difference in the way DSR views the world.

Research Philosophy			
Basic Belief	***Positivist***	***Interpretivist***	***DSR***
Ontology	A single reality Knowable, Probabilistic	Multiple realities, socially constructed	Multiple, contextually situated alternative world-states Socio-technologically enabled
Epistemology	Objective; dispassionate, Detached observer of truth	Subjective (i.e., values and knowledge emerge from the researcher-participant interaction)	Knowing through making: objectively constrained construction within a context Iterative circumscription reveals meaning
Axiology: what is value	Truth: universal and beautiful; prediction	Understanding: situated and description	Control; creation; progress (i.e., improvement); understanding

Table 2. 2 Philosophical Assumptions of The Three Research Perspectives

(Vaishnavi & Kuechler, 2007)

This research study has selected DSR as the philosophical approach based on the characteristic of maturity models, the problem solving nature of DSR involves in the creation of artifact as a central output. DSR has been chosen as the philosophical approach for discovering and identifying opportunities and problems relevant to improve the problem solving process in designing and developing context specific maturity model.

2.3 The need for transformation

Networks exist to deliver applications, services and user experience. Due to the introduction of the smartphone, proliferation of mobile devices, and the near ubiquity of network access, new innovative applications and services are quickly and substantially increasing demands on

the network infrastructure. Most of today's networks were designed to provide fast, reliable connectivity but not to meet the new demands that digital transformation will inevitably make on them (Greene, Parker, & Perry, 2017). There are signs that the following period of rivalry in telecommunications may appear to be unique from the past, quickening the requirement for administrators to forsake incremental activities for transformational development (Alsafadi, 2018).

Service providers should align digital services from the open ecosystem to the customer's subscriber identity and specified network requirements. By integrating IT data management with network provisioning, service providers can offer the customer a unique, yet open experience. This is different from the undifferentiated, open digital experience new player's offer. Previously, this differentiated customer experience was called "personalization"; but the personalization offered today is not personal. It is simply developing automated responses based on the self-declared characteristics of the digital service customer. True personalization is using the combination of subscriber, network and digital service preferences to offer a unique customer experience. This service innovation is within the telecom service provider's grasp if the provider transforms to enable it (Technology Business Research, 2015).

According to World Economic Forum, investment by the telecommunications industry in interoperability and technology has underpinned a huge shift in information and capital flows through the global economy. In general access to a globally connected network has enabled millions of people around the world by giving them access to marketplaces, social programs, and real-time information in a way that will have long-term effects on their quality of life (Krolivets, 2017).

2.4 Telecom digital journey challenges

The telecom service has been providing the potential benefits from the transition of analog to digital and the emergence of 2G to 3G, 4G which led to broadband that can transmit even more information, as well as digital services in the 2010s. The next-generation network (5G) is creating new business models and roles for both operators and vendors. Along with this, SDN (Software-defined network), NFV (network function virtualization), and service orchestration are the approaches that are going to make telecom networks and operations more Agile, programmable, and cloud-connected. One of the reasons is that it must be a very special type of virtualization. It must be ready for the telecom environment and support telecom service performance. But, to manage this an increasingly divergent set of

capabilities, policies, features, and functions will remain a challenging task for telecommunications industries.

Nassir (2018) also described the top challenges facing operators when undergoing this transformation. The first challenge is the Introduction over-the-top services which relate to content and ancillary telecom services. This means a new set of relationships for the operators, shifting alliances and flexible business models, whereby the operator might have to split new revenue streams in their alliances. Secondly, introducing new services beyond their core ICT capabilities could include big data and artificial intelligence. Such services require a completely new skillset, in-house. Skillsets that are applicable to devising such offerings, from the value proposition and price/bundle perspective, to the go-to-market, enabling channels and direct-sell skills for B2B, B2C or B2B2C.

2.5 Related work

One of the works conducted related to digital maturity is the work by (Đurek, Kadoić & Begičе, 2018). The work is aimed to develop a digital maturity framework for higher education institution in Republic of Croatia and assessing the level of maturity with the developed model. The methodology used throughout the development process was mostly qualitative. The authors followed two main phases of framework development. The first phase was aimed to develop a framework with a focus on information and communication technologies. The second phase was undertaking two focus groups to obtain input from experts on defining new framework areas and their elements. The results of the qualitative analysis of 15 digital maturity frameworks and the results of the two focus groups led to the proposal of 7 areas and 53 elements for DMFHEI. The Q-sorting process was applied to sort 53 elements into the seven proposed areas. Then, the authors calculated a content validity ratio (CVR), which decreased the number of elements from 53 to 43. The resultant elements were not mutually exclusive. The digital maturity for higher education institution identifies 7 areas within which there are 43 elements. The next process was to determine the description of each of elements. As an example The Learning and Teaching area consists of seven elements: preparation, storage, and use of digital content in learning and teaching; innovative learning and teaching methods with ICT; the development of teachers' digital competence; the development of students' digital competence; the use of learning analytics to improve learning and teaching; ubiquitous learning and open curricula; and personalization and support for underrepresented groups by using ICT in learning and teaching.

In measuring the digital maturity for HEI the authors did not find these criterions are equally important. So, they calculated their weights using the multi criteria decision making method called the Analytic hierarchy process/analytic network process (AHP/ANP). And they decided to use appropriate instrument: rubrics and ratings for the answers (judgments) form examiners that are used for collecting and assessing the digital maturity level of HEI. They used a hybrid approach which is ANP to determine the weights of the area and AHP to determine the weights of the elements. The ANP also used to establish the network structure (a structure more appropriate for modelling strategic problems) on both levels –areas and elements to prohibit the dependencies influence exist between areas and elements. They used AHP method based on pairwise comparisons of decision-making elements using a Saaty scale in which it consists of nine degrees (1-9). Value 1 means that two elements in the pair are equally important. Other values represent the domination of one element over others (weak, strong, very strong, and absolute.

The weights of the areas in the DMFHEI (Decision-Making Trial and Evaluation Laboratory) are therefore calculated using the ANP integrated with the DEMATEL. In DEMATEL, the intensities of the influences between criteria are measured on a scale of 5 degrees: 0 means no influence, and 4 means very high influence. By multiplying the local priorities of elements with associated area weights, the total weights of the elements (TW) was gained. To calculate the digital ML of certain HEI in some elements for instance for (HEI SP/achieved priority of HEI per each element), the total weight of each element (TW) must be multiplied by the HEI's element priority (i.e., the HEI's ML per some element), which can achieve values from 0 to 1. The authors considered using Rubrics combined with ratings, as rubrics offer a process for making explicit the judgments in the evaluation and are used to judge the quality, the value, or the importance of the service provided. Criteria (in this case, element) and levels of how a specific criterion (element) is satisfied (e.g., poor, adequate, good, and excellent are taken as basic elements of rubrics. For each element and level, a statement is defined, and the experts can easily determine the local ML of HEI for certain element. Rubrics reduce assessment subjectivity. The authors used direct assessment (by defining the levels) and pairwise comparison ((i.e., make pairwise comparisons of the levels and calculate the priorities, which must be normalized) to assign a quantitative value to each level.

The authors collected data in the workshops, seminars, and meetings and the respondents were HE employees with experience in managing HEI. First, respondents evaluated the intensities of the influence between areas using the DEMATEL scale (0 = no influence, 1=

weak influence, 2 = medium influence, 3 = strong influence, and 4 = very strong influence). Then it has been converted to weighted super matrix using the normalization procedure. Each of the areas were given weight between 0 and 1 based on the response given form the respondents. The maturity level of Croatia HEI is identified as Basic, Initial, e-Enabled, e-Confident, and e- Mature by multiplying the obtained priorities from the AHP with associated area weights. Finally, the HEI ML is calculated by summing all the HEI SPs, by doing so the authors get 0.4296 cumulative maturity level.

On the second work conducted by (d'Angella and De Carlo, 2017), the authors focused in studying the maturity of tourism networks of the Italy business networks. The network concept the authors used in this study was in line with the managerial approach and it may be defined as a form of organization of the economic activities between companies. Based on the management literature on networks, the networks' activities may be split into primary activities, related to product development, and support activities, focused on managing the network's operations to enhance its effectiveness. The author's aims identifying the ways in which tourism networks carry out their primary and secondary activities by stating 5 network activities (Promotion, Product development, Booking and sale, Coordination, Selection, control and support) based on reference materials in accordance to the activities.

The empirical analysis the authors used was based on a mix method that combine quantitative and qualitative research. It was carried out from January to April 2014 on a sample of 100 tourism business networks set up in the top 20 regional destinations for tourist overnights. Network identification is based on a desk analysis of a sample of national and international business networks. The sample includes a balanced mix of homogeneous (47%) and heterogeneous networks (53%). On the activities carried out by the network, support activities are present in the 100% of the sample, while primary activities show different frequencies. Promotion is a key activity, always present in tourism networks and in some cases, it is the reason why they have been set up. Product development is quite present (82%), while booking and sales is carried out only by the 32% of the sample.

In their qualitative analysis the authors analyze the ways networks carry out primary and support activities and suggested the existence of three levels of maturity corresponding to growing levels of ability (elementary, intermediate, evolved) in carrying out operations. The authors noticed that, advanced promotion activities generate for network members both "process and economic advantages" due to promotion cost optimization and a greater brand visibility. Besides, they generate "advantages of brand/ land identity" as they increase the

customers' perception of the unique features of the product, also in relation to the territory. As for the support activities, if carried out with high levels of sophistication, they guarantee an efficient and effective network operations in the long term, which is a necessary condition for the development of the primary activities.

The third work conducted related to maturity assessment is by (Schumachera, Erolb and Sihn, 2016). In this work the authors propose an empirically grounded novel model and its implementation to assess the Industry 4.0 maturity of industrial enterprises in the domain of discrete manufacturing. They give emphasis on recently developed models including organizational aspects. Then, the model has been transformed into a practical tool and used to test several companies after validations of the model structure and it's shown the model is transparent and proved its applicability in real production environments.

Industry 4.0 refers to recent technological advances where the internet and supporting technologies (e.g. embedded systems) serve as a backbone to integrate physical objects, human actors, intelligent machines, production lines and processes across organizational boundaries to form a new kind of intelligent, networked and agile value chain. The recent environmental, societal, economic and technological changes lead manufacturing companies of the future to need increased capabilities for managing their whole value-chain in an agile and responsive manner. Experiences from several strategic orientation workshops with various companies have shown that companies have serious problems to grasp the overall idea of Industry 4.0 and concepts hereof. To overcome growing uncertainty and dissatisfaction in manufacturing companies regarding the idea of Industry 4.0, the authors propose new methods and tools to provide guidance and support to align business strategies and operations.

The framework methodology the authors used to develop their model is based on Becker's step-by-step process for the development of maturity models. A multi-methodological development approach was carried out including a systematic literature research and review, expert interviews, conceptual modelling, and validations as well as testing of the new model in the field. Their development procedure includes three distinct phases. An initial phase to create complete understanding of the domain of Industry 4.0, a core development phase to design and architect the model's structure as well as a practically applicable tool and an implementation phase to validate the resulting tool in real life application. Semi-structured interviews conducted with practitioners and researchers assisted at determining the underlying problem and experts interviewed (duration of around 60 min following pre-

defined open questions) supported their initial assumptions regarding the problems when implementing Industry 4.0 in practice. In the next step, the authors compare existing models in other domains to gain a design strategy where the basic architecture of already successfully tested assessment tools as a starting point for designing their new model.

They considered 72 works on maturity and derived concepts relevant for the structure of our model, e.g.: the maturity levels (commonly 5 levels whereby 1 is the lowest), the dimensions (maturity assessed in 4 to 16 dimensions). The mode of assessment (self-assessment or through external auditor) or the mode of representation (numerical representation commonly visualized using radar charts). In phase two of the development procedure the overall design of the model, the maturity items as well as maturity levels and their characteristics were defined. The authors defined a total of 62 maturity items that are unequally grouped into nine organizational dimensions. The third phase contained transformation of the model into a practically usable tool and the conceptualization of an adequate media for distribution. Finally, the authors employed the assessment tool in two industrial enterprises to validate it for real-life application.

To test the practical usability of their model, the authors conducted a case study within an Austrian manufacturing enterprise with around 400 employees. The company received a questionnaire per e-mail to allow for reflected assessment of their internal situation on their own time. The Maturity level (MD), of each dimension results from calculating the weighted average of all maturity items (*MDI*i) within its related dimension. The weighting factor (*gDIi*) equals the average importance rating from all experts for each item. The response then was inserted into the software tool to calculate the maturity levels and to create the maturity report. A radar chart is used to depict the overall result at-a-glance.as an example the assessment and calculation of the dimension named "Strategy" is resulted in level 2.7 out of 5 is the lowest rating of all nine dimensions. It is caused mainly by the missing "utilization of an Industry 4.0 roadmap" as well as missing "communication and documentation of Industry 4.0 activities" Future research activities will mainly aim at a method to identify company-specific target states, improved accuracy of the maturity items as well as defining strategic steps to reach the indented maturity levels.

On the fourth work done by (Maasouman and Demirli, 2015), Their study is slightly like the previous work. but it is different in a way that their work is more domain specific for manufacturing maturity assessment. The authors developed a data driven operational level lean maturity model. Then it is used to assess the level of lean in seven axes of lean

manufacturing industries. A case study is carried out for gathering data of analysis and explanatory study of results. The focus of their study was on descriptive analysis and explaining the relationships and outcomes (Yin, 2003). The units of analysis are the MCs of a manufacturing company. The main lean control items are the elements of analysis. A conceptual model is developed based on the review of literature.

The authors developed a conceptual model based on the qualitative and quantitative findings of literatures they had reviewed and tailored to the operational level in the following two steps.

Maturity levels (4): characteristics of maturity models are applied considering change management principles and evolution concept of lean manufacturing. (Focus of level, expected level of implementation, expected level of results constitute the maturity levels). Maturity axes (7): balanced development of lean concept is very important and it's necessary to evaluate the progress of lean manufacturing in each axis. The authors used the concept of 5M's from lean lexicon, manufacturing resources can be classified into Man, Machine, Material, Method and Milieu (Environment). The authors customized and arranged the 5M's for the best possible outcomes. Leanness indicators are defined for each axis of LMM in the form of guidelines. Based on the specifications of each axis and characteristics of each level, leanness indicators in each axis-level of LMM are defined and main control items are added as a guideline to better understand indicators.

The authors developed Checklists as a data collection instrument containing several questions. (To identify leanness indicators) For each question, a 4- grades scoring system is used. (0 is assigned for absence of implementation and score 5 was given for complete accomplishment of an items requirement) of each lean indicator. Leanness of each item is calculated on a scale of 0 to 1. finally, overall leanness of each MC (manufacturing cells) is suggested as the minimum of overall leanness between seven axes of LMM. Form the collected checklists, leanness of each lean indicator is calculated on a scale of 0 to 1. Finally, overall leanness of each MCs is suggested as the minimum of overall leanness between seven axes of LMM. Considering both the validity of results and time factor, the theoretical validity of model initially is examined by comparing its elements with general design principles of maturity models. The model is also validated practically in an industry scenario. Two MCs of the case study are selected based on the different times they had started implementing lean manufacturing.

Leanness indicators of each axis are first calculated. As an Example, 3, 5 and 1 forms the code *L351* which correspond to the first indicator of axis 5 (Axis Quality) in level 3. Results of leanness indicators for the axes of People and Facilities in levels 1 and 2 obtained through audits and observation of MC1 are summarized.

Overall leanness of each maturity level is calculated (LLi).

Overall leanness of each maturity axis is calculated (LAj)

Overall leanness of manufacturing cell is calculated (L): minimum of leanness between all axes (minimum of LAjs) is suggested as the indication of overall leanness in a MC. On the analysis result the authors found, Good progress was made to achieve the leanness objectives in level 1 and level 2. However, there are still some activities to be done in the axes "Facilities" and "Leadership", in which the leanness index at Level 1 is 0.70 and 0.85, respectively. The overall leanness of MC1 is 0.70. However, it should also be noted that overall leanness measure L is on a scale of 0 to 4.

The fifth additional work conducted related to digital maturity is the study done by (Kyriakidou, Michalakelis and Sphicopoulos, 2013). The researchers try to analyze the level of ICT maturity level form 159 developed and developing countries. The clustering is done based on the calculation of GNI per capita for each of countries. They used a two-year data for 2007 and 2008 for the analysis. On their study the authors try to reveal the causes driving ICT adoption and their impact and importance and the barrios or drivers to their development.

The authors used ICT development index which is introduced by ITU (2009b) that works by taking the simple average of the normalized weight values and by summing up the sub – indices and their relative indicators. The methodology used in their study was structural equation modeling (SEM), a technique that combines the benefits of. multiple regression and Principal component analysis. SEM allows to decide the set of variables that will explain a specific latent variable as well as which paths of relationship by between observed and latent variables should be investigated by the model and which are not. The first phase of the SEM allows the identification of latent variables or constructs that can better explain the various relationships. The second phase corresponds the testing of several possible models. SEM help in estimating many important latent variables with only a single observed measurement. SEM methodology also allows the concurrent construction of flexible assumptions and estimation

of correlations between considered parameters. It also provides exploratory factor analysis and a confirmatory analysis as well.

In the application of SEM first, the authors developed conceptual model. Acceptance or rejection of the model depends on the several goodness of fit measures. Thus, results validation is activated by the comparative fir index CFI, IFI, TLI, RMSEA. In line with the authors defined three maturity level elements that are, Access (A1-A5), Use (U1-U3) and Skills (S1-S3). In the context of SEM these elements are the latent variables, described by several observed factors. Their model is based on four major hypotheses.

1. Link between GNI per capita and ICT maturity: it has an important ICT adoption and its impact seems different between developed and developing countries.
2. ICT maturity level related with access: access related to basic wire line and cellular components. Quality of service in bandwidth per user and network operators tend to upgrade their capacity to satisfy their customers.
3. ICT maturity is related with use: fixed and mobile broadband usage are both considered, and they must meet the needs of end user's requirements.
4. ICT maturity level is related with skills: a low education level could be a barrier to technological adoption.

The sub-indices are described by a few observed indicators and the indicators variability in the dataset reached 99% based on ITU, 2009b. The GNI per capita and the indicators of the three sub-indices are observed variables whose values were extracted form ITU and the World Bank. The implementation of the proposed model was performed by using ordinary least squares (OLS). According to World Bank countries are grouped into developed and developing based on their income level.

The IMLI (ICT maturity level index) is calculated for each country by using SEM approach. The weights provided by the proposed model are in generally quite different for the two countries. The developed conceptual model provides good fit to the data and goodness of fit indices above accepted threshold for both countries.

On their result discussion, in developing countries the lack of education remains an obstacle for ICT development and access remains the most important element related with ICT maturity level. On the other hand, the analysis reveals that basic infrastructures, such as telephone lines (A1) and computer possession (A4) are the dominant driving indicators for

further ICT growth in developing countries. The strong relationship between GNI per capita and IML restrict their ICT development due to their low-income level. The IMLI result for developing countries show

that the ICT maturity level of these countries doesn't increase over time. The impact of telephone lines on IML reflects the lack of required infrastructures. According to the analysis result for developed countries, Europe is the leading area regarding ICT development. In all cases IMLI values were improved in 2008. The Use element is significantly more important for developed countries. But, the importance of skills is lower. In general, developed countries improvement could indicate that developed countries enhance their ICT maturity level which is in line with ICT society.

The sixth work reviewed was (Boström and Celik, 2017) developed a maturity model that can guide companies in their work with analyzing and evaluating their digital business strategy process. To develop the maturity model, the authors conducted a literature review in combination of a multiple case study that included interviews with several managers in different organizations. Their concept of digital business strategy acknowledges the impact of newly emerging digital technologies on other functional areas within companies and accepts that IT strategy has not only implications on performance but also provides competitive advantage and strategic differentiation.

Through the literature review on IS strategy, the authors found the recent developments of alignment literature and the new phenomena of digital business strategies, they have identified three levels of maturity in which an organization can position itself: 'IT strategizing', 'Aligned strategizing', and 'Digital strategizing', which are labeled form level 1 to level 3 respectively. The authors also derived potential dimensions that can help an organization to assess their maturity. This includes Communications Maturity, Value Measurement Maturity, Leadership Maturity, Ecosystem Maturity, Technology Maturity and Skills Maturity.

The authors followed qualitative approach and interviews has been used as a primary source of data. They performed in-depth interviews with digital/IT strategists, business developers, IT/business managers, and IT consultants. The authors conducted in total eight interviews and initial codes were gathered across the cases and linked to the models propositions of levels and dimensions and they looked especially for interesting features or practices, which

reflected the elements of their proposed model. The dimensions included ‘Communication’, ‘Value Measurement’, ‘Leadership’, ‘Ecosystem’, ‘Technology’ and ‘Skills’.

In developing maturity models consists of eight different requirements that are adopted from design science and the seven guidelines defined by (Hevner et al., 2004)Through the literature review on IS strategy, the recent developments of alignment literature and the new phenomena of digital business strategies, they have identified three levels of maturity in which an organization can position itself: ‘IT strategizing’, ‘Aligned strategizing’, and ‘Digital strategizing’ on their chronological stages of maturity. In addition to the levels, each of the three levels focuses on dimensions that potentially can help an organization to assess their maturity. The authors derived those dimensions from Luftman’s model of business/IT alignment.

After the authors developed the maturity model of digital strategies, they demonstrated how the maturity model of digital strategies can be used to assess an organization. Through applying the model in four organizations from different industries with distinguishable competitive landscapes, they were able to assess the organization regarding the six dimensions and their level of maturity.

Lastly, (Volker, Lei, and Ligtvoet, 2011) explore the elements of capability maturity models and infrastructure asset management. Then they compare some of these existing maturity models and discuss the advantages and disadvantages of the research methods used to fill these models the authors discuss the need for an infrastructure maturity model and show the development of their infrastructure management maturity model (IM3) by using a case of a Dutch highway agency.

The authors distinguished four different kinds of domains: software, HRM, manufacturing, and management of assets and related to the second aspect that differentiated the models; the nature of the assets. For asset management purposes, the inclusion of the specificity of the assets could be important. When appraising the asset management process, the status and lifecycle path of the assets provide important input for the asset management process. The third aspect they studied were the maturity levels and their implication areas, which they identified as key process areas. The different key process areas usually include issues on a strategic level, such as leadership and policy, topics on a tactical level, such as quality management and process redesign, and issues on operational level include items such as data management, planning &scheduling or supply management. Fourthly they found differences

in the method of maturity appraisal, which related to the fifth aspect: the approach of the measurement.

The authors distinguish four forms of maturity models as follows: a maturity roadmap, maturity check, maturity matrix and a maturity model. A *maturity check* can be regarded as an appraisal, a *maturity matrix* is a structure -for example for data collection or policy planning- and a conceptual *maturity model* can be regarded as the integration of goals, levels and process areas on a conceptual level. By using a maturity model, an organization can compare the scores of the appraisal to the targets and strategic goals by using the matrix structure.

The authors develop the Infrastructure Management Maturity *Matrix* (IM^3) that could perform a maturity check. The IM^3 for road infrastructure consists of five maturity levels on the vertical axis (ad hoc, repeatable, standard, managed, optimal) and seven asset management dimensions on the horizontal axis (information management, internal coordination, external coordination, market approach, risk management, processes & roles, and culture & leadership).

Then the authors conducted interviews with all regional departments of the largest Dutch highway agency called Rijkswaterstaat which is responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. Each interviewee was asked per dimension how they would assess their own department on a scale from ad hoc to optimal. The results of the interviews were compared between departments, between interviews (tactical / operational or management level), and between the different themes. Based on the data, the researchers determined a general 'asset management maturity level' for the whole organization. This level was determined by discussing the results of the interviews, reading the strategic asset management plans, and using other kinds of background information.

2.6 Maturity models

There are various maturity model assessment tools available in information systems domain. But limited tools are available for assessing digital maturity of companies, mainly for telecom companies. Here for comparison two digital maturity models are presented. The first one is developed by (Anderson and Ellerby, 2018) it is the first industry standard maturity model assessment tool. In their model they provide five core dimensions which are further divided into 28 sub-dimensions, which in turn breakdown into 179 individual criteria on which digital

maturity is assessed. The major core dimensions are customer, strategy, technology, operations, organization, and culture. The authors believe that the developed maturity model removes the ambiguity that can result from using multiple digital assessment tools and provides a firm basis from which to set a path to reach the desired outcomes simultaneously across the business. In developing the model, they used various key contributions from other industry and subject matter experts, and the developed model was reviewed by a broad spectrum of global telco businesses.

The other digital maturity assessment model is the model developed by Omar Valdez-de-Leon. In this model development process, the scope definition of the model takes place in which the aim was to develop the digital transformation of communications service providers. the initial design began with a comprehensive review of the relevant literature, case studies from several industries, and interviews with subject matter experts. This formed the basis for the identification of set of key elements of digital transformation. The author used Delphi method to complete the model development process. The outcomes of the Delphi study included are, Strategy, Organization: Customer, Technology, Operations, Ecosystem, and Innovation. The model aims to depict the level of maturity of a communications service provider at a given point in time.

The distinguished different kinds of domain are considered. The model by Deloitte and TM forum has 5 dimensions. And the second digital maturity model developed by Oman has 7 dimensions. The comparison of two models gives an understanding that the models mainly focuses on the general dimensional elements and the applicability of each model to the specific domain is not convenient. Both of models has provided a wide company level assessment tool. But applying the tools to the specific level needs detail criteria to evaluate needs of an organization. Based on the above reasons developing domain specific maturity model considers parts of requirements that feet desired domain to better know the what the expected level will be. Here the major requirement for the development of the above reviewed and compared models are very complex and unpoint nature of the model and make it very difficult to measure and depict specific areas as is maturity.

Source/study	Purpose	Method	Sample	Outcome measures	Relevant finding
Đurek, V., Kadoić, N., & Begiče, N. (2018). Assessing the Digital Maturity Level of Higher Education Institutions. 747-752.	Propose digital Maturity Framework for Higher Education Institutions and assess the he digital maturity level (ML) of HEIs in Croatia.	Quantitative	15 systematic review	prioritizing the elements in the DMFHEI and calculating the digital ML of HEIs in Croatia	prioritizing the elements with respect to each criterion to determine the maturity level of Higher education institution which was found 0.4296
d'Angella, F., & De Carlo, M. (2017). The Maturity of Tourism Networks: An Exploratory Study. Symphonya. Emerging Issues in Management, 59-70.	To measure the maturity of tourism networks of the Italy business networks.	Mixed	A sample of 100 tourism business networks.	To introduce a taxonomy of the maturity levels of tourism network's operations.	Advanced promotion activities generate for network members both "process and economic advantages" due to promotion cost optimization and a greater brand visibility.
Schumachera, b, A., Erolb, S., & Sihn, W. (2016). A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises. Institute of Management Science, Theresianumgasse, 161-166.	Propose a model and its implementation to assess the Industry 4.0 maturity of industrial enterprises in the domain of discrete manufacturing.	Multi	72 systematic review	Assess the Maturity level of Austrian manufacturing enterprise with developed model.	the dimension named "Strategy" is resulted in level 2.7 out of 5 is the lowest rating of all nine dimensions due to missing "utilization of an Industry 4.0 roadmap".
Maasouman, A. M., & Demirli, K. (2015). Assessment of Lean Maturity Level in Manufacturing Cells. IFAC-PapersOnLine, 48(3), 1876–1881.	To develop a Lean Maturity Model adapted to the specifications of Manufacturing Cells.	Quantitative	26 systematic review	Assess the level of lean in seven axes of lean manufacturing industries.	Good progress was made to achieve the leanness objectives in level 1 and level 2. However, there are still some activities to be done in the axes "Facilities" and "Leadership
Maasouman, A. M., & Demirli, K. (2015). Assessment of Lean Maturity Level in Manufacturing Cells. IFAC-PapersOnLine, 48(3), 1876–1881.	to analyze the level of ICT maturity level developed and developing countries	Quantitative	159 developed and developing countries	Define the maturity level elements and their causal relationship across the developed and developing nations.	The Use element is significantly more important for developed countries. But, the importance of skills is lower. In developing countries, the lack of education remains an obstacle for ICT development
Boström, E., & Celik, O. C.(2017). *Towards a*	analyzing and evaluating their digital business strategy process	Qualitative	eight semi-structured interviews were	Assess the digital strategies maturity of an organization	useful tool for organizations with a highly competitive landscape

Source/study	Purpose	Method	Sample	Outcome measures	Relevant finding
Maturity Model for Digital Strategizing			conducted		
Volker, L., Lei, T. v., & Ligtvoet, A. (2011). *Developing a maturity model for infrastructural asset management systems*	develop infrastructure management maturity model (IM^3) by using a case of a Dutch highway agency	Qualitative	20 interviews performed	Assessed and determined a general 'asset management maturity level	Maturity models can help develop or change their asset management processes

Table 2. 3 Literature Review Summary

Chapter Three

3. Methodology

3.1 Research Methods and Methodology

The word research is composed of two syllables, re and search. The prefix “re” means a new or over again and the verb “search” means to understand, to investigate or to seek out. The term research refers to a process of systematic, methodical, and ethical steps to solve a problem, to understand a phenomenon, to answer a question or to establish facts (Neville, 2007).

Research methods include all the techniques and methods which have been taken for conducting research whereas research methodology is the approach in which research troubles are solved thoroughly. And the scientific approach which is adopted for conducting a research is called methodology (Mishra and Alok, 2017).

3.2 Design science methodology

Design science research is sometimes called “improvement research” and this designation emphasizes the problem- solving (performance improvement) the activity (Vaishnavi & Kuechler, 2015). Design science, as the other side of the IS research cycle, creates and evaluates IT artifacts intended to solve identified organizational problems (Hevner, March, Park, & Ram, 2004). In Design Science, the relationship between people, practice and problems is explored from several viewpoints with the aim of creating an artefact for solving life issues (johannesson & perjons, 2012).

There are different types of world views of maturity models depending on the purpose of use and motivation behind its development. One of the world views portrays maturity model as a practical benchmarking tool, wherein organizations are classified and compared against each other using a scale of low to high maturity (Luftman, 2000). This research paper also gives emphases on developing a maturity model to use as a benchmark for self-assessment for the mentioned sectors.

(Bruin, Kulkami, Freez, and Roseman, 2005) described the importance of a standard development framework is emphasized when considering the purpose for which a model may be applied including whether the resulting maturity assessment is descriptive, prescriptive or comparative in nature. If a model is purely descriptive, the application of the model would be single point encounters with no provision for improving maturity or providing relationships

to performance. This type of model is good for assessing the here-and-now i.e. the as-is situation. A prescriptive model provides emphasis on the domain relationships to business performance and indicates how to approach maturity improvement to positively affect business value i.e. enables the development of a roadmap for improvement. A comparative model enables benchmarking across industries or regions. The main purpose of this maturity model is descriptive application specific.

Figure 3. 1 General Model Development Phases

(Bruin et al., 2005)

The output of a design science project should be a design science knowledge. design science knowledge can be in the form of artifact-constructs, models, frameworks, architectures, design principles, methods and/or instantiations and design theories (Vaishnavi & Kuechler, 2015). Design science is inherently iterative. The search for the best, or optimal, design is often intractable for realistic information systems problems (Hevner et al., 2004). The first step in the application of design science methodology is the awareness of the problem context through problem identification. the problem definition will be used to develop an artifact that can effectively provide a solution. In this process, the researcher identifies the problem and studies a number of materials in the area of digital maturity. On this process, the researcher realizes that the term "maturity" is not a new concept but, "Digital maturity" is an emerging term that attracts industries mostly tech oriented ones. Telecommunications service providers are the first lines that holds the maturity process digitally. In the process, the aspect, in which identified as important that has to be improved was selected as a problem area. Thus, in this step, the researcher informed by the existing gap in the current operation of the company, believing network and security sections are both the core backbone of the service.

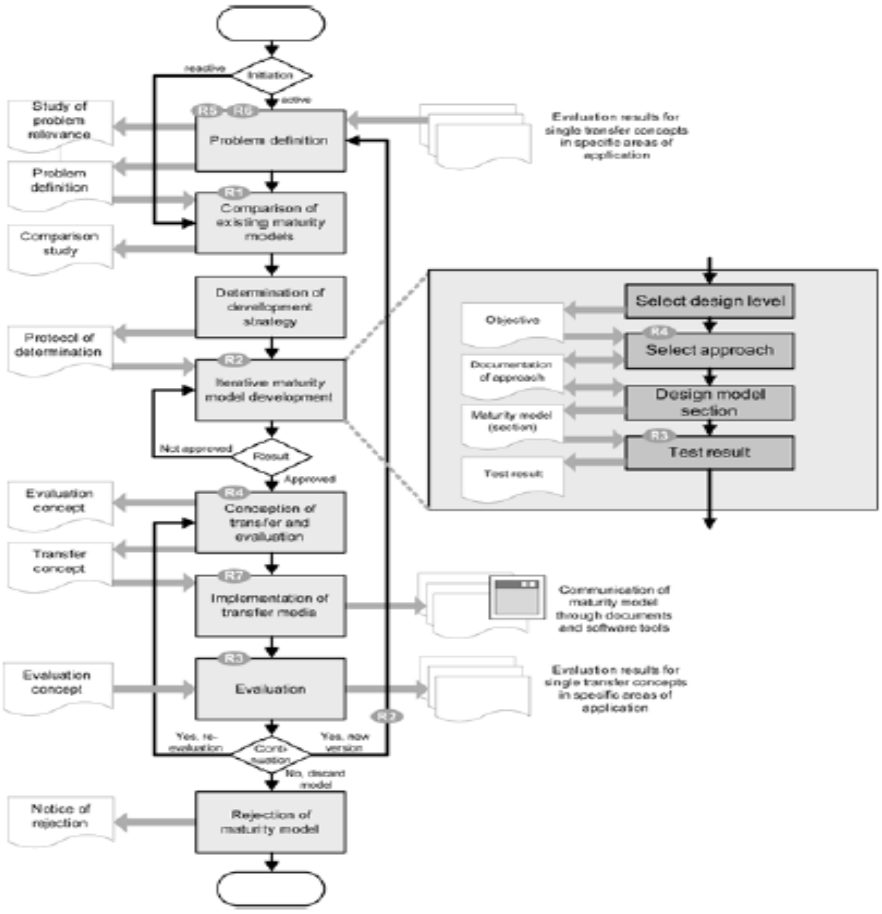

Figure 3. 2 Procedure Model for Developing Maturity Models

(Becker, Knackstedt, & Pöppelbuß, 2009)

In the next step combined analysis (quantitative and qualitative) was conducted to answer the research questions. Developing maturity models by conducting design-oriented research means finding solution patterns for important unsolved problems or giving advice in solving problems in more effective or efficient ways (Hevner et al. 2004).

Dimensions that are identified in the problem area taken as the bases for the development phase. This is the stage where the actual model development takes place. In this step the DMM specific to those sections and the major stage of development for each stage of maturity was developed. On the analysis part of the model development, the researcher identifies the needed dimensions and specific attributes for the process activity. The selected dimensions extracted from each of the analysis step result. Then the researcher enumerated the specific attributes for each the needed dimensions. The maturity levels are often labeled relative to a "state" or "step" in the progression. (Lasrado, Vatrapu, & Andersen, 2015)

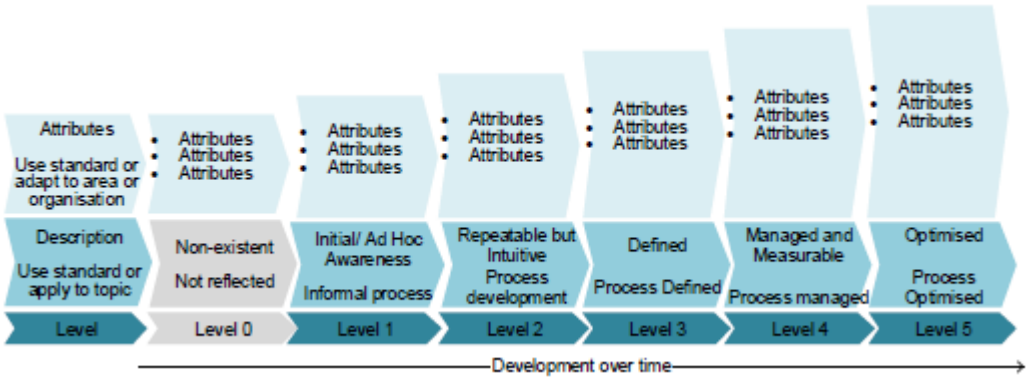

Figure 3. 3 Maturity Model Framework

(Westerlund, 2016)

The iterative maturity model development is the central phase of the procedure model. Based on this, the activities or states that best represent the dimensions developed using iterative consolidation of indicators (indicated by buckler). The states that are continually evolving until the last stage development, which is briefly described in chapter 5.

The next most important step in the development of maturity model is evaluation. It is the step the result is tested against comprehensiveness, consistency, and problem adequacy. Selection of the different forms that the targeted communication of the maturity model can take. Besides the widespread publication of document-based check lists and manuals, software-tool supported accessibility of the maturity model (e. g. via internet) offers another alternative.

3.3 Research design

Case study research focuses on a specific event, person, place, thing, organization, or unit. (Schoch, 2020). Case study research offers benefits in terms of process and outcome. The case study design helps to focus within confined space and time on a specific case. it also gives an opportunity to collect various kinds of data. Such as interviews, observations and others about the case and provides with in-depth look at an organization practices and working interactions of individuals of that organizations. The case study design in this research helps to provide a comprehensive understanding of the identified bounded unit and to apply the practices and principles learned from the case. Case study and mixed methods research are not separate entities but rather the boundary between them is permeable and fluid allowing each to either support or lead in a research endeavor (Carolan, Forbat, & Smith , 2016).

Giving a problem context, it helps to look in-depth for a specific case, which is also the aim of these research that is to analyze the identified problem extensively with in the defined boundary (the two sectors). Additionally, the process and outcome oriented nature of case study research supports to select process elements and incorporate it into a design process to develop a comprehensive design output.

Creswell (2014) defines mixed design as a technique to inquiry involving both quantitative and qualitative data collection, integrating the two forms of data, and using distinct designs that may involve the above philosophical assumptions and theoretical frameworks. Data collection and analysis for this study was conducted using mixed design. It involves combining or integration of qualitative and quantitative data in a research study.

In designing the research, explanatory sequential mixed design is used. According to Creswell (2014) explanatory sequential mixed design is the one in which the researcher first conducts quantitative analysis, analyzes the results, and then builds on the results to explain them in more detail with qualitative analysis. It is considered explanatory because the initial quantitative data results are explained further with the qualitative data. It is considered sequential because the initial quantitative phase is followed by the qualitative phase. This type of design is popular in fields with a strong quantitative orientation.

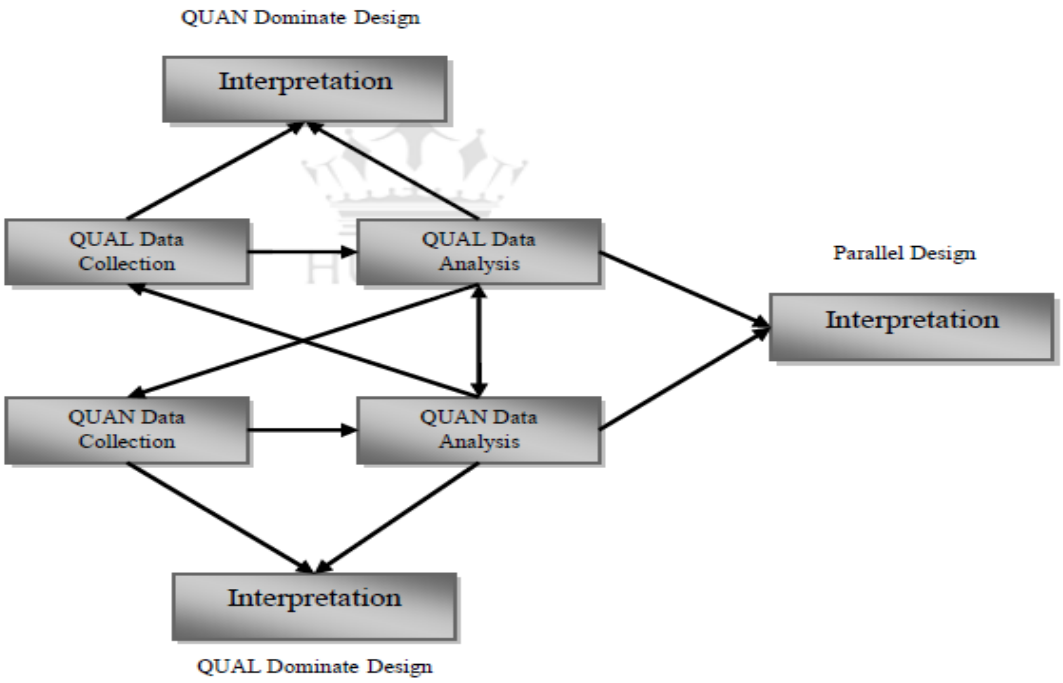

Figure 3. 4 The Three Types of Mixed Research

(Askarzal and Unhelkar, 2017)

The general model used in this study is the model provided by Omar Valdez-de-Leon. The model describes the seven dimensions and their respective characteristics to define each level of maturity. This model is selected because it provides characteristics on each dimension's stage of development which gives a foundation to develop questionnaires for quantitative analysis. It is used as the general guideline to further identify specific criterion questionnaires that are aligned with the given seven dimensions. Through conducting this study complementary criteria are added with the corresponding dimensions defined in the model below shown in Figure 3.2. The figure shows the digital maturity dimensions along with the expected core values of each dimension.

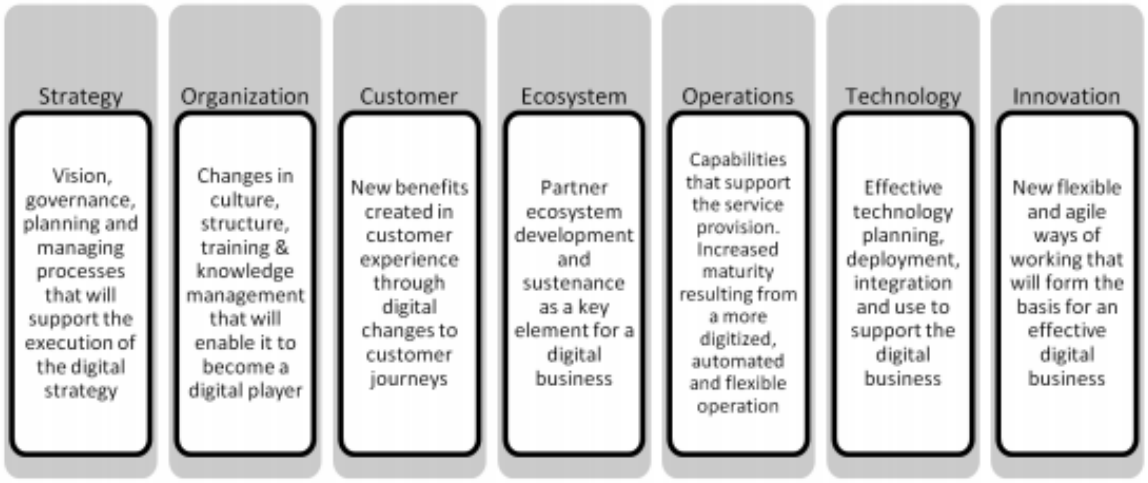

Figure 3. 5 Seven Dimentions of Digital Maturity Model for Telecom Service Providers

(Omar Valdez-de-Leon, 2016)

3.4 Philosophical Worldviews

(Creswell 2014) explains about the philosophical assumption (world view) researchers explain why they choose the qualitative, quantitative, or mixed methods approaches. According to his definition worldviews are a general philosophical orientation about the world and the nature of research that a researcher brings to a study. Below is a definition of basic ideas of worldview that researchers bring to inquiry.

1. The post positivist worldview: this world view holds a deterministic philosophy in which causes probably determine effects or outcomes. The problems studied by post positivist reflect the need to identify and assess the causes that influence outcomes. It is common world view for quantitative research approach.

2. The constructivist worldview: in this world view individuals seek understanding of the world they live and work. Here individuals develop subjective meanings of their experiences. It is typically seen as an approach to qualitative research.
3. The transformative worldview: this position arouses from individuals who felt that the post positivist assumptions imposed structural laws and theories that did not fit marginalized individuals and societies. It holds that research inquiry needs to be intertwined with politics and a political change agenda to confront social oppression at whatever levels it occurs.
4. The pragmatic worldview: this world view arises out of actions, situations, and consequences rather than antecedent conditions. Pragmatism is not committed to any one system of philosophy and reality. This applies to mixed methods research in that inquirers draw liberally from both quantitative and qualitative assumptions when they engage in their research.

Here in this research the pragmatic world view assumption is followed. This assumption allows to accentuate the research problem and to use all available approach to understand the problem. it also opens the door to multiple methods and follow different forms of data collection and analysis. For this study, it creates a convenience way to collect different forms of data to better analyze the research problem and to answer the research question.

3.5 Sampling design and target population

Mixed method sampling techniques are often appropriate for mixed methods studies that incorporate both goals of generalizability of research findings and in-depth understanding of the research context (Mobley, Stringfield, Withington, & Stipanovic, 2012).

The target population for this study is professionals under the network and security domain which consist of 6 network and 4 security sections. The sampling frame for the study is the network and security sections separated employee database. The total number of sample population under the two sectors is 400. The criteria to select this sample population are because the defined population can best suit to analyze the problem domain. Probability Sampling Techniques are used for selecting a representative population for quantitative part and stratified sampling technique applied to divide the total population in to sub population based on their technology category. This sampling technique allows having various sample representatives in the population. Using strata, independent simple random sample was drawn

from each of selected stratum. Mixed method sampling process is depicted in the below diagram.

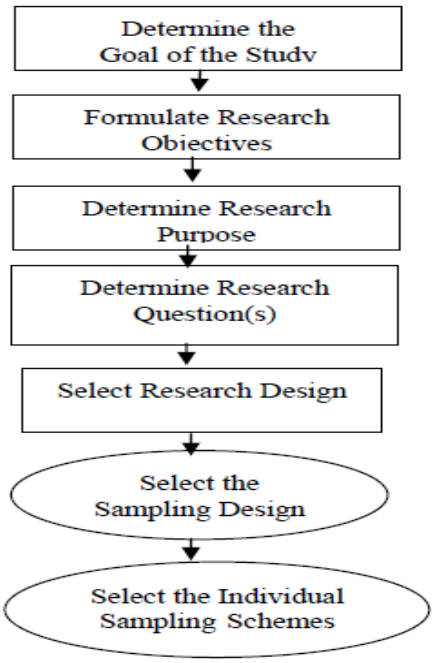

Figure 3. 6 Steps in The Mixed Method Sampling Process

(Onwuegbuzie and Collins, 2007)

If the mixed methods purpose is development, then sequential designs are appropriate because development involves using the methods sequentially, such that the findings from the first method inform the use of the second method (Onwuegbuzie & Collins, 2007). In this method explanatory mixed method design was followed in which initially the quantitative data collected and then the qualitative phase followed to more explain further with earlier result.

During the selection of the sample size three basic considerations are seen as important. The first the margin of error (the level of precision) which means the level of acceptable risk level that is normally 5% in Information system research. The second is the level of confidence that the results revealed by the case study findings are accurate that means the degree to which the researcher can be sure the characteristics of the population have been accurately estimated by the sample case study. A 95 percent level of confidence applied, implies that 95 out of 100 samples will have the true population value within the margin of error 5% specified. The appropriate sample size for the population size 400 is determined in the above table is 196 with indicated margin of error and level of confidence. but since the researcher used stratified sampling techniques for the defined strata, by taking 10 to 15 from each of the

strata makes a total of 130 sample size were considered optimal and could provide enough information required.

	Variance of the population P=50%		
	Confidence level=95% *Margin of error*		
Population Size	5	3	1
50	44	48	50
75	63	70	74
100	79	91	99
150	108	132	148
200	132	168	196
250	151	203	244
300	168	234	291
400	196	291	384
500	217	340	475
600	234	384	565
700	248	423	652
800	260	457	738
1000	278	516	906
1500	306	624	1297
2000	322	696	1655
3000	341	787	2286
5000	357	879	3288
10000	370	964	4899

Table 3. 1 Sample Size Based On Desired Accuracy

(Gill et al., 2010)

For qualitative section, nonprobability sampling techniques and purposive or judgmental Sampling technique is used to get experienced and skilled populations in the sample. The technique involves selecting a sample based on a specific purpose rather than randomly. As it is explained in the study design part, the sequential sampling design followed gradual sampling principle of selecting samples evolves of its own accord as data are being collected and relevance to address the research questions.

Purposive or judgmental sampling is the more acceptable sampling procedure for qualitative research, particularly, when it involves selecting participant for special situations. This sampling procedure uses the judgment of an expert in selecting cases or the researcher selects cases with a specific purpose in mind. Purposive sampling is useful for case study in three situations: (1) when a researcher wants to select unique cases that are especially informative,

(2) when a researcher would like to select members of a difficult-to-reach, specialized population (Ishak & Abu Bakar, 2014).

Qualitative research experts argue that there is no straightforward answer to the question of 'how many 'and that sample size is contingent on a number of factors relating to epistemological, methodological and practical issues. Samples in qualitative inquiry tend to be small in order to support the depth of case-oriented analysis. As the research follows quantitative dominant analysis technique and looks to support and get a full understanding using this analysis, the researcher preferred the sample to be small to get richly textured information on the case raised. it is determined by the concept of data saturation. (Grady, 1998) describes data saturation as the point at which:

> *New data tend to be redundant of data already collected. In interviews, when the researcher begins to hear the same comments again and again, data saturation is being reached …It is then time to stop collecting information and to start analyzing what has collected.*

Since the research question is very specific, it needs to investigate the informant's opinion to get precise and reach information to answer the research question. And, the individual participants are knowledgeable and have a potential to provide enough data. The researcher believes, saturation will be achieved using 9 participants having a desired level of data collection.

3.6 Methods of data collection

There are various types of data collection used in research studies. In this research two distinct phases data collection methods. In the first phase semi- structured were used along with different documents and reports and in the second phase one to one interview has been conducted.

3.6.1 Questionnaire Development

The case study questionnaire was developed based on particularly Omar Valdez-de-Leon model and items in the existing instruments were adapted and some domain area questions has been added to address specific as is situation regarding the sector's services.

The second step next to the development of questionnaire was piloting the prepared items. Conducting a pilot study provides the researcher with the opportunity to develop and enhance the skills necessary before commencing the larger study (Doody & Doody, 2015). Pilot studies are

commonly associated with quantitative approach to test of a research instrument. Apparently, the importance of pilot work has been expanded to qualitative inquiry where it is carried out as preparation for the major study (Abdul Majid, Mohamad, Mohhidin , & Lim, 2017). Piloting semi-structured questionnaires has been administered with 10 experts for the reliability of the study. Based on the given feedback, some refinement has been made and after the accepted level of goodness is reached, the semi-structured questionnaires are prepared and distributed to the sampled population.

There are four data measurement scales that are mainly used in research: nominal, ordinal, interval, and ratio. Nominal scales are used to label variables, without any quantitative value. Nominal scale indicates the difference of the variable but does not indicate the magnitude of the difference and order. With ordinal scales, it is the order the values are what is important or significant (Sekaran & Bougie, 2010) pointed out that the ordinal scale not only categorizes the variables in such a way as to denote differences among the various categories, it also ranks orders the categories in some meaningful way. The ordinal level of measurement is used when the observations are organized in categories that are ranked or ordered. The interval scales are numeric scales in which we know the order, but also the exact differences between the values. Compared to nominal and ordinal scales, the interval scale allows a researcher to interpret the data in terms of the order of scaled scores as well as the distance between them. Interval scales are used when the distance between observations is measurable, equal, and ordinal, but a true zero point is unnecessary. Also, they pointed out that a ratio scale ranks observations, contains equal and meaningful intervals, and has a true zero point. Ratio scales are the ultimate nirvana when it comes to measurement scales because they tell us about the order and the exact value between units. They also have an absolute zero -which allows for a wide range of both descriptive and inferential statistics to be applied. In administering semi-structured questionnaires', the questions regarding respondent's educational qualification, specific divisions were included, and Likert type scale questions are used to rate from 1 to 5. (Cooper and Schindler, 2003) noted that the goal of measurement (assigning numbers to empirical events in compliance with a set of rules) is to provide the highest. Researcher assigned numbers to the items which were included in the questionnaire as: Strongly Disagree (01), Disagree (02), Slightly Disagree (03), Neither Agree nor Disagree Agree (04), and Strongly Agree (05).

3.6.2 Interview process

Interviews are the main quantitative research techniques which involves exploring of ideas and perspectives with small number of respondents on an area or situation. There are three different formats of interviews: structured, semi-structured and unstructured. Structured interviews consist of a series of pre-determined questions that all interviewees answer in the same order. Interviewers ask questions with fixed choices in standardized manner. Whereas Unstructured interviews, no questions are prepared prior to the interview and data collection is conducted in an informal manner. In semi-structured interviews it contains the components of both, structured and unstructured interviews. In semi-structured interviews, interviewer prepares a set of same questions to be answered by all interviewees. At the same time, additional questions might be asked during interviews to clarify and/or further expand certain issues. (Batmanabane & Kfouri, 2017). Another important element to the interview preparation is the implementation of a pilot test. The pilot test will assist the research in determining if there are flaws, limitations, or other weaknesses within the interview design and will allow a researcher to make necessary revisions prior to the implementation of the study (Kvale, 2007). In this case study qualitative data collection part,9 semi-structured interviews have been prepared and administered for the selected managers and specialists of the company. Prior to the main interview pilot interviews were conducted to test the interview format, structure of questions and to correct possible flaws observed during the preparation of the interview session. The main interviews were 25-30 minutes long. The first section discussed about leadership practices and perceptions, the second their problem-solving experiences in relation to knowledge sharing practice and third the intersection between the two concepts in relation to the quantitative findings. Substantial time was given to the interviewees to allow for reflected and comprehensive answers as noticed from the pilot interviews.

Chapter Four

4. Data collection and Analysis

4.1 Introduction

This chapter presents the quantitative results of this study with the goal of assessing the level of digital maturity within Ethio-telecom Network and security Sectors. Here in the analysis both network and security data sets are analyzed and separate question items for each of the sections is collected to specifically understand their weak aspects and to propose improvement directions.

4.2 Quantitative analysis

4.2.1 Population description

The sample of respondents completing the digital maturity assessment consisted of 117 valid cases out of 130 distributed papers. Out of the distributed questionnaires 5 of them were not filled and the rest 8 papers were not given back to the researcher. Ignoring the response questionnaires, the rest 117 valid questionnaires were used for analysis. Out of the collected paper, 89 workers were under Network division and the other 28 were workers under Information Security. Also, out of the 117-total number of populations, professional under Network domain were represented with the most representation and the rest of the population were under the IS domain. In the demographic data collection, master's degree holders had the highest representation and bachelors and associate degree holders were second and third, respectively.

4.2.2 Evaluation of measurement test

Cronbach's alpha is the most used measure of internal consistency to ensure the reliability of the quantitative analysis. It is a measure of internal consistency, that is, how closely related a set of items are as a group. A general accepted rule is that Cronbach's alpha 0.6-0.7 indicates an acceptable level of reliability with a minimum threshold of 0.7, testing reliability. In this quantitative analysis 0.82 composite reliability is attained which is an acceptable level of reliability analysis.

Response Rate and Respondents' Profile

Analysis of the Data Based on the result of the questionnaire case study and interview result is presented. Table 4.1 summarizes the profile of the company and the professionals under the company involved in the study. Among the sectors who participated in the study,76.1% of

them are under the network sector and the remaining 23.9 % are under the information security sector. which implies that participants included in the study have a proportional amount of participation according to the population size of the sectors involved in the case study. In analyzing the questionnaire, the researcher uses the first three highest scores for what respondents think for the level of maturity on the given items. And the three lowest scores used to further analysis on the gap existed on the respective dimensions and to extend the observed weakness for the development of domain-specific digital maturity model.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Network	89	76.1	76.1	76.1
	IS	28	23.9	23.9	100.0
	Total	117	100.0	100.0	

Table 4. 1 General Respondents' Profile

Respondents' Educational Qualifications

Among the participants, 44.4 % of them have beyond first degree and 38.5 % and 14.5% of the participant have a bachelor's degree and Associate degree, respectively. Moreover, advanced diploma holders comprise 2.6% percent of the participants. Table 4.2 summarizes the participant's educational qualification in the case study.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Advanced diploma	3	2.6	2.6	2.6
	Associate degree	17	14.5	14.5	17.1
	Bachelor's degree	45	38.5	38.5	55.6
	Master's degree	52	44.4	44.4	100.0
	Total	117	100.0	100.0	

Table 4. 2 Respondents Educational Qualification

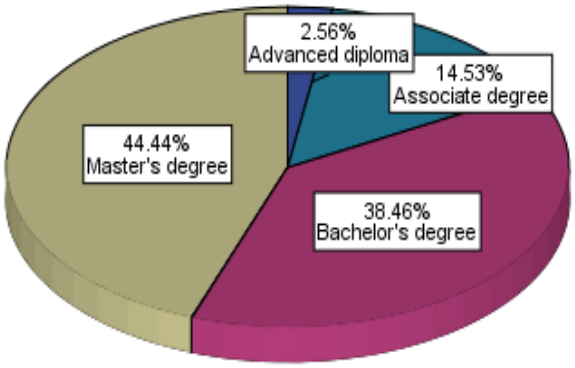

Figure 4. 1 Respondents' Educational Qualifications

Furthermore, the position of the respondents within the company was also provided (see Table 4.3). Among the respondents, 48.7 %, 22.2 %, 10.3%, of them were found to be specialists, analysts, engineers, and technicians respectively in the company, Advanced specialists and Experts hold the 6.8% and 1.7% of the total participants.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Technician	12	10.3	10.3	10.3
	Engineer	12	10.3	10.3	20.5
	Specialist	57	48.7	48.7	69.2
	Analyst	26	22.2	22.2	91.5
	Advanced specialist	8	6.8	6.8	98.3
	Expert	2	1.7	1.7	100.0
	Total	117	100.0	100.0	

Table 4. 3 Expertise Level of The Respondents

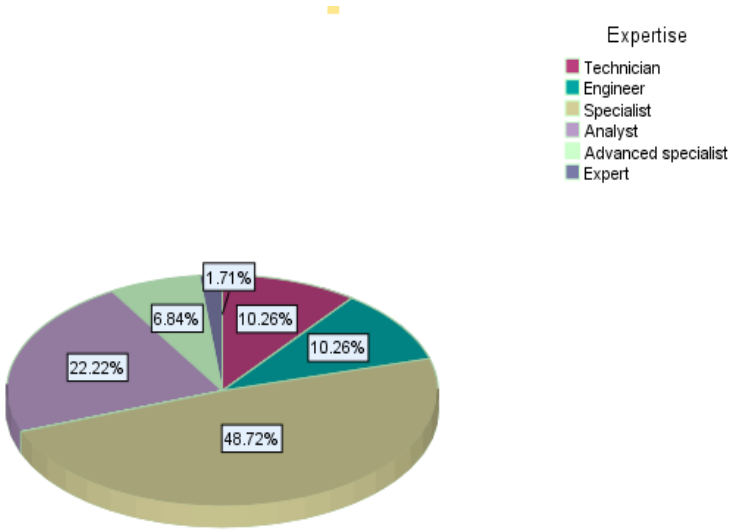

Figure 4. 2 Expertise level of the Respondents

4.2.3 An assessment result of the case study

In assessing, the maturity level for Ethio-telecom network and security sectors the researcher uses three data sets which comprise questions related to both sectors and independent questions for each of the sectors. General ratings on the overall dimensions of the provided questionnaire used as an input to further explain what specific dimension weaknesses exists and on what extent. Most of the respondents work in technically oriented roles.

Among the case study participants, 41% low rating for the question, "the organization is focused on digital innovation" followed by 35% of the respondents rated lowest regarding the practices of selecting experts to bring needed skills in teams. 29.9 % (limited) of the respondent's rated the organization digital initiatives programs did not incorporate people from several functions and departments. On the other side, the respondents rated 48.8% that the organization understands the need for digital transformation and has the vision to drive change towards a digitally savvy workforce.

Of the respondents in the innovation dimension, 42.7% say that division is in an early stage in breaking new ground for establishing an innovation process that is new to the industry. For metrics and key performance indicators implementation specific to digital innovation was given 38.5 lower rates.

Lastly, clearly defined process and performance metrics implementation in new digital services was given 39.4% early and limited stage. The most popular response (70.9%) was given for the need to develop a more agile and innovation company with some resistance (31.9% moderate) response.

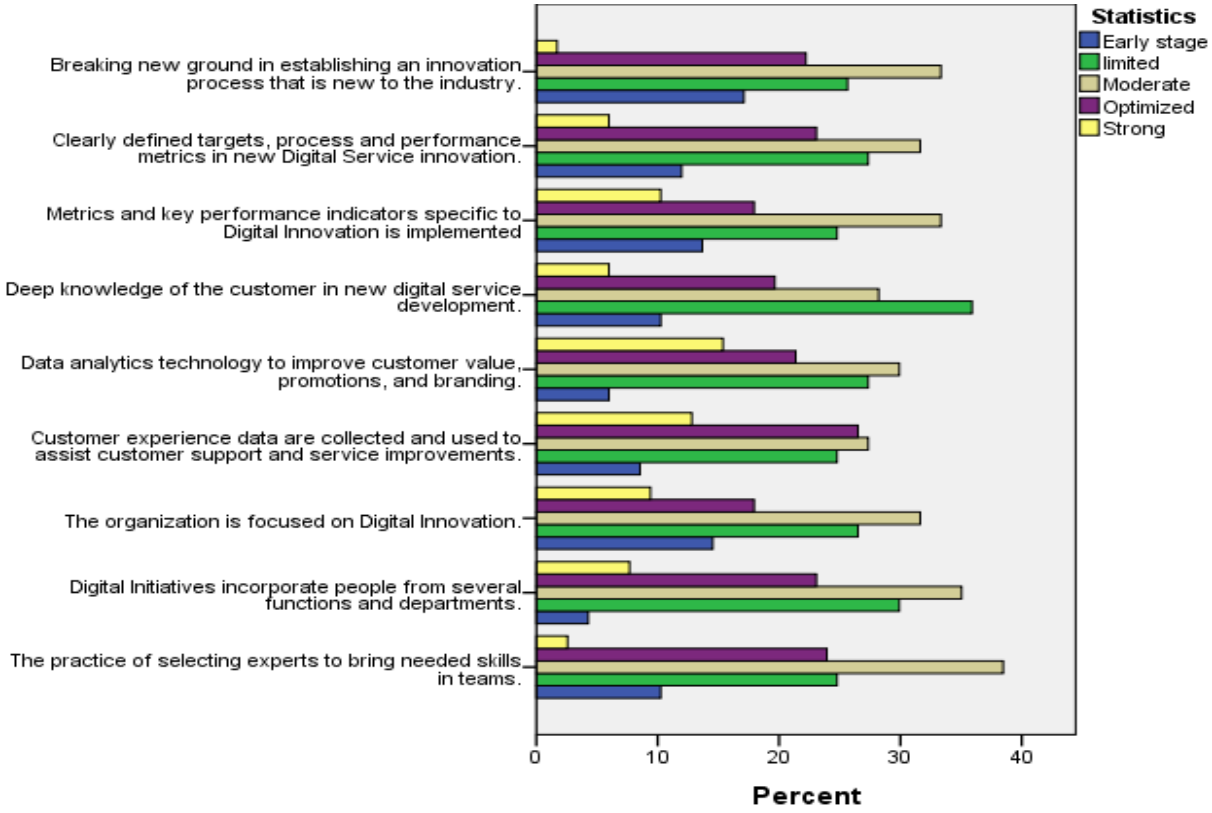

Figure 4. 3 Organization, and Innovation challenges

4.2.3.1 Data analysis for the network data set

From the respondents of the technology dimension,39.8 % comprises real-time data processing for proactive decision making across the division as early stage and limited. 38.6 % of answer if processes across the division are aligned to their high-level IT plans are rated as early and limited. lastly, the question for the use of big data analytics for optimizing services and process rated as 36.4% in its early and limited stage.

From the respondents on the operation dimension,42% responses were the as early and limited stage for the application of advanced analytics for service assurance improvements. Secondly, 40.9% of the respondents said the automation of the end-to-end process to support digital services is in its early and limited stage. At last, 35.3% said automated processes are optimization is in its early and limited stage to improve service efficiency. The overall

response on the technology dimension gives as a significant core aspect that must be focused to foster technological improvements.

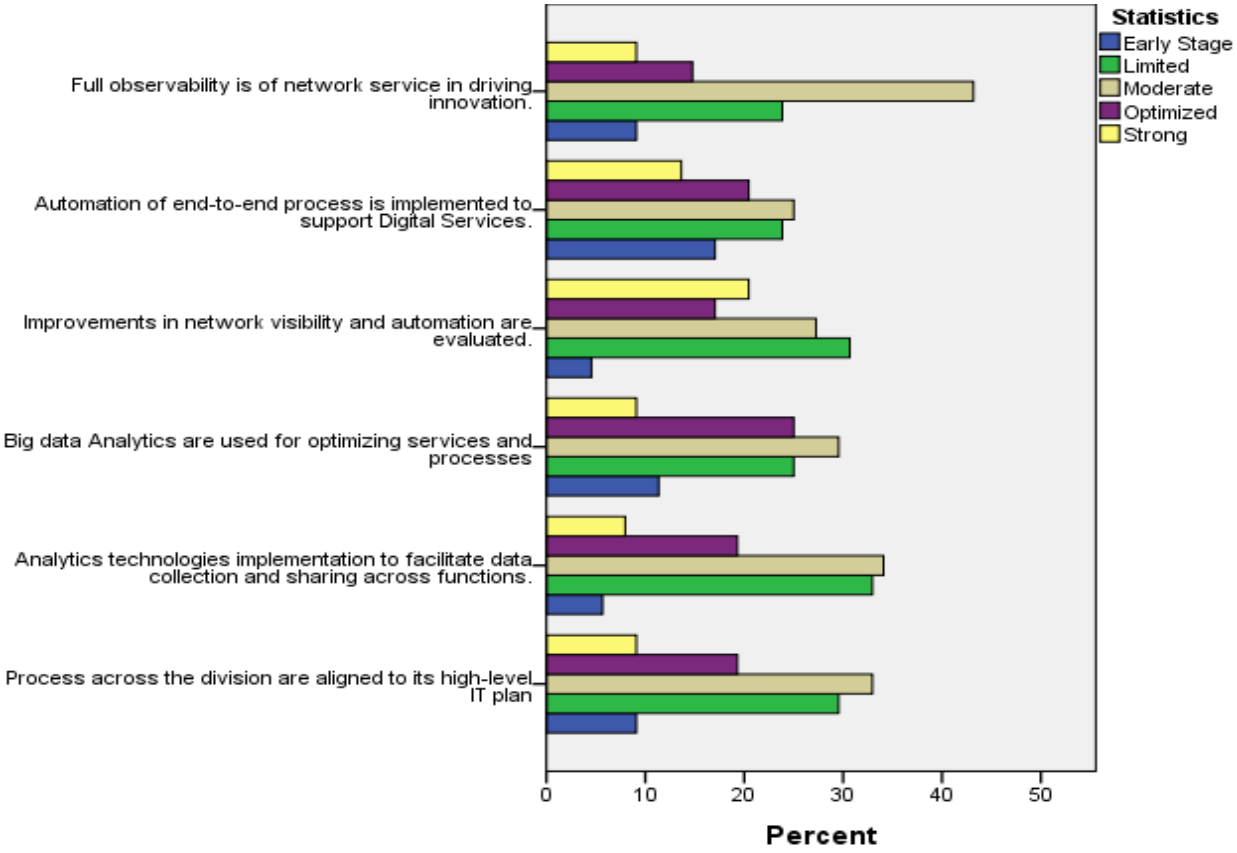

Figure 4. 4 Technology and Operation Challenges Observed in Network

4.2.3.2 Data analysis for information security data set

From the study conducted regarding operation dimension, most of the respondents said exclusive leadership and support regarding cyber resilience in their division are in its early stage which is 44%. Secondly, questions related to digital strategy communication practices across the whole division at all levels scored 24% early and limited stage. At the last, respondents reply 44.8 % indicated that the division is not considering "digital" as their distinctive capability.

On the technology dimension, majority of the respondents regarding the questions answered has fallen on similar ranges. Of the responses, 24.1 % and 27.6 % of the response regarding whether the security infrastructures can anticipate complex network security threats rated early stage and limited respectively. The use of machine learning technologies for predictive analysis such as, for service reliability rated as 44% is limited. At the last, respondents for the questions related to if the required transformation of hardware and software is started in

their division which is rated 34% as its early stage. and lastly, 27.6% of the respondents said that the implementation of advanced data analytics for service assurance and customer support is limited in its application.

For the strategy dimension, 24.1 % and 34.5% of the respondents said that early stage and limited regarding whether the division has a robust cyber resilience operational strategy to detect the emerging security risks. And next, the respondents were asked whether proactive measures are taken for security threats and respondents rated 17.2% says early stage and 27.6% are limited. Lastly, 24.1 % of respondents say it is limited for the practice of testing the risk profile of its operation regularly.

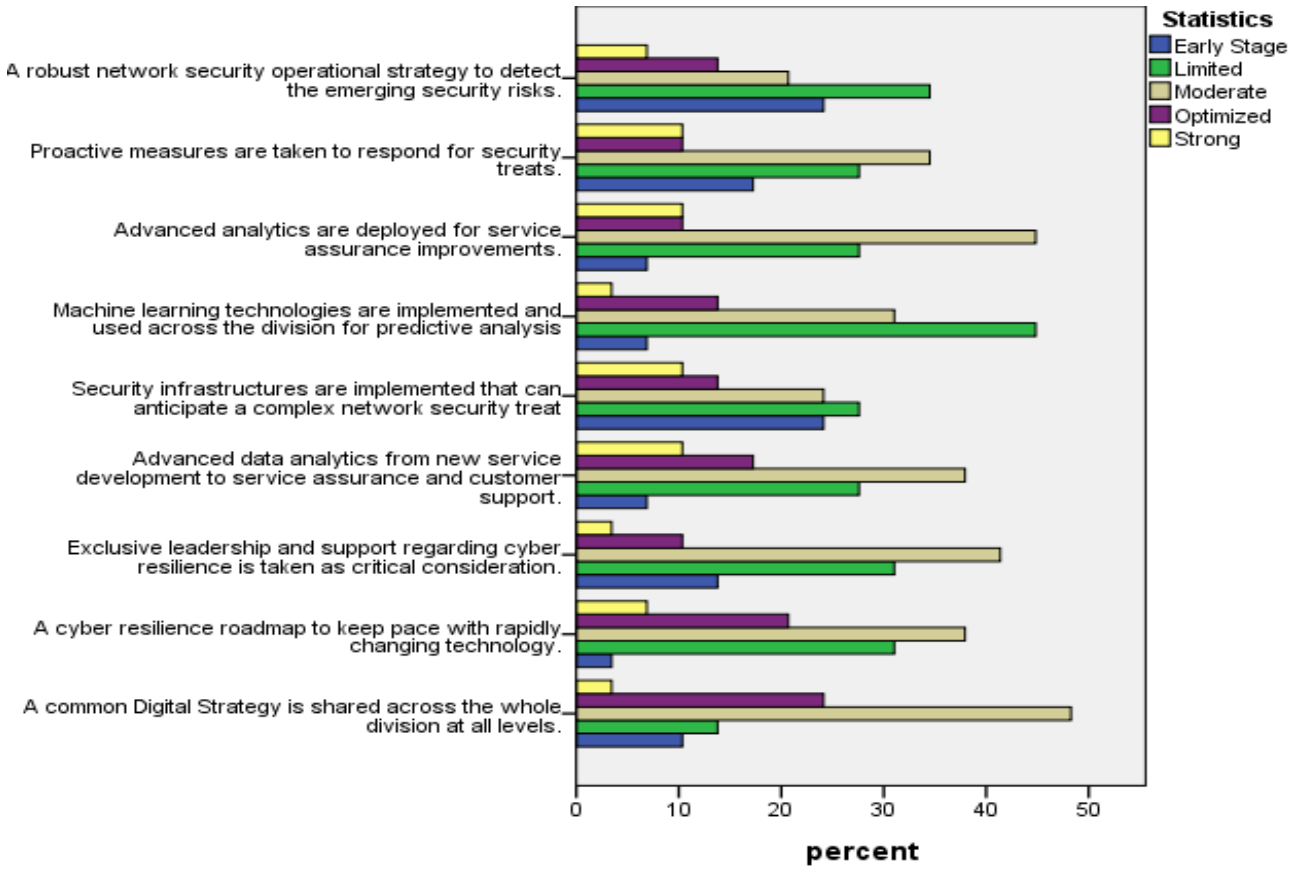

Figure 4. 5 Strategy, Technology and Operation challenges observed in Information Security

4.3 Overall digital maturity level

The researcher tries to assess the digital maturity of the sectors by forming different data sets for which both sectors asked common questions and there were independent questions that are related to their specific working behaviors and situations. The maturity level for each of the sectors regarding specific dimensions was assessed and lastly, the maturity level of IS and Network datasets were identified. For the commonly provided questions regarding the organization, and innovation dimensions the average mean value were calculated, and the total maturity score was 3.1681 out of 5 which depicts the level of maturity. The score shows a moderate level maturity. for the independent Network data set the total maturity level score was 3.0280 which is again a moderate maturity level. And lastly the IS dataset was analyzed, and it gained a total maturity of 2.9448, a limited stage maturity level. When we combine the average mean value for the three datasets, the results of the overall analysis were the attainment of Level 3(moderate) with 3.0469of digital Maturity score.

The assessment result has shown as that there is a clear weakness area that need to be improved in the future. The major ones are “innovation”, “analytics technology” and “leadership”. These weaknesses are obstacles that are hindering to go further to the desired digital competitive company. To enhance and better understand the problem area the researcher raised another question and tires to analyze how digital leadership could have a supportive role on the sectors innovation process to become better digital transformed company.

How can digital leadership support the promotion of innovation process within the sectors?

To answer the above question the researcher use interview analysis techniques to analyze and understand the topics raised above and identify the roles of leadership and innovation with in those sectors.

4.4 Qualitative data analysis

4.4.1 Thematic analysis

Thematic analysis is a method for identifying, analyzing, and reporting patterns or themes within Data (Braun & Clarke, 2006). Thematic analysis is a flexible method that allows the researcher to focus on the data in numerous different ways. It helps to focus on analyzing meaning across the entire dataset, or to examine one aspect of a phenomenon in depth. (Ibrahim, 2012) explained that thematic Analysis could be appropriate when the study aims to understand the current practices of any individual. The process of thematic analysis involves six phases: reading the collected data, coding, searching for themes among codes, reviewing themes, analyzing themes, and summarizing findings. Theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set (Braun & Clarke, 2006). The entire process of thematic analysis is typically an iterative process and progresses back and forth between the six phases (Wang& Khalil, 2018).

According to (Braun & Clarke, 2006), themes or patterns within data can be identified in one of two primary ways in thematic analysis: in an inductive or bottom up. An inductive approach to data coding and analysis is a 'bottom up' approach and is driven by what is in the data. What this means is that the codes and themes derive from the content of the data themselves. so that what is 'mapped' by the researcher during analysis closely matches the content of the data. In contrast, a deductive approach to data coding and analysis is a 'top down' approach, where the researcher brings to the data a series of concepts, ideas, or topics that they use to code and interpret the data. What this means is that the codes and themes derive more from concepts and ideas the researcher brings to the data. here what is 'mapped' by the researcher during analysis does not necessarily closely link to the semantic data content. On this qualitative data analysis, the researcher starts with observations of the data and tries to thematically analyses what is in the data and what possible relationship could have between the themes.

4.5 Thematic data analysis

The qualitative analysis section involves with in a total of 9 knowledgeable participants which are previously participated in the quantitative data collection process. The participants are consisting of (3 specialists, 3 supervisors, 1 manager ,1 expert, 1 engineer). A face-to-face interview involved a physical encounter and is generally more intense, flexible, and

interactive one. For analyzing the interview questions Nvivo 12 plus software were used. This software is powerful qualitative data analytic software in analyzing text, audio, video, and various formats of texts. It helped a lot in identifying the initial themes in more convenient way. The coding technique used in the analysis is open coding, means there is no pre-set codes, but developed and modified the codes as worked through the coding process.

All interviews started with general questions regarding the academic background, job role, and task of the participant. Semi structured interview was used since it allows the researcher to ask to follow up or probing questions to get clear insight about the topic. On doing the analysis, Braun, and Clarke (2006) six main steps of qualitative data analysis was followed. This qualitative data analysis was driven by answering the third research question.

Case/Topics/	Respondent	Role	Duration(M)
Leadership practice(L)	L1	Operation support manager	20:00
	L2	Mobile supervision supervisor	23:00
	L3	Voice gateway supervisor	25:42
	L4	International roaming supervisor	27:00
Working Culture(W)	W1-W5 &I1-I5	IT Engineer	21:27
		Radio network specialist	30:46
		Fraud control specialist	28:57
Information and knowledge perception and practice		International gateway specialist	23:06
		International transmission expert	26:01

Table 4. 4 Overview of Respondents and Duration of The interviews

Step 1: Become familiar with the data

The first task when doing the qualitative data analysis is becoming familiar with the data itself. After one to one interview has been conducted, each of respondent's answer is transcribed arranged and prepared for the next phase. The researcher tried to read the data and the transcribed interview thoroughly and organized the data in a meaningful and systematic way for the next analysis. The researcher early assumptions and impressions on the general interview responses are below on the extract.

"Digital leadership could have an enormous contribution on sections innovation process. But it needs some important leadership qualities and behaviors from leaders' side

and committed, engaging and motivational mindset from the individuals to quickly learn, fasten innovation process, and to drive change."

Step 2: Generate initial codes

In this phase, the first task coding with each segment of the interview data. Coding reduces lots of data into small chunks of meaning. There are 2 major types of coding in Nvivo12 software. Auto coding feature allows the software to read throughout the document and code using the source structure of the document. The second type of coding is manually selecting discussions that are assumed important and adding to the desired labeled node.

Transcribed text from the interview was used as an input for Nvivo 12 plus software. The word format of transcribed document was imported for the initial coding process. When the transcribed data were prepared for the coding process, line by line coding done by focusing on parts of the segment text that seemed to be relevant to answer the research question. Codes were created inductively to capture the meaning and content of each sentence in relation to the collected data. The use of line by line coding helped to focus more on what has been described as one of the key tasks in the synthesis of interviews. And auto coding feature of the software was implemented and check to better analyze the result of the two ways of coding.

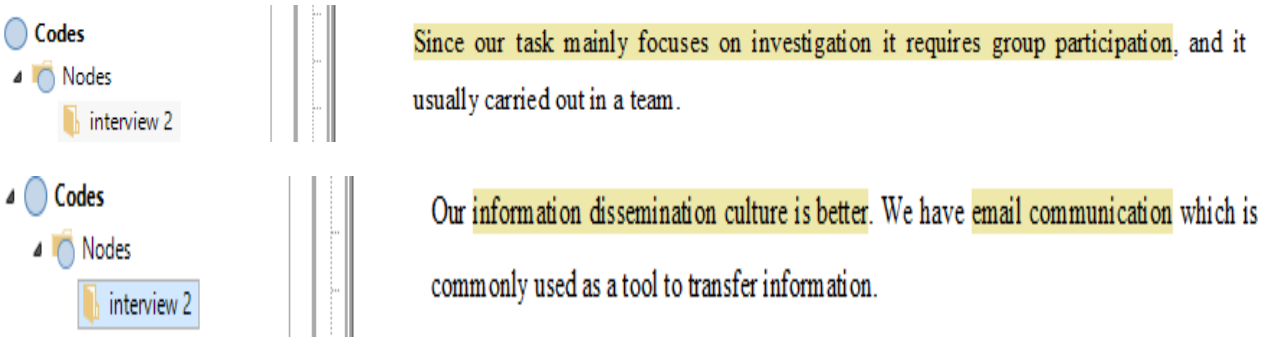

Figure 4. 6 Auto Coding In Nvivo 12 Plus

Step 3: Search for themes

As defined in introductory part, a theme is a pattern that captures something interesting about the gathered data. As Braun & Clarke (2006) explain, there are no hard and fast rules about what makes a theme. A theme is characterized by its significance. In this case the codes generated has been organized into broader themes that promised to say something specific about the research question. This stage tries to identify preliminary themes that are fitted based on their significance. The first case that was discussed with the interviewee was

perception of leadership practices and the significance change it had brought in their working environment. The second topic discusses about working culture of teams and the communication between their respective domains. The third and the last topic discussed the information and knowledge perception and practices within teams. Themes were predominately descriptive, they mainly described patterns in the data relevant to answer the research question.

In searching for descriptive themes, the patterns of word or phrase the most discussed by the respondents was taken as more relevant themes. patterns among codes are identified and construction of single theme is coming up. To organize codes into broader themes the word frequency helps in calculating the most frequently used words across all the interview data.

Word	Length	Count	Weighted Percentage (%)
knowledge	9	54	1.91
problem	7	51	1.81
team	4	42	1.49
information	11	41	1.45
work	4	35	1.24
learning	8	29	1.03

Table 4. 5 Word Frequency Table

The above table shows the most frequent appeared words that can possibly help to draw preliminary themes. The next task was looking for similarities and differences between the weighted percentage of each words appeared during the word count. Then the text search query was applied to group words together before and after the most frequently appeared word. As you can see in result below, the word" sharing" has frequently comes after the word "knowledge". so, it is telling that respondents are talking knowledge sharing rather than knowledge more generally.

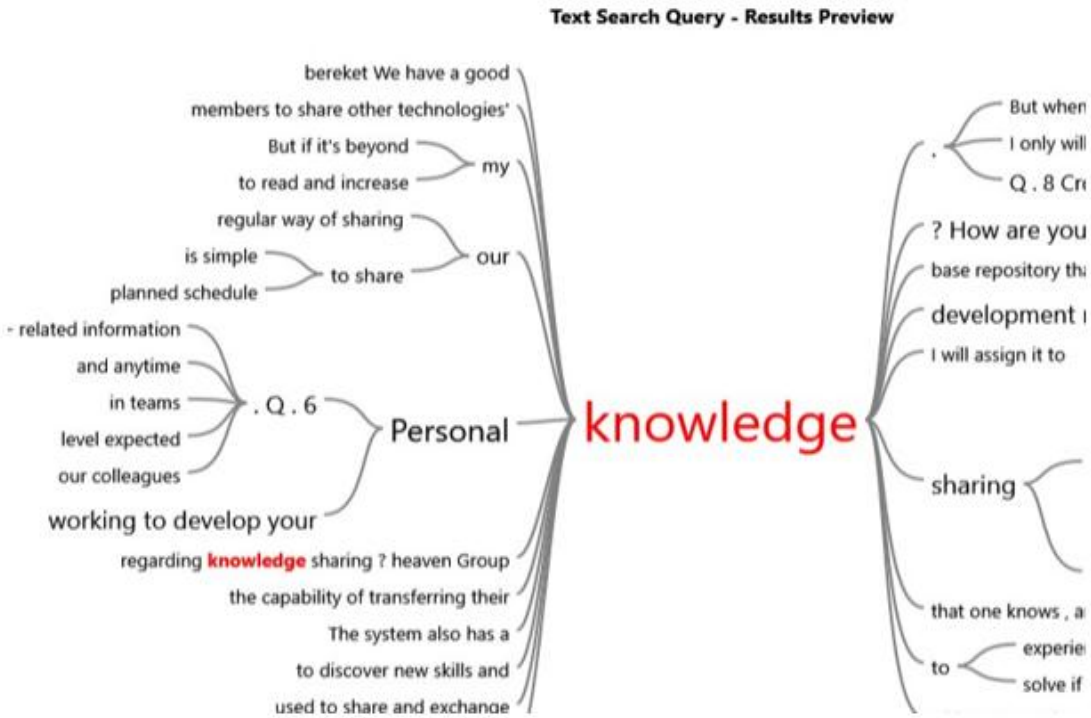

Figure 4. 7 Text Search Query Result

The next subsequent words that appeared most frequently are" team", "work" and "learning". These three possible words were considered useful to capture and group the meaning of the selected words. "teamwork" taken as the second emerged theme that can synthesize and relate with the first theme. The last theme identified in relation to digital leadership characteristics that can fit to one theme is "learning" which has a strong linkage with teamwork theme identified earlier. The next step after the selection of preliminary themes is synthesizing each of identified themes and making sense of the related concepts concerning the connection between digital leadership and innovation process. Even though other some words have been appeared in the word search query, they are not considered relevant enough to work with other themes. So, they are discarded and a total of 3 descriptive themes has been organized.

Step 4: Review themes

During this phase reviewing, modifying, and developing the preliminary themes takes place that are identified in Step 3. On this stage, the researcher returned to the data set and compared the defined themes against it and make sure that the themes are useful, accurate, coherent, and distinct from each other. Some of things to think about include:

- Does the emerged theme make sense?

- Are these themes really describing the data?
- Are there other themes within the data?

As an example, In the word frequency text search result the researcher does not take "information" as a useful theme. There is not much data to support it and it overlaps with the other themes, since it was discussed as a good practice within sections and across functional units. As a result, the researcher does not consider it useful to relate with the other defined themes and does not believe it is helpful in answering the specific research question.

Step 5: Define themes

This is the final refinement of the themes and the aim is to '*...identify the 'essence' of what each theme is about*.'. (Braun & Clarke, 2006, p.92). At this step what the theme is saying about, if there are subthemes, the interaction and relation to the main theme and how these themes relate to each other is going to be analyzed. In this analysis, it is understood that knowledge sharing theme is the predominant theme in which other themes ("teamwork" and" learning") has rooted in it. The below figure shows a final thematic map that illustrates the relationships between themes and the main expected role of digital leadership in innovation process.

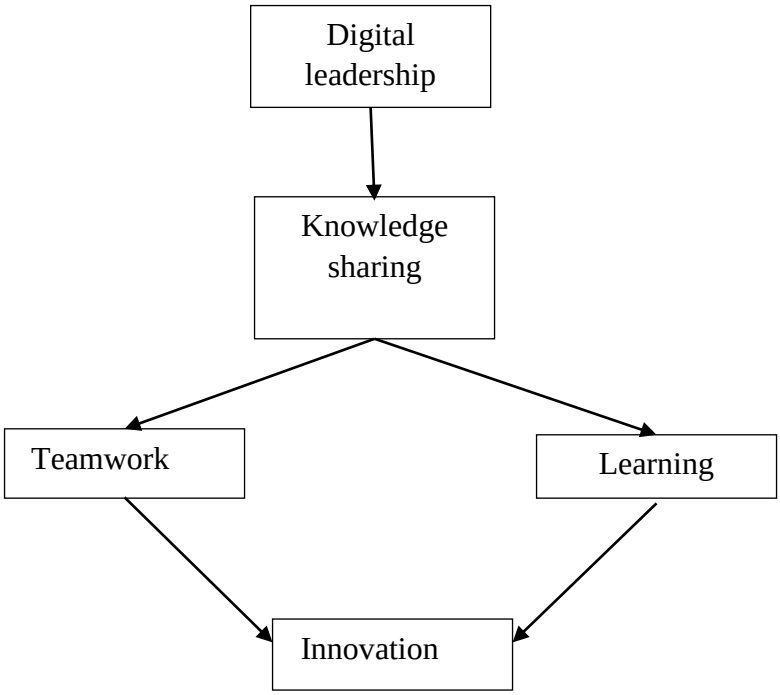

Figure 4. 8 Thematic Map

Knowledge sharing

Knowledge sharing is a process in which knowledge is exchanged among and within members of an organization. the participants described that the experience of sharing knowledge in the teams and section. There is no structured, well organized, and time-oriented knowledge sharing process in the sections. Many bits of knowledge transferring process is informal. Asking other colleagues to solve current incidents is very common. No e-learning or knowledgebase system is developed for sharing different kinds of domain knowledge. The respondents said that there is no such matured knowledge sharing plans and practices.

> *"We have a good knowledge sharing practice in our team. But it is not a scheduled and planned activity. Telling other team members how I solved the problem is the most regular way of sharing our knowledge."*

Learning

The participant expressed that the culture of learning in the section is not well suited to the expected level. The observed learning to progress within the section was very limited to difficulties occurrence basis.

"If we have face problems today, we will resolve it by calling and emailing to different units and if that problem happened again, and we go through the same activity. We did not have a culture to learn and take the experience from our yesterday mistakes. Communications are dependent on needs such as if there is an incident."

Step 6 write up

leadership played a critical role in the implementation of any large-scale organizational change such as a digital transformation. Sow and Aborbie (2018) define the digital leadership as the capabilities and capacities that could provide the creativity environment by optimizing the technology and digital capability. Digital capability can be described as the needed skills and attitudes that can support digital functions. Digital characteristic in digital leadership can be shown as being creativity leader, inspiring leader, credibility leader, wider knowledge leader, collaborative and interactive leader. In our case knowledgeable leader is a leader that perceive knowledge sharing as a central core activity. The exchange of knowledge exists between members of an organization. The flow of knowledge between teams helps fasten the learning process among the members of the team through allowing collaboration in teams as well as in one-to one communication. Knowledge sharing plays a major role in

facilitating team performance in sections. It also enhances and improve team outcome. Performance improvement through the implementation of knowledge management could lead to the creation of new innovative ideas.

Digital leadership exceptionally, plays a vital role in facilitating knowledge sharing practices among teams through creating dynamic and flexible knowledge management platforms to facilitate unprecedented ways of working and learning process. Galbraith, (1982) defined Innovation as the process of' applying a new idea to create a new process or product. creating continuous learning team, encouraging collaboration and teamwork, and enabling the proper exchange of knowledge within team brings improved innovative performance. At the end, the viability of effective knowledge management that can facilitate team's innovation is mainly reliant on adequate leadership skills.

4.6 Discussion

A digital transformation requires a significant shift in processes and procedures within an organization and necessitates that employees understand how this change may impact their roles and responsibilities. (Vey, Meyer, Zipp, & Schneider, 2017). Digital transformation practices require an organization to prepare for significant changes to their routine activities and processes, typically a longer time.

By the analysis conducted using quantitative assessment technique, the researcher tried to locate the digital maturity level of the specific two sections of the company. The case study found that the most important overall aspects of digital transformation is digital service development by improving analytics technology to improve their values to assist service improvements and branding. The second most important aspect of digital transformation is emerging a clearly defined as a digital target, the process and aligning it to equipping and bringing experts and providing the needed skills across departments.

Furthermore, the case analysis for the respective domain reveals that there are critical improvement areas that are needed to be focused on. The first important concept in the network area is analytics technology implementation for optimizing services and processes. In addition, Improvements in network visibility and automation needs to have more attention by automating the end-to-end process to support digital services.

The case study summary for information security data set implies that there should be movement into the development of strategy regarding leadership and support concerning

network security, a clear roadmap development to keep pace to rapidly growing network attacks. The other most crucial aspect is advanced data analytics technology as it is a common need for both sectors, from new service development to service assurance and security infrastructures implementation to overcome a complex network security threat.

The case study result has shown that the overall digital maturity of the sectors is just on the moderate stage. Therefore, the scored maturity does not indicate that the sections are firmly adapting their technological and strategical aspects in a desired level to achieve digital transformation. So, continuous identification of weakness areas should be labeled to further continue improving its services by focusing on the areas the company needs to further improve.

The qualitative interview analysis tried to understand how digital leadership could contribute for the success of innovation process within the earlier defined sectors. The interview analysis showed that leadership could play a critical role in bringing the innovation process more realistic. In this sense, a leader could fasten sections and organization innovation process through developing knowledge, skills and learning process. Building a good digital vision on its environment and developing appropriate leadership qualities through introducing and leveraging important norms, procedures, and practices within sections. It is important for an organization's core leadership to support this type of change and to have a vision that is required to accomplish related goals and objectives. The concept of being a digital leader goes far more than this. a digital leader embraces several skills within it. It also requires significant leadership practices to make this change real.

Bringing together technological and strategical pieces of dimensions only could not transform to the fully desired digital goal. Rather consolidating and merging the qualities of digital leadership with technology and strategy plans is important to promote innovative ideas through bringing knowledge and skills together. So that it needs members of the company and high-level supervisors' determination to look every aspect of activity in a well digital manner that turns in strengthening telecom in a wide manner to fasten business agility and un-greater creativity, which lead to we might collectively call digital transformation.

Chapter Five

5. Model development

5.1 Maturity Model

In the previous chapter, assessments have been done by using both forms of analysis (quantitative and qualitative). After getting the necessary information and knowledge of existing assessment results and the emerged weaknesses, this chapter identifies requirements for each of the areas identified. In developing maturity model, processes which are the most important ones, in the selected areas will grow when moving to the next progressing level of growth. This level of growth identifies the more mature state of activities in terms of processes within the scope. The chapter briefly describes starting from the definition of maturity model and the development of maturity model that can help to position the sectors.

Maturity can be defined as "the state of being complete, perfect or ready" (Simpson & Weiner 1989). Maturity thus implies an evolutionary progress in the demonstration of a specific ability or in the accomplishment of a target from an initial to a desired or normally occurring end stage (Mettler, 2009). A maturity model is a set of characteristics, attributes, indicators, or patterns that represent progression and achievement in a domain or discipline. The artifacts that make up the model are typically agreed upon by the domain or discipline and are validated through application and iterative recalibration (Caralli et al.,2012).

5.2 Focus of Model

The first phase of developing a maturity model is to determine the scope of the desired model. The combination of scoping decisions will influence all remaining phases in the proposed generic model development framework. Determining the scope of the desired model will set the outer boundaries for model application and use (Bruin et al., 2005).

Criterion	Characteristic			
Focus of Model	Domain Specific		General	
Development Stakeholders	Academia	Practitioners	Government	Combination

Table 5. 1 Decisions When Scoping a Maturity Model

(Bruin et al., 2005)

In this maturity model development process, the focus of the model is domain specific and the specific stakeholders are ethiotelecom network and security departments. The proposed

model is belived to provide a self assesement tool that can help to measure the maturity of each deaprtments by considering various determinats. And the target stakeholders are the practitioners in the company. The maturity model constructs are taken from the mixed method study design and the architecutre of the model is based on case study result and literature review of defined focus areas. The application of maturity models can be supported by predetermined procedures, e. g. by questionnaires. Based on the results of the as-is analysis, recommendations for improvement measures can be derived and prioritized in order to reach higher maturity levels (IT Governance Institute2007). The developed model on this study is based on the existing model. Some improvements have been made and new dimensions are included so as make it simple and usable for the applicability of the model within specific domain level.

Requirement	Application
Comparison of existing models	Review of maturity models in telecommunications areas.
Iterative Procedure	Development of initial model with literature review and integration of important indicators
Evaluation	Evaluate the proposed model using expert review questions
Multi-methodological procedure	Refine of maturity model to ensure the applicability
Identification of problem relevance	The problem relevance was showed by the as is analysis result of the sectors and reviewing the literature
Problem definition	Providing maturity model and enabling conditions for continuous use
Targeted publication of results	The design process of the model is presented.

Table 5. 2 Design Process of The Maturity Model

Becker et al. (2009)

5.3 A procedure model development process

2. Iterative procedure

To build maturity assessment model, this study uses a procedural model for the design of maturity model defined by Buckler. Buckler's procedural maturity model starts in identifying the problem relevance of the model. In this study as it is tried to explain earlier the main purpose of model is to provide practitioner level maturity model to make easy to assess the as is maturity of the sectors.

In the design phase the important findings result from the qualitative and quantitative assessment results are taken as the major requirement in developing the domain specific model.

The questionnaires and interview analysis result give the researcher the recommended weakness and improvement ideas. These areas are taken as necessary requirement for the maturity development process. The characteristics are derived from both data sets from the quantitative data result and the interview conducted from network and security sections. The underlined specific weakness areas and the recommended measures along with the corresponding hub topics are taken as the major dimensions in this model development process.

The first dimension is" ***technology***": Under the dimension technology the first and most important aspect is analytics technology. Analytics is the science or method of using analysis to examine something complex. When applied to data, analytics is the process of deriving knowledge and insights from data (Siow, Tiropanis, & Hall, 2018). Digital service providers value data, and they value analytics. Moving beyond information management, DSPs collect data during every interaction, thereby deriving meaning from every interaction. Communication service providers would collect data associated with the event and analyze it in the context of specific functions, such as fraud (Behan, 2014).

The second dimension is **Strategy:** (Schallmo, Lohse, & Williams, 2018) defines digital strategy as the strategic form of digitization intentions of companies. The short and mid-term objectives are to create new or to maintain competitive advantages. The characteristics to describe the strategy dimension includes regarding network security and development of agile and adapting strategy to rapidly growing network security attacks. The kind of strategy concerning network security will further have expanded using various literature.

The third dimension is **Digital leadership** which is discussed in qualitative study part. Sandel (2013) define the digital leadership as the capabilities and capacities that could provide the creativity environment by optimizing the technology and digital capability. This dimension will cover the concepts of leadership and the practice of expected characteristic on each level of maturity.

The fourth and final dimension is **knowledge management**: (Skyrme, 1999b) defines knowledge management as explicit and systematic management of vital knowledge and knowledge creation, collection, organization, diffusion, use and utilization process. Many studies reveal that the objective of knowledge management is to use knowledge to provide a competitive advantage for the business and transform knowledge to add value to the processes and operations of the business leverage knowledge strategic to business that

accelerate growth and innovation. (Raudeliūnienė, Davidavičienė, & Jakubavičius, 2018). The knowledge should be externalized and socialized among company's employees to allow them to create a "new" one (Morales , 2005). On this dimension the focus is improving the knowledge management process and to improve existing knowledge for convenience use by using system-oriented platforms to help better transfer of knowledge that can also fasten innovation process.

The fundamental requirements for the development of maturity model were taken from the study result and those findings further extended by reviewing literature on the found domain attribute area. The initial model dimensions focused on major 4 core elements that were mainly observed and identified as a weakness area.

Dimensions	Initiating	Enabling	Integrating	Optimizing	Pioneering
Technology					
Strategy					
Digital leadership					
Knowledge management					

Table 5. 3 Initial DMM for Network and Security Sectors: Maturity Levels Against Maturity Dimensions

On the knowledge management dimension, the specific attributes are knowledge creation and explicit knowledge management. The qualitative data result on knowledge management practices implies that there is lack of proper knowledge sharing because there is very traditional way of knowledge creation process and the explicit knowledge management process is not supported by systems. So, this attribute was selected to enhance the existing practice in managing knowledge.

Besides, the interview result indicates that there must be a clear understanding on how important knowledge management is and what useful contribution it brings for the sections teamwork and learning process. The researcher selects important attributes that are believed to have an impact on the continued value creation. The attributes on the specific dimensions are selected and on the knowledge management part, two basic attributes selected, and they are knowledge creation and explicit knowledge management.

Knowledge creation is one of the major process in knowledge management, it involves the interaction of peoples and communication. It also accelerates person to person approach and tacit knowledge sharing process. The knowledge should be externalized and socialized among company's employees to allow them to create a "new" one (Moreira, 2005). It is important to understand and enhance the creation of knowledge in organizations so that organizations can gain value and outperform rivals through the adoption of knowledge management that support innovation (Sin, 2008).

The second considered attribute is explicit knowledge management: explicit knowledge is a knowledge that exists in written form. Managing this type of knowledge is important to have a competitive advantage and to continue learning process as well as to retain organization corporate memory. The below table shows the specific attributes and the corresponding article reviewed to include them on the model building process.

Domain	Operationalization	Reference
Strategy	Digital strategy	kane et al. (2015), Sow (2018), Matt et al. (2015), Vantara and Kalakota (2018)
Technology	Analytics technology	Yayah et al. (2017), Deloitte (2015), Chen (2015), Banerjee (2013)
Leadership	Digital leadership	Wasono and Furinto (2018), Sow (2018), Khan (2016), Abbas and Asghar (2010)
Knowledge management	New knowledge creation	Sin (2008), Botha (2019), Stenmark (2003), Tenório et al. (2017), Maier (2007), Venkitachalam and Willmott (2017), Krishnaveni & Raja (2008)
	Explicit knowledge management	

Table 5. 4 Operationalized Findings Derived From The Literature Review

As Becker et al., (2009) identifies the multi methodological procedure of for development of maturity models. widespread is the use of literature analysis, which extracts assessment criteria for the maturity model from success factors and typical development and consolidation of indicators are also suitable for this step. After the main attributes has been defined the possible stages of growth is provided using the selected attributes and consolidation of indicators to the next level of growth. During the consolidation of indicators

various literatures has been reviewed regarding each defined dimension to specifically understand the attributes level of growth and fit the desired level in accordance with the chosen procedure. For a specific design process, the transformation of process used for designing process consists of the following steps:

1. **Identifying elementary requirements**

The elementary requirement is made up of the major derived preliminary processes from the literature reviews. In our case the four identified dimensions: technology, strategy, leadership, and knowledge management are the parent requirement and each of sup topics within the major requirements identified as elementary requirement.

2. **Identifying the processes which cover the elementary requirements**

Each elementary requirement identified instep 1 was then associated to one specific process coming from all literatures reviewed as an input. Then the researcher analyzed each of elementary requirement meanings. It is associated to the possible activity or common processes of each level. for example, the elementary requirement for knowledge management (knowledge creation and explicit knowledge management) 14 common practices were defined.

3. **Identifying the generic or base practices addressing elementary requirements**

In this step, each maturity level is then to be defined with a unique identification or description. once each elementary requirement has been associated to process then, drilled down into that process to select the most appropriate base elementary requirement. the generic practice identified in step 3 are considered an indicator of the achievement of the elementary requirement. Then these base practices are associated to with a generic practice. From the earlier stage of development derived 14 initial common practices for knowledge management, mapped to two of sub themes (knowledge creation and explicit knowledge management processes).

4. **Define the maturity scale**

The proposed maturity has five maturity assessment levels. Each of levels represent a view or a status in a current IS maturity model literature. The first and the second levels shows the initial foundation of areas raised and the levels from three to five represent a progressive incremental level of growth. This maturity model tried to describe the characteristics or processes each state of maturity will have. The above reviewed literature gives an insight on the main attributes to focus on after the major operationalization areas has been defined.

Maturity in each dimension is depicted across five levels which is the most prominent assessment description developed by Carnegie Mellon Software Engineering Institute (SEI) and comprises five stages that organizations go through as they move from an immature to a more mature state level, these levels include:

1. *Initiating:* The organization has decided to move toward a digital business and is taking initial steps in that direction.
2. *Enabling:* The organization is implementing initiatives within the dimension that will form the foundation of its digital business.
3. *Integrating:* The organization's initiatives are being integrated across the organization to support end-to end capabilities.
4. *Optimizing:* The organization's digital initiatives within the dimension is being fine-tuned and used to further increase overall performance.
5. *Pioneering:* The organization is breaking new ground and advancing the state of the practice within the dimension.

5. Assigning each process to a maturity level

In this stage process of each maturity level is used to qualify an organization/section to reach that maturity level. this was driven by the purpose of this processes as well as the meaning of each maturity level. for example, to determine the processes to be associated with maturity level 2 of knowledge creation process, the researcher tried to answer what are the processes required by enabling organization(section) and determined processes that are necessary for an organization to be considered as enabling. In answering this question there must be efficient ways for the members to communicate across department to share stimuli and ideas. So, the process “Knowledge initiative facilitates knowledge creation” is assigned to enabling or level 2 maturity. And next to enabling process the third question is what are the process next to” enabling” to move the knowledge creation process to” integrated” level of maturity? through practice and problem -solving activities the exposure of knowledge at large takes place. Then, the “Disclosure of tacit knowledge is open” assigned to the third maturity level. the adaptation and application of knowledge takes place in the next stage of development by answering what processes required to optimize the tacit knowledge sharing process. On the last maturity level what knowledge creation process is exhibit in pioneering organization? And answered as knowledge become part of the organization’s intellectual capital, in work processes and routine and learning occurs in different level of aggregation. Answering the question lead to assign “Knowledge become part of the organizational learning cycle”

process to the last level.

6. Identifying optional processes

To make maturity models more flexible and usable in different contexts some of the contexts can be identified as "optional" processes. In this case optional processes are those that are not required to comply with the requirements of the maturity level. The processes without any associated requirement identified in step 3 are omitted and have not been used in this specific context. For example, during elementary requirement definition on knowledge management dimension "***KM encourage ecosystem wide innovation***" was considered as one requirement. But on the following stages it was identified that this process cannot meet specific context process and have not been used maturity level assignment process.

Dimensions	Areas	Initiating	Enabling	integrating	Optimizing	Pioneering
Technology	Analytics technology	service efficiency improved by traditional analytics.	AT analyze real time network traffic but do not able to do much about it.	Analytics create reliable network quality	Real time analytics help churn prediction	Analytics accelerates Intelligent network planning
			semi - automated mobile fraud detection	Identify real time cyber security treats	AT enhances discovery and predictive recommendations	Improve forecasting and decision-making
Strategy	Digital strategy	No or little understanding on digital strategy importance	Structured strategy exists but not operational	Digital Strategy stimulate creativity and innovation mindset	Digital strategy is aligned with organizational culture	Digital Strategy drive agility and innovation
Leadership	digital leadership	no clear digital leadership exits, and traditional management style exercised	digital leader exists at manager level but does not influence strategy.	digital leader creates digital strategy but focused on operational delivery	senior and skilled digital leader exists, and leadership is seen as a shared responsibility	digital leadership at all level drives organizational strategy forward and innovation.
Knowledge management	knowledge creation	Communication and interaction among team member is limited	Knowledge initiative facilitates knowledge creation	Disclosure of tacit knowledge is open.	Knowledge creations stimulate knowledge diffusion.	Knowledge become part of the organizational learning cycle
	Explicit knowledge management	Documented Knowledge management exists	Formalized explicit knowledge management exercised	Explicit knowledge is embedded in systems and within workflows	Knowledge insights can support decision-making	knowledge proliferation delivers radical innovations

Table 5. 5 Proposed Digital Maturity Model

5.4 Model evaluation

Maturity Models are normative reference models that embrace the assumption of predictable evolution and change patterns. The main purpose of maturity model is to assess the current situation, to evaluate the strengths and weaknesses and then prioritize and plan for improvement. Maturity model assessment focus on comprehending and enhancing the process under investigation whereas the evaluation focus is to understand and improve the maturity model itself.

After the model is built, it becomes the object of the evaluation activity. this activity compares the performance of a solution to criteria or metrics, or functional specifications. The aim of evaluation is to decide not „why‟ or „how‟, but „how well‟ the artifact works (March & Smith, 1995). There can be two types of conducting evaluation. The first one is "Artificial" Evaluation in which the artifact is tested in a limited way where it may pass on to external evaluation or return to the design step for refinement before entering the same loop again (Venable, 2006). and "Naturalistic" Evaluation that is a "real" test where the invented designed solution or artifact is tested in a real-life setting to check its validity (Venable, 2006). Artificial evaluation techniques are preferred to evaluate the developed model by using expert review forms having defined requirements against the developed model.

This section of the study discusses about the evaluation of the proposed digital maturity assessment model. After maturity model building process is finished, it must be examined and validated if the model is enough to use in practical problem -solving process. In the evaluation model there are three types of model evaluation. But, for this maturity evaluation purpose the researcher uses one of the three evaluation matrices that is domain expert evaluation. The template has 3 sections with defined criteria's along with ordinal scale to depict the level of evaluation the experts give.

Expert information					
Date					
Name(optional)					
Organization/Institute					
Position					
Email					
Criteria	**Strongly Disagree**	**Slightly Disagree**	**Neither Disagree Nor Agree**	**Slightly Agree**	**Strongly Agree**
Maturity Levels					
The maturity levels are enough to represent, all maturation stages of the domain (Sufficiency)					
There is no overlap detected between descriptions of maturity levels (Accuracy)					
Processes and Practices					
The processes and practices are relevant to the domain (Relevance)					
Processes and practices cover all aspects impacting/ involved in the domain (Comprehensiveness)					
Processes and practices are clearly distinct (Mutual Exclusion)					
Processes and practices are correctly assigned to their respective maturity level (Accuracy)					
Maturity Model					
Understandability					
The maturity levels are understandable					
The assessment guidelines are understandable					
The documentation is understandable					
Ease of Use					
The scoring scheme is easy to use					
The assessment guidelines are easy to use					
The documentation is easy to use					
Usefulness and Practicality					
The maturity model is useful conducting assessments					
The maturity model is practical for use in industry					

Table 5. 6 Maturity Model Domain Expert Evaluation Form

Model Evaluation is an essential part of the model development process. This process ensures that whether the developed model provides the expected benefits and an enhanced solution for the defined problem. Regarding the subject of evaluation, it is possible to test the design process or the model itself. Technology domain experts from the both sectors have been selected to evaluate the evaluation template. In this case the evaluation process was carried out by 12 domain experts selected, and the proposed model distributed via email.

The evaluation form comprises 5 sub criterions. This are ***Maturity Levels, Processes and Practices, Understandability, Ease of Use and usefulness and practicality of the model.*** The received evaluation of experts tells that the first three criteria's i.e. the sufficiency of the model to represent the maturity stages of the domain, the accuracy of the maturity level descriptions, and on the processes and practices sub criterion part the comprehensiveness of process and practices defined, mutual exclusiveness of the defined process and finally the accuracy the respective maturity level assignment to their respective maturity level was evaluated. Of the respondents 9 of them strongly agree on the above-mentioned criterions by saying they are well represented in the model. On the next sub criterion, that is on the understandability and ease of use and usefulness of the model the respondents slightly agree on those criteria's and suggests that some attributes need to be revised. based on the outcome received, the researcher revised the maturity model and try to make it more understandable and simpler to relate model item with the section's practical scenario. In addition, some enabling factors that can drive to attain the proposed maturity has been prepared to help support what prior actions or conditions could help to achieve the desired maturity level.

5.5 Discussion

The model developed has potential for guiding analysis and understanding of how telecom companies evolve from less digital processes to a more digital processes and practices. This thesis was an attempt to develop a maturity model, which helps practitioners to assess their as-is situation and prioritize improvement measures (Becker et al., 2009). The developed model can be applied on different companies, aspiring to increase their level of digital maturity by integrating organizations processes, structures, humans and other resources into digital processes.

The developed model purpose is to indicate the states in digital context within the specified dimension by providing more efficient processes when sections are moving to the next level of maturity. It also helps to compare the current activities considering the model processes and to locate themselves on which states they are and to scheme what to plan and strategize digitally to achieve the desired maturity level.

The proposed maturity model is based on the foundation of five levels of maturity model, which are the most widely used levels of maturity in CMM/CMMI. The selection of dimensions of maturity model is reasoned using empirical findings and those findings also supported by qualitative analysis. The findings based on the insights gained form the analysis, indicate that maturity serves as a basement in digital transformation and it is not limited only on technological advancement but also, soft skill practices like cultural dimensions and digital leadership play an increasing role for making digital transformation fully achievable. This research gives equally important emphasis for both dimension while developing the maturity model which is not seen in other digital maturity models and found that changing mental model that frames what those sectors does through combining the leadership skill and the digital capability is important to optimize the benefit of digital maturity.

Chapter Six

6. Conclusion and recommendations

6.1 Conclusion

Digital technologies throughout all industries have changed the environment of firms and digitization is a current topic that affects every organization's operation. Telecommunication sector is the focus area due to its technology disruption, and digital maturity studies the maturity of organizations in digital aspect. Digital maturity has become a recent topic since technology disruption in the past decades. The aim of this research was to assess the current as is digital maturity of Ethio telecom network and security sectors using mixed method design and to develop domain specific self-assessment model based on the observed weakness areas. The quantitative assessment result has explained that technology and strategy are the main weakness areas that should be focused on and improved, and the qualitative analysis showed digital leadership practice will have a significant support in the digital transformation of the sectors.

Maturity models are helpful for businesses for setting up goals to improve various aspects of operations. The main objective of maturity model is to provide a structured approach that directs areas of growth and step by step attributes to the next highest level. In this study first the mixing of quantitative and qualitative data collection methods has been applied to identify the clear areas that are helpful to answer the research question as well as to take those improvement areas as major attributes for the development of domain specific maturity model. The attributes that are considered very important has taken as the core requirements for the development of domain specific model. Through the process of maturity model development procedures, the researcher produced fully bounded and useful maturity model. The developed model has 5 maturity levels in which most maturity assessment models usually have. Four dimensions were included in the model as a major element to assess those sectors. Within the process the researcher used quantitative dominant mixed design by adding interviews to better elaborate the quantitative findings. Lastly domain specific maturity assessment model was developed with provided recommended improvement activities for the operationalization of the model. The suggested model can be used for sensitizing to support the change process to be competitive in the telecommunication landscape.

6.2 Recommendation

In maturity assessment model development process, the model evaluation process is usually undertaken by conducting case study or survey and then by comparing the desired delivering capacity of the model. In this research model, evaluation is done simply by listing a model evaluating criterion and by asking practitioners if this model could be adequate to measure the sectors maturity level. So, further work is recommended test the applicability of the model.to make the tool more rigorous, it needs further research to test with practitioner it in a larger sample size.

In addition, full documentation to further assessment is not provided. It only gives the main enabling conditions to understand what specific requirements are needed to transform to the next stage of development and attain the desired maturity level. further research is recommended aimed at providing the full documentation that shows the clear procedures and processes to reach the desired digital maturity level.

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Appendix A

Key readiness enablers

Key readiness enablers (or activities) for digitization of network and security sectors

Strategy

1. prepare strategic planning to define digital strategy requirement.

2. Formulate a digital transformation strategy to integrate coordination and operational efficiency implementation.

3.. Adequate employees with needed skill to realize and lead the digital strategy.

4.lookup for available digital opportunities to retain the digital competitive landscape.

Technology

1. Identify and acquire the skill sets required to understand and leverage analytics.
2. Identify the best software and hardware solutions and determine the best overall infrastructure solution.
3. Prepare digital initiatives that support for open new threats and opportunities for network attack.
4. Perform capability enhancements as required for network service tracking and improvement.

Leadership

1. Start looking every aspect of jobs through a more digital lens.
2. Accelerate performance through collaborative and strong teams.
3. Inspire mobility to bring motivation for change inside and mobilize resources to bring the change about.

Knowledge management (knowledge creation)

1. Understand that knowledge is a key asset and it is the fundamental resource in company innovation process.
2. Accelerate the existing person to person communication and learning by doing with cross-functional and self-organized teams.
3. Train soft skill leaders that can promote motivation and company vision building,
4. Adopt electronic communication channels such as forums and video conferences.
5. Encourage workplace collaboration, learning and recognition process.

Knowledge management (explicit knowledge)

1. Build strong information technology (IT) framework to design and implement the systematic storage and dissemination of knowledge.
2. Deploy knowledge portal and content management techniques for updating externalized knowledge.
3. Develop and maintain best practices repository.

Appendix B

Questionnaires

Part I: General information

- ❖ You can put tick (√) "□" mark sign for your response from the given choices.

1. What is your educational level? Diploma ☐ bachelor's degree☐ master's degree☐

2. How do you describe your level of expertise in your position?

Technician ☐ Specialist ☐ Expert☐ analyst ☐

3. what is the department/section you are working now?

NNOC ☐ O&M☐ SMC ☐Engineering☐ FAN ☒ Pro ☐ Fraud Management ☐It Security☐ Network Security☐

For each of the questions below, circle the response that best characterizes how you feel about the statement, where: 1 = strongly Disagree, 2 = disagree, 3 = Neither agree nor Disagree, 4 = Agree, and 5 = strongly Agree

Part II: Questions related to strategy

	strongly Disagree	disagree	Neither agree nor Disagree	Agree	strongly Agree
	1	2	3	3	5
1.The section has defined an initial digital vision and focused on incremental operational investments.					
2.The section understands the need for cyber resilience in relation to its operational landscape.					
3.Digital initiatives implemented across the sections, including cross-departmental projects.					
4.the section builds a cyber-resilience					

roadmap to keep pace with rapidly changing technology.					
5.key performance indicators and performance metrics across the sections include the digital element (including inter departmental targets).					
6.Digital is a tool to meet specific set of skills and service techniques to deliver additional value					
7.New work/business models are implemented with pure digital elements in your section.					
8.Exclusive leadership and support regarding cyber resilience is taken as critical consideration in our sectors.					
9.The section has a culture to quickly react and mange for security attacks					

Part III: Questions related to organization

	1	2	3	4	5
1.The section articulates the need for digital transformation.					
2.The practice of selecting experts to bring needed skills in teams is ongoing.					
3.The organization has a vision for digital transformation, which begins to drive change towards a digital savvy work force.					
4.Digital initiatives incorporate people from several functions and departments, as well as external partners.					
5.Digital capabilities are well developed, and partnerships are continuously formed					

to access new ones.					
6.key performance indicators are driven by digital services.					
7.The organization is forced to digital innovation.					

Part V: Questions related to Technology

	1	2	3	4	5
1.A digital specific, information technology is developed in our section.					
2. An effort to define require transformation of IT architecture is started.					
3.Some initial pilots are planned to test new digital tools and platforms.					
4.A digital specific information technology is defined and changes to enterprise IT are ongoing to align it to target architecture, tactical IT investment plans are aligned to target architecture.					
5.Platforms are deployed to support digital services. (E.g. an internet of things platform/ that enable billions of devices to connect, communicate, and interact/)					
6.Process across the organization (e.g. customers support) are aligned to digital IT architecture.					
7.Analytics technologies are implemented to facilitate data collection and sharing across functions.					
8.The organization has a basic security infrastructure that are adaptable to new security treats.					
9.End -to-end process supporting digital services are optimized by leveraging the digital enterprise IT architecture.					
10.Analytics technologies are used for optimizing for services and processes.					
11.The security infrastructures/Firewalls/					

can anticipate a complex security treat.					
12.Automation of processes are using real time data processing used for proactive decision making across the department.					
13, Technologies such as advanced data analytics underpin innovation processes across the department					
14.Automation throughout the department drives superior performance. (E.g. speed, reliability)					
15.Tools using technology such as machine learning are implemented and used across the section for predictive analysis. (e.g. service reliability)					
16.The organization uses artificial intelligence and machine leaning techniques as a strong safeguard for security treats.					

Part IV: Questions related to operation

	1	2	3	4	5
1.Improvements in network visibility and automation are evaluated.					
2.Advanced analytics are deployed for service assurance improvements.					
3.The section has complete view on the security risk and treat landscape.					
4.Systems and processes to collect analyze customer usage data is deployed.					
5.Systems and processes to collect analyze customer usage data is deployed.					
6.Processes and policies to better support digital services are designed and implemented in some key areas of the organization.					
6.Automation of end-to -end process is being implemented to support digital services.					

7.Network data is being actively collected including user-end partner -contributed data to improve network visibility and to assist expansion planning.					
8.Network, customer, and other usage data is being collected and combined to provide visibility of end-to-end processes across the organization.					
9.Testing and managing the risk profile regarding network security is aligned with the organization strategy.					
10.Real-time network, customer and usage data is combined and analyzed to optimize service reliability well as key process (e.g. customer support).					
11.The section tests the current practices and risk profile of its operation regularly.					
12.The full observability of services and usage data is driving innovation within the security sectors					
13.Automated end-to-end processes ensure rea-time data flows functions for improved planning decision making.					
14.The sectors have built a robust cyber resilience operational strategy to detect the emerging security risks.					
15.Real -time, automated decision making is fully implemented in the service provision of digital services.					

Part VI: Question related to Innovation

	1	2	3	4	5
1.The need to develop a more agile innovative organization has been identified.					
2.New processes are implemented to foster digital innovation.					
3.Metrices and key performance indicators specific to digital innovation is					

implemented.					
4.Innovation in new digital services is mature, with clearly defined targets, process, and performance metrics.					

Appendix C

Interview questions

1. Introductory phase

- First, I want to thank you for agreeing to help me with this research.
- The interview will take 20 to 30 minutes.

Before jumping into specific research questions,

1. What is your highest attended education?
2. Can you tell me a little bit about yourself, your academic background, and your job role in your position?
3. Can you tell me about your specific task on your job?

2. Questioning part

1. How would your staff and colleagues describe your leadership/management/ style? Give us an example to support your answer.
2. What methods have you used to gain commitment from your team?
3. What was the most significant change you brought about in your team/division?

Professionals

1. How do you solve problems? Do you ask someone for help? Study it for a while? Look for answers in documentation? Jump in and try different approaches?
2. Think about a time when something out of the ordinary happened. Problems, incidents,

how you handled it? what you learned.

3. Tell us about an innovative solution you developed to a non-traditional problem? Could you please give me one practical example?
4. How are you working to develop your personal knowledge? How are you improving existing skills and routines?
5. How do you think your sections culture of networking capability in synthesizing and disseminating information?

6. How does your team is working for collective intelligence regarding knowledge sharing?

7. Do you think there is a strong collaboration and cross functional work and learning? If yes? Could you give me an example?