TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Syed Mohsin Raza Naqvi (184723IVGM)

CHALLENGES AND OPPORTUNITIES OF APPLYING E-ID (SMART NATIONAL IDENTITY CARD) IN PUBLIC SECTOR OF PAKISTAN

Master's Thesis

Supervisor: Silvia Lips
LLM, MSc.

Co-Supervisor: Sidra Azmat Butt
MSc.

Tallinn 2020

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

Syed Mohsin Raza Naqvi (184723IVGM)

PAKISTANI AVALIKUS SEKTORIS E-ID (RIIKLIKU ID-KAARDI) RAKENDAMISE VÄLJAKUTSED

Magistritöö

Juhendaja: Silvia Lips
LLM, MSc.

Kaasjuhendaja: Sidra Azmat Butt
MSc.

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: "SYED MOHSIN RAZA NAQVI"

06.08.2020

Abstract

The evolution of technology is making the governments to take innovative decisions so the public services can become more efficient and less human dependent. Governments are adopting latest technological solutions, which are scientifically approved and practiced by the advance countries. Following the developed countries and successful e-Governance models, several e-Governance projects initiated in public sector of Pakistan. In this study, the author aims to identify challenges of implementing electronic identification (e-ID) in public sector of Pakistan and opportunities for raising citizen's awareness of information technology, with the expectation that this research will support the stakeholders to implement e-ID initiatives and to suggest effective recommendations for practicable solutions. This study tends to understand how e-ID has revolutionized the public services in the developed countries by studying their state-of-the-art solutions as well as the success criteria, which can be adopted in public services of Pakistan. Additionally, to evaluate the perception of public service executives in NADRA (National Database Registration Authority of Pakistan) about e-ID initiative and citizen's understanding regarding electronic services in public sector, surveys will be conducted. To finalize the thesis, the researcher has concluded the work with recommendations to improve e-ID management system in Pakistan based on e-ID lessons learned from the developed countries, research analyses, survey evaluations and key issues highlighted by NADRA employees. In addition, the recommendations will be made for further studies, which need to be done to improve e-ID service design and citizen's awareness of e-ID applications and usefulness in Pakistan.

Keywords: e-Government, e-ID, SNIC, NADRA, e-ID Implementation challenges

Annotatsioon

PAKISTANI AVALIKUS SEKTORIS E-ID (RIIKLIKU ID-KAARDI) RAKENDAMISE VÄLJAKUTSED

See lõputöö koosneb kuuest peatükist. Esimene peatükk on sissejuhatus e-ID haldamisse Pakistanis, millele järgneb probleemi kirjeldus, uurimistöö eesmärk ja uurimisküsimused, uurimistöö kavandamine ja metoodika, uurimistöö olulisus ja struktuur. Teises peatükis antakse ülevaade e-ID teoreetilisest raamistikust ja kontseptuaalsest taustast. Kolmas peatükk keskendub nii kirjanduse ülevaatele kui ka arenenud riikide nüüdisaegsetele e-ID haldussüsteemidele. Neljandas peatükis antakse ülevaade Pakistani e-valitsuse edusammudest, eriti e-ID valdkonnas, mida tuntakse konkreetselt SNIC-projektina, sellega seotud avalikus sektoris tehtud jõupingutustega ja SNIC-i iseloomustustega. Viiendas peatükis kirjeldatakse rakendusuuringute metoodikast saadud analüüse ja järeldusi, millele järgneb kokkuvõte ja arutelu. Kuuendas peatükis käsitletakse üldsuse ja NADRA töötajate küsitluste soovitusi ja järeldusi, võimalikke tulevasi töövaldkondi ja üldisi järeldusi.

Märksõnad: e-valitsus, e-ID, SNIC, NADRA, e-ID Rakendamisprobleemid

Acknowledgment

I dedicate this thesis to my Parents, Syed Akhtar Hussain Naqvi and Syeda Ishrat Parveen Naqvi, without their struggle and pursuit for my education I would never have reached this position. I also extend my sincere wishes for my siblings for their support and encouragement for master's studies.

I wish to express warm regards to my supervisor, Silvia Lips and co-supervisor Sidra Azmat Butt who were always there for me whenever I needed them. They helped me from the very beginning to get on the track and until finalizing this research, they were so persistent in assisting me throughout this period, the goal of this thesis would not have been accomplished without their support.

Syed Mohsin Raza Naqvi

August 2020

List of Abbreviations and Terms

APP	Associated Press of Pakistan
CAN	Card Access Number
CNIC	Computerized National Identity Card
CPU	Central Processing Unit
DNA	Deoxyribonucleic Acid
ECP	Election Commission of Pakistan
EEPROM	Electrically Erasable Programmable Read-Only Memory
e-ID	Electronic Identity
eIDAS	Electronic Identification, Authentication and Trust Services
EU	European Union
FBR	Federal Board of Revenue
FRC	Family Registration Certificate
ICAO	International Civil Aviation Authority
ICT	Information and communication technology
IDMS	Identity Management System
ISO	International Standards Organization
IT	Information Technology
IVTF	Internet Voting Task Force
MLI	Multiple Laser Images
MRTD	Machine-Readable Travel Document
MRZ	Machine Readable Zone
NAB	National Accountability Bureau
NADRA	National Database and Registration Authority
NICOP	National Identity Card for Overseas Pakistanis
OVI	Optical Variable Ink
PACE	Password Authenticated Connection Establishment
PBGB	Police and Border Guard Board
PC	Polycarbonate
PET	Polyethylene Terephthalate
PIN	Personal Identification Number

PKI	Public Key Infrastructure
PKR	Pakistani Rupee
POC	Pakistan Origin Card
PTA	Pakistan Telecommunication Authority
PVC	Polymerizing Vinyl Chloride
QSCD	Qualified Signature Creation Device
RAM	Random Access Memory
RFID	Radio Frequency Identification
ROM	Read Only Memory
SAC	Supplemental Access Control
SNIC	Smart National Identity Card
UN EGDI	United Nations Electronic Governance Development Index
UNHCR	United Nations High Commissioner of Refugees
UV	Ultraviolet
SIT	Social Identity Theory
UN	United Nations
ESCAP	Economic and Social Commission for Asia and the Pacific

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1 Introduction

Governments are using Information and communication technologies (ICT) to develop its services for the welfare of citizens. Different services are provided through ICT tools which allows the citizens to get variety of government services online without the restrictions of time and place (Rao, 2004). There is a noticeable trend of transforming government services with ICT tools and such electronic public services can be seen in majority of governments now a days. This tradition is also giving opportunities for the government sector organizations for taking necessary steps to evolve their services recurrently with latest technology features for providing competitive solutions. The outcomes of these steps could include wide range of everlasting paybacks e.g. participation, impartiality, access to the information, transparency in operations, inexpensive processes, efficient delivery of services which can certainly boost the citizens confidence in public sector organizations (Colesca & Dobrica 2008). Providing public services by ICT means is relatively new methodology which is renowned as e-governance. The adoption of e-governance programs will prevail rapidly in near future. Majority of governments are focusing on adopting e-Governance programs but most of them are working in intermediate phases of integration. Ideal e-governance models are adopted in European and few other pro-western countries (Backus, M. (2002). For successful e-government transactions, electronic identity (e-ID) play an important role by giving opportunity to the citizens to get public services through electronic sources.

Pakistani government has improved its identity management system from biometric cards to Smart National Identity Card in early 2012 which is the first major step towards electronic governance. CNIC was introduced earlier in the year 2000 as a replacement for paper-based NIC. The CNIC is a machine-readable identity card, carries facial image and fingerprints and it has unique 13-digit identity code. However, SNIC is a smartcard with integrated electronic functionality and contains 36 security features. SNIC card also complies with International Civil Aviation Organization (ICAO) recommendation 9303 and ISO standard 7816-4 (UNHCR Refworld.org). However, regardless of introducing Smart National Identity Card, majority of the public are unable to use its features like digital signatures and electronic identification due to lack of infrastructure and

insufficient knowledge. In this thesis, author is inspired by Estonian e-Governance model and aims to understand the challenges which are obstructing Pakistani government to use SNIC in public services and to come up with viable recommendations for improving citizen's awareness of IT while considering the model of Estonian e-ID management system.

1.1 Statement of The Problem

World economic crisis are affecting the countries with the rise of costs as well as poor quality of governments services which is getting worse by the jurisdictions of national and global sanctions. The international economies are shrinking and challenges for the underdeveloped countries are increasing due to high administering costs involved in public services (Huque, 2004). Pakistan is also struggling with similar challenges, with huge population and poor GDP ratio, economic deficits and high index of corrupt practices and large number of graduates and skilled workers but no sufficient jobs. And to overcome these socio-economic issues, politicians from the different past governments often launched projects, initiatives and established several institutions but they all lacked strong will, long term planning and aim of public welfare. These initiatives only aided the politicians for short term benefits to retain the political power but drained billions of dollars over the past two decades. Regardless of all above issues, Pakistan joined e-Governance world in early 2002 and launched Computerized National Identity Card and later, followed by Smart National Identity Card. However, despite of successful issuance of Smart National Identity Cards in general public, Pakistan could not yet implement the applications and usefulness of SNIC in public sector services as we observe in advanced countries. Therefore, this study aims to find out following research questions.

1.2 Research Objectives and Questions

The research goal is to emphasize on two core elements of Pakistan's SNIC project, National database registration authority and the citizens, who are the main participants of this initiative launched by the government of Pakistan.

First NADRA to find out the challenges it is facing for the implementation of SNIC project in public services and to recommend solutions to handle those challenges. Secondly, it is the citizens, who play vital role in the success and failure of SNIC project. The aim is to assess citizen's awareness of e-ID in public sector of Pakistan and make recommendations to elevate the awareness of citizens. For this purpose, following research questions are formed:

RQ. How the use of Pakistan's e-ID can be improved?

This is the main research question which will be further elaborated in following sub questions. It is essential for Pakistan to prevail e-ID usage across the country while developed countries are already using it. The objective is to identify the key challenges, learn from the early adopters of e-ID and to assess citizen's awareness of e-ID and related technologies.

- *What are the challenges of e-ID initiative that public sector of Pakistan is dealing with currently?*

Identifying the barriers which public sector institutes are facing regarding e-ID implementation will help us analyse the problems and to formulate solutions and recommendations to overcome those hurdles.

- *What are the international practices of e-ID management that supports Pakistan's SNIC project?*

The formation of e-governance practices and infrastructure varies from country to country, suitable practices and techniques used in these projects can be adopted. Moreover, lessons can be learned from different countries that how did they manage with similar circumstances which are faced by Pakistan.

- *What is citizen's perspective of e-ID and how their awareness can be raised?*

It is significant to find out citizen's perception and awareness of e-ID, it will assist the authorities to evaluate citizen's need and to identify the deficient areas.

1.3 Research Design and Methodology

In order to answer the proposed research questions, design science research methodology is adopted by applying quantitative methods and multiple case study approach as a research methodology has been employed in this thesis. Following is the enlightenment of adopting design science research methodology in this context.

According to Aken (2004) design science is the research which produces the outputs far from the expectations, theories and observations. Whereas, Dresch, Lacerda, & Miguel (2015) says, "A kind of research, with a prescriptive approach, finds support in a search method called design science research. Design science research is considered as a research method that devotes attention to the development of studies that aim at prescription, project and artefact building. This research method has design science as its epistemological basis, a concept which differs from traditional sciences because it concerns itself with the artificial, that is, with everything that has been designed and conceived by man" (Dresch, Lacerda, & Miguel, 2015).

Moreover, design science research methodology is solely not related with understanding the issues, but with practical solutions. "On the one hand, there is research based on the paradigm of design science, whose objective is to design artefacts and prescribe solutions to existing problems, improving or creating new systems" (Aken, 2004).

Initially, thesis will examine the challenges of e-ID management system in Pakistan through quantitative methodology by gathering data from NADRA employees through an online survey that is circulated among 60-70 employees, which is comprised of six questions including multiple choice and one open ended question. Out these, 53 employees responded, though 53 answers in generally for a survey is not enough but as it is survey conducted among experts is a remarkable percentage of people dealing with this area to make viable conclusions. The results will also provide professional insight from NADRA executives, which will be very helpful in identifying the challenges that SNIC project is facing in public sector of Pakistan.

Secondly, to answer next research question, case study methodology is adopted to find comprehensive information related to e-ID management systems in developed countries. Multiple country's e-ID management system will be reviewed thoroughly to study the best practices and successful experiences which can be employed in SNIC project of Pakistan. On the top of it, a recent research which is conducted in Iran on a similar topic

is also reviewed to study the challenges which neighbouring country of Pakistan in e-ID implementation from public and government side.

For answering third research question, again quantitative approach is utilized for another survey conducted online from the Pakistani citizens through Google forms and it was distributed by using social media apps and messengers as a communication tool to assess the awareness level and the difficulties that public is facing regarding SNIC project during the period of June-July 2020. This survey contains 18 closed end multiple choice questions and the data received from this survey will be analysed using graphs and tables. Finally, the recommendations based on findings will be proposed to the government for educating citizens and to make e-ID initiative more successful. Following is the graphical illustration of the research design approach for this thesis.

Research Design Concept

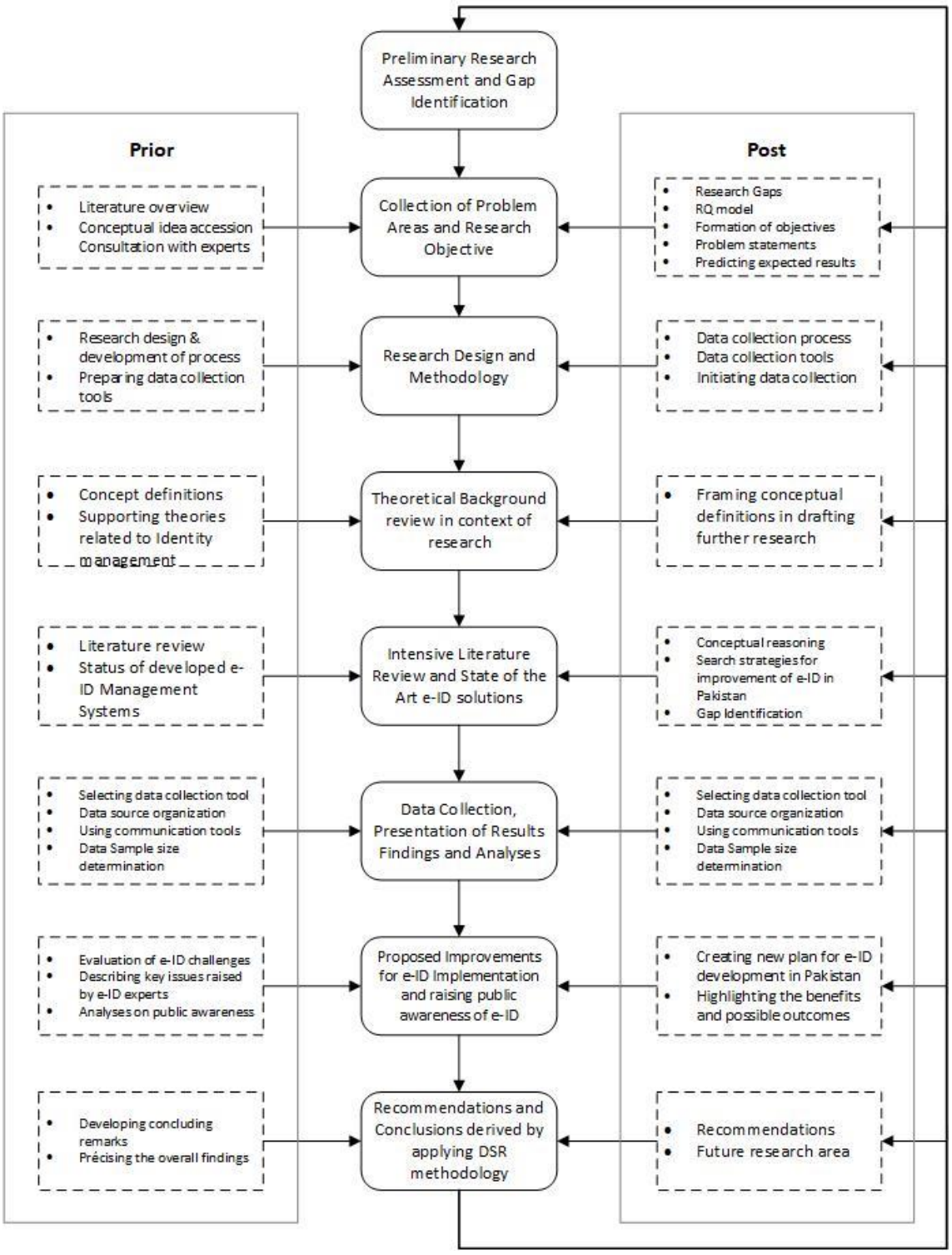

Figure 1. Research Design Concept

1.4 Significance of the Research

Evolution of technology is compelling the governments to use the digital solutions to govern the countries which is termed as e-governance. While this research can endorse viable recommendations for the government of Pakistan to successfully execute e-ID applications in public sector of Pakistan.

Initially, recommendations can be presented to government of Pakistan through evaluating the issues that are faced by NADRA which have decelerated the SNIC project and examining the challenges NADRA employees are facing as well as studying similar challenges faced by other countries.

Secondly, the factors can be highlighted which are impeding government's efforts to educate the citizens regarding SNIC usability in public sector and the communication failure towards public for accepting SNIC as advantageous tool. The results can be very useful for NADRA in proper implementation SNIC initiative and future electronic based projects. In addition to this, findings can be used for improving the e-ID system in government services of Pakistan, meanwhile less usage of paper based and human dependent services. Also, public can be served with effective and time saving services.

1.5 Structure of Thesis

This thesis is comprised of six main chapters. The first chapter is an introduction to the e-ID management in Pakistan is given, followed by statement of problem, aim of the research and research questions, research design and methodology, significance and structure of the research. Second chapter enlightens theoretical framework and conceptual background of e-ID. Third chapter is focuses on literature review as well as state of the art e-ID management systems of the developed countries. Fourth chapter reviews Pakistan's e-Governance progress especially in the field of e-ID which specifically is known as SNIC project, related efforts done in public sector and SNIC properties. Fifth chapter states the analyses and findings obtained from the applied research methodology, followed by summary and discussion. Sixth chapter will discuss recommendations and conclusions derived from the surveys conducted from general public and NADRA employees, possible future work areas and overall conclusion.

2 Theoretical Background

In this chapter author will explain the theoretical background and important concepts which are pertinent to the topic of this research. In first subsection, author will briefly explain Identity theory, Social identity and National identity theories. In second subsection of this chapter, Good governance theory and its principles will be elaborated. And finally, author will enlighten Technology acceptance model and its distinctions.

2.1 Identity theory

Burke & Stets says, that "over the past four decades the concept of identity has been one of the major topics' areas of both theoretical and empirical development within sociological social psychology" (Burke & Stets, 2009). This indicates that the notion of identity relies on understanding the individuals within their social designations and values which are integrated within the society. "Generally, we consider an identity to be a shared set of meanings that define individuals in particular roles in society (for example, parent, worker, spouse, or teacher role identity), as members of specific groups in society (for example, a church, book club, or softball group identity), and as persons having specific characteristics that make them unique from others (for example, an athletic or artistic person identity)" (Stets & Serpe, 2013). Hence, it means that the set of meanings associated to different characters which individuals possess in social environment is what makes then different from others.

2.2 Social Identity Theory

Social identity theory was first introduced as social psychological by Tajfel (1978) and later improved by Tajfel and Turner (1979). Social Identity theory proposes that individuals classify themselves associated with several groups such as professional group, a band or a music group. Tajfel further says that, along with self-classification, individuals appraise the groups they think they belong to (in groups) and groups they do not consider themselves a member of (out groups). "To determine the in-groups' and out-groups' worth, individuals constantly categorize themselves, evaluate in-groups and out-groups, and compare their value. Social categorization, group evaluation, and the value of group memberships for the self-concept constitute an individual's social identity". However, a

constructive social identity is rewarded with encouraging self-confidence, however a negative social identity is trailed by continuing struggle, social mobility behaviours, or intellectual policies to develop more constructive picture for the in-group.

Turner and colleagues argue that identity operates on different levels, depending on their accessibility and fit of the context (Turner, 1987). Turner also classify three levels of self–categorization important for the shaping of identity: Superordinate identity (the category that supersedes other categories. i.e., a person as a human being), Social ingroup identity (various groups that a person belongs to), and Subordinate identity (personal identity).

2.3 National Identity

National identity persists in this growing world, and probably the nation is the pre-eminent element which forms an identity. According to Edensor & Tim, leading perceptions of nation correlates with country's or region's ancestral history and political economy, and national factors people often mention are derived from dominion of legacy values, traditions and rituals invented hundreds of years ago. But these elements on which these cultures are standing only represents a small part which surrounds the nation. Interestingly, regardless of studies and researches conducted in the field of cultural studies, there are quite few numbers who tried to set up unconventional ways by which the nation is practised (Edensor & Tim, 2002).

The aim of national identity is to reduce the public conflicts within the sketched geographical limits that grades in achieving a high level identity. Scientists often highlights the implications of social conflicts and in context of social identity. The major cause behind these conflicts is the social denial that sentiments and rage of the individuals influence the social identity (Jenkins, 1996).

The concept of identity has evolved into e-Identity with the revolution of technology. Governments are introducing public services via electronic means and for acquiring these services it's a pre-requisite to possess electronic identification. The whole concept of electronic identity is derived from identity theory with the only variation that all social exchanges are performed electronically.

2.4 Theory of Good Governance

Since late 19th century, Good governance concept is getting unusual attention and certainly becoming the widely referred terminology in the world of administrative and political sciences. The indistinctness attached to the notion of governance is apparently the biggest cause behind its fame. “it can be shaped to conform to the intellectual preferences of the individual author and therefore to some extent obfuscates meaning at the same time that it perhaps enhances understanding” (Kovač, Tomaževič, Leben & Aristovnik, 2016). According to Keersbergen & Waarden (2004), Governance infers to the outset of responsibility so the individuals participating in the process of making goals and aiming to reach those goals, no matter its via private or the public sector activity, should be made answerable for the activities towards civil society.

In simplified terms, good governance guides us to the concepts and problems related to the social participation and the psych of each framework of law with least focus on federation’s history and culture (Bevir, 2011). According to the World Bank (2015), meaning of good governance revolves around ethics and principles under which government authorities and organizations perform their obligations in order to make public decisions and deliver associated services.

According to UN Economic & Social Commission for Asia and Pacific (UN ESCAP) defines the term ‘governance’ as a methodology through which decisions are made and enforced in public sector. UN ESCAP elaborates eight main components of governance, which are Participation, Justice and rule of law, Transparency, Responsiveness, Consensus focused, Impartiality and completeness, effectiveness and efficiency and accountability. In following, these good governance characteristics will be explained in the light on UN ESCAP.

Participation

Participation or contribution of men and women is the fundamental key of good governance. This participation can be done directly by individuals or via legal intermediary institutions and their representatives. It should be considered that representative democracy not just means to address the issues which only belongs to the helpless segment in society while decision making. The participation should be well

informed and maintained. This depicts freedom of expression and belonging as well as organized civil society.

Justice and Rule of Law

Rule of law is one of characteristics of governance which is noticeable to everyone. The concept of good governance demands neutrality in legal processes that are imposed objectively. It also focuses on the protection of human rights especially the minorities. Unbiased execution of laws needs judicial independence and honest police system.

Transparency

Transparency denotes that the process of decision making, and implementation of policies are performed by following rules and regulations defined by law. Which also means that access to such information is available for the people who are going to be affected by this implementation. In other words, information related to processes and policies should be expressive and in comprehensible format for the public.

Responsiveness

Responsiveness is an attitude of government towards good governance, which stresses the public institutes to address citizen's applications in appropriate amount of time. Not only addressal of services but also providing positive and legal outputs.

Consensus Focused

Every society has its own opinion of good governance as there are several factors involved in it. But good governance needs arbitration of various interests of a society to obtain consensus-oriented decisions which benefits each participant of the society. Moreover, it also needs a comprehensive and long-lasting perspective on the requirements for sustainable human progress and how to accomplish these objectives.

Impartiality and completeness

Society's welfare is dependent on encouraging all inhabitants to feel that they are playing substantial role in outlook of the overall society which requires every segment of society especially deserted communities to participate and avail the opportunities to make progress in their lives.

Effectiveness and efficiency

The public institutions and the affiliated developments should provide outcomes which corresponds the criteria and the expectations of the society as well as utilizing the appropriate resources within their reach. The terms Effectiveness and efficiency, which are associated with the concept good governance also recommends that the natural resources are distributed sustainably for the protection of environment.

Accountability

The most essential foundation of good governance is accountability. Along with government sector it also includes private organizations and general society who are answerable to the public and respected authorities. Overall, institutions should be answerable all associated individuals who can be affected by the policies or decisions made by the particular institution (UNESCAP, 2009).

In this the above explanations it is obvious about good governance concept that it is an ideal phenomenon that is tough to accomplish in its entirety. Only few governments and societies managed to achieve the ideal meaning of good governance. In the framework of good governance definitions and the characteristics, it is observed that the desire to form an e-government is associated with above eight pillars of good governance. Governments are striving to develop and strengthen e-ID infrastructures to fulfil the criteria of e-Governance. Over the time, various e-ID services are provided by the e-Governments in the developed countries for both public and private sectors, including business community as well. Few salient features of electronic identification systems and its profits in terms of e-governance are as below:

- Online authentication and transactions
    - Eliminates human involvement from government side
    - Reduces burden for citizens and bureaucracy
    - Cost and time saving system
- Encrypted and secured communication
    - Insures safe and faultless transactions

    - Reduces clerical mistakes
    - Improves the citizen’s trust in government services

- e-Democracy
    - Provides citizens to vote online
    - Reduces the distance between government and the citizens

The above features indicate that e-Governance can improve the quality of governance by aiding the essentials pillars of good governance such as transparency, participation, accountability, efficiency and effectiveness.

3 Literature Review

This chapter will explore the experiences of developed countries in terms of e-ID management system will be reviewed especially, Estonian e-ID management system will be reviewed which has got tremendous success in such a small period of time and many countries like Ukraine and Faroe Island are seeking Estonia as the benchmark for their e-ID projects. Other countries which will be reviewed are Sweden, Germany, Singapore and Iran.

3.1 State of the Art e-ID management systems

In this sub section, author will enlighten the state-of-the-art e-ID projects implemented in developed world countries. For this purpose, governments practices will be discussed which were used to resolve the barriers in the successful implementation of e-identity project, and other experiences which are correlated with the research topic. Learning from previous adopters of e-ID projects will help in finding appropriate solutions for e-ID initiative in public sector of Pakistan. Four countries are chosen for this study which are related to this area of research, these are Estonia, Singapore, Germany and Sweden. The results learned from these countries can very helpful in the implementation of e-ID project in Pakistan.

Motivation for opting these countries

- **Estonia**

Estonia is without any doubts the most advanced country emerged in e-Governance field from past two decades and various developed countries are following the Estonian e-governance model for profitable investments. Apart from Estonia's achievement in this field, author has experienced using electronic services in Estonia from quite some time and inspired by the usefulness of electronic services and this study is an effort to recommend e-governance practices for Pakistani government for effective use of Smart National Identity Cards.

- **Singapore**

This thesis aims to find the challenges in implementation of Smart National ID in Pakistan, whereas both Pakistan and Singapore are Asian countries with regional similarities so it would be very helpful to study a successful country which is close by and achieved remarkable success with similar circumstances. Moreover, Singapore has tremendously maintained its ranking in economic growth and ranked in top 5 countries according to World Economic forum from last 20 years.

- **Germany**

Pakistan has a huge population of 221 million[1], therefore the it's very important to study e-governance initiatives taken in highly populated countries and Germany is the highest populated country in Europe with 83.7 million[2].

- **Sweden**

Pakistan is among the countries with highest number of private banks and the aim is to study the public and private partnership in the implementation of e-IDs. And Sweden is among those countries that initiated e-IDs with the coordination of private banks, this approach could be very beneficial for the government of Pakistan, since all banks have their own e-banking platforms and little investment would be required if private banks are integrated with electronic identity services.

e-ID management systems in developed countries

3.1.1 Estonia

Estonia is a Baltic country with 1.4 million population situated in northeast Europe and restored it's political, economic and geographical independence in 1991 against Soviet Union (Kalvet, 2012). According to the EU Bank for reconstruction and development (2000), Estonia is recognized as one of the successful countries among others in eastern Europe in terms of improving its economy. Estonia is also renowned for establishing world's best e-Governance infrastructure to provide online public services for its citizens and business functions. Around 90% of Estonian citizen's use e-ID for banking transactions in everyday life (Palginõmm, 2016). Since 2000s, Estonian government has

started working on digitalizing public services to eliminate the vacuum between citizens and the government, which gained a huge international recognition and Estonia is now considered as top e-administered country in the world. The Guardian published an article on Estonia in 2016 as "Estonia "rapidly transformed from a Soviet state to digital utopia" and according to Forbes "the tiny European country that became a global leader in digital government" (Forbes, 2016), as well as Heller calls it a "digital republic" with "a virtual, borderless, blockchained and secure government" (Heller, 2017). e-ID cards were first introduced in January 2001 and were made mandatory for the citizens above 15 years as a primary source of identification and this ID-card has a validity of 5 years.

The design of Estonian e-ID card is a rounded shape polycarbonate material compliant with EVS-EN ISO / IEC 7810 standard. The e-ID contains following information on the front and the back side:

Front side (blue, green & gray)	**Back side** (blue, green & gray)
Cardholder picture	Place of birth
Surname	Date of Issue
Given name	QR code
Gender	Barcode
Date of Birth	Smart chip
Document number	Machine readable zone
Personal code	
Date of expiry	
Citizenship	
Holder's signature	

Table 1. Textual information on Estonian e-ID card[1]

Figure 2. Sample Estonian e-ID card[2]

The e-ID can also be used for physical identification and lot of Estonian citizens use it in EU member states instead of passports (PBGP). The Estonian e-ID card comes with a smart chip contains citizen's information and sealed envelope which holds 2 pins for user authentication and digital signatures respectively. The ID-card holds the public key infrastructure (PKI) and therefore also an electronic identity component – e-ID. This allows for identification online (cardholder authentication) and digital signing (Palginõmm, 2016).

- e-Identity Estonia

Estonia is the most advanced country which issues digital identity to all its citizens. While other countries are struggling to find ways to provide digital authentication systems, Estonia has expanded the digital authentication to next level and now the digital identity solutions are provided in four variants provided by public and private sector organizations: ID-card, Mobile-ID, Smart-ID and E-Residency.

- **ID-Card**

Estonian ID-card is integrated with 384-bit Elliptic Curve Cryptography (ECC) and PKI mechanism that provides access to Estonia's e-services securely. ID-card is recognized by QSCD (Qualified Signature Creation Device) and some common services used by Estonian citizens through this ID card are using it for legal travel ID in EU, as an identification for accessing banking channels, for digital signature, i-voting, e-health, medical records and tax filling. As per e-estonia.com e-ID is used by 67% of Estonian citizens on regular basis and it saves 5 days a year with electronic signatures.

According to Lips, Aas, Pappel & Draheim (2019), ID-card is compulsory document for the Estonian citizens which provides electronic authentication as well as qualified e-

signature as per eIDAS regulation. Similar card is provided to EU citizens who are residents of Estonia. Moreover, various e-ID tokens are also provided with similar electronic functionalities:

1. Residence permit cards – are provided to foreigners belongs to third world and the aliens whose citizenship is not confirmed.
2. Digital identity cards which also covers e-residency card – Digital ID cards can be obtained by choice for electronic use only.
3. Diplomatic identity cards – These are cards possess complete e-ID features and these cards are provided by department of foreign ministry for the purpose of diplomatic affairs.

As a useful substitute for the card format, mobile IDs can also be used for authentication (Lips, Aas, Pappel & Draheim, 2019).

- **Mobile-ID**

Mobile-ID is another form of digital authentication which is widely used by citizens. Just like an ID-Card, mobile-ID is used to perform secured electronic services and digital signatures. The added advantage of this service is that the citizens do not need to use smart card readers to login for desired e-service platform. The mobile id works with a sim card provided by the telecom operators, which is embedded with a private key among with a small application which supports the authentication process and digital signatures. The mobile-ID does not come with every sim card, it is kind of customized feature added to a sim card, so the user must request the mobile operator for this feature along with other telecom utilities. According to e-estonia.com 16% of voters use mobile-ID.

- **Smart-ID**

Smart-ID is a cloud-based application compatible with smart mobiles basically serviced by private sector which serves the purpose of authentication for the electronic services. It is very convenient and widely used by majority of smart phone users, as it does not require any complicated operation for the users. Once configured in the smart phone, it appears by itself and notify the user to enter the secret code to authenticate for the desired transaction, once the code is entered, it disappears by itself and sends the message to the relevant service provider at the back end to fulfil the operation. Smart-ID is ideal for the

user who do not have smart card reader or a mobile-ID sim card and wants to use electronic service. The smart id does not require any fast internet connection, it only consumes 5kb of data for one transaction. As per e-estonia.com Smart-ID is recognized by QSCD (Qualified Signature Creation Device) which is the highest level of recognized body in European Union. The usage of Smart-ID is free of cost for the users and no subscription is required for the service and the application as well.

- **E-Residency**

Estonia has established a digital society not only in Estonian territory but also beyond the borders. E-residency is the concept of issuing electronic residency to the foreigners resided anywhere in the world. With this initiative Estonia became world's first country to introduce e-residency. The individuals holding e-residency would be allowed to access various economic platforms but for legal and transparent business purposes. These e-residents can further extend their privileges to European business sector with the use of their digital identification. E-residents can avail different type of services such as launching an online business platform regardless of the location, establishing a company in single day which is trusted by European union, opening business accounts to avail e-banking, access to electronic payment providers such as Paypal, digital signatures and Estonian tax declaration online. So far, 62000 people have applied for e-residency from 162 countries.

- **Interoperability Services**

Estonia has developed a digital service-oriented society to serve the citizens at its best level by working as an integrated federation to serve its citizens and the organizations. The concept is to interlink the information database of various public and private organizations which entails the citizens to submit the credentials only once for obtaining the desired services. And to fulfil this purpose, Estonia has developed 'X-Road', a software-based solution which acts as a backbone for digital Estonia. Unlike other countries, Estonia does not store public data in master database, each public entity administers its own data and no duplication of record is performed. When another entity needs an information related to a citizen which is outside their jurisdictions, X-road provides data exchange provisions while insuring confidentiality, integrity and authenticity.

Each organization uses X-tee which insures secured outgoing and incoming connections, data encryption, signatures, authenticity and logging. X-road brings ease to various public service matters where manual processes could take days, even months for exchanging authentic information between the organizations. X-roads efficiently makes it possible for the authorities to exchange the information with each other which also gives a larger picture to the state to see how different services are connected and working with each other. X-road has evolved into a robust software solution which can integrate multiple information systems to run and write large data search queries among different information systems at the same time. Scalability is one of the finest features of the X-road, scaling up with new platforms and services can be done efficiently without hampering the performance. However, the implementation of X-Road in a country is neither simple nor automatically guarantees a success story similar to Estonia. X-Road requires appropriate prerequisites that must met before a successful adoption phase (Saputro, Pappel, Vainsalu, Lips & Draheim 2020).

Today, it is implemented in Finland, Kyrgyzstan, Faroe Islands, Iceland, Japan and other countries. Similar technology that is based on the Estonian interoperability experiences has also been implemented in Ukraine and Namibia (e-estonia.com). One more function of X-road is exchanging data between two or more X-road ecosystems as federated. For instance, two members of the different X-road ecosystems can exchange the services just like they do within the same ecosystem. The practical example of federated X-Road ecosystem is cross border coordination at data exchange layer between Estonia and Finland which was established in February 2018[1].

Best practices and lessons to be learned

In this section a summarized view of best practices adopted in Estonia will be elaborated.

- Leadership and public sector potential

It can be observed that one of the most important elements behind Estonia's e-government success is government's visionary leadership and intellectual support by public service experts for implementing consistent policies. According to the World Bank (2006), Government of Estonia adopted a persistent policy in recent years for initiating e-Governance projects in all public sectors (Verheijen, 2007). Ernsdorff & Berbec (2006) says that Estonian rapid development in e-Government and appearance as a digital leader shows a great commitment of the politicians who demonstrated their determination for

the integration of e-government programs in public service operations and political institutions across the board in addition to the civil society as well (Ernsdorff & Berbec, 2006). Hence, demonstrated that devoted political leadership among enthusiastic civil servants is essential for successful implementation of e-governance.

- Legislative and Regulation

Studies shows that, Estonia has done a remarkable effort in legislating ICT reforms in public sector services. Whereas, in underdeveloped countries reluctance is often seen by the political leaders for legislating ICT reforms under the fear of losing powers, various instances have been stated in the studies where e-governance initiatives (e.g., i-voting) were withhold by politicians. Unlike such countries, the most essential aspects are approved by the government of Estonia in legislative acts that facilitate the access and use of internet for administrative activities (Kalvet, 2012).

- Public Support and Awareness of IT

Over the past decade Estonia has been an attraction for IT companies and start-ups. It indicates public's interest and potential in ICT sector. Moreover, government and EU has also launched several projects to raise public's awareness of IT in Estonia. Raising Public Awareness about the Information Society (2007–2015) is one of these initiatives. The aim of the programme "Raising Public Awareness about the Information Society" is to enhance the awareness of the Information technology especially those technologies which interacts with Estonian public service sector[1].

- Coordination between the Public and Private Sector

The utmost focus of Estonian government in terms of Public and Private sector seems to be on the role of telecom companies and banks (Kalvet, 2012). E-ID and e-Voting are worth noticing in this regard. Verheijen (2007) states that Estonian government's policy of using existing technology developed by banks and cyber security organizations will aid in launching and expansion of electronic services especially through already covered market regions by the banking sector as well it will reduce the cost outlays.

- IT infrastructure development

One of the major contributions to the success factors in e-governance domain is investment in IT infrastructure. Almost 99% computers used in central government offices had internet access by 2005 (Kalvet, 2012). Estonian ministry of finance has done tremendous efforts in building up consistent economic policies which facilitates the

government to invest more for developing IT infrastructure. According to studies, Estonia among other Baltic countries has proved constant improvements in fiscal surplus that provides opportunities for investing more in creative projects (Verheijen, 2007).

3.1.2 Singapore

Singapore has developed an e-government model with a successful matrix. Singapore has invested suitable resources and showed determination for the improvement of online public service delivery. Legislation of suitable policies, strong vision and long-term planning are the influencing factors behind successful e-Government. Moreover, Singapore established intrusion control system to face any unwanted threats in the future (Ha & Coghill, 2008).

According to Minardi (2017), government of Singapore claims for developing to have a "world-class e-Government" that facilitates the citizens to have equal participation and authorization (Infocomm Development Authority of Singapore, 2000). Singaporean government has revolutionized its outlook, perception and public dealing. Government's commitment was regarded when EGDI ranked Singapore in top five countries of the world (Lee, 2002). The government of Singapore has established a long-standing agenda with 5 major thrusts and 6 programs for e-Government development. Government has spent $1.5 billion between 2002-2005 for e-government initiatives and to accomplish these objectives which are led by Infocomm Development Authority of Singapore (IDA, 2000). Fung says that five mottos of Singapore's e-Government are

1) Reviving government,
2) Providing e-services,
3) Efficient and effective
4) Utilizing Information Technology and the field of telecom to introduce new possibilities and competences
5) Bringing inventiveness with the use Telecom (Fung, 2004, p. 3)

According to Ha & Coghill (2008) e-Government is a strategic procedure and it demands determination by the government side to establish high standard accountability system in terms of policy making, resource allocation, building strategies and finally the implementations (Minardi, 2017). In light of this criteria, Singapore e-Government's mottos are abetted by six major programs:

1) Organizations founded on knowledge-based
2) Infocomm edification
3) E-service provisions
4) Innovation in technology
5) Flexible, upgradable and robust IDA infrastructure
6) Competent functional improvement (Ha & Coghill, 2008).

- e-ID card

National Registration Identity Card is a mandatory document provided to all legal residents of Singapore[1]. If an individual is under 15 years, NRIC will be provided after gaining age of 1 year, this card is not issued to exempted and criminal persons [1].

In order to provide personal data protection, Singapore government introduced two step access method, one time password (OTP), Sing Pass (Singapore Personal Access) and passcode. IDA states that with the increasing trend of SingPass authentication system 60% of SingPass users will be using the system for acquiring the data from the main database which will also prevent the hackers from intrusion (Minardi, 2017).

Further, Singaporean government introduced a state portal under the supervision of Immigration checkpoint authority[1] where citizens can obtain different public services online such as NRIC renewal, birth certificate, citizenship applications etc. Under each service, specific time in minutes is also mentioned which indicates the amount of time this particular service requires to complete the process. This portal enables the citizen's and the acquirers to get public services in just few minutes and let the government to invest fewer human resources.

- Singapore Personal Access

Singapore Personal Access service or Singpass[2] was initiated in 2003 which facilitates the citizens to make online transactions more than 60 government services in convenient and secured fashion. Singpass is administered by Government Technology Agency or GovTech and there are several new security operations which are in progress to ensure security and transparency of this service for the users. Singpass comes with user friendly interface which is compatible with all types of operating systems and devices such as computers and smartphones, and enhanced security features like two factor authentication mechanism for all digital transactions. Two-factor authentication requires the users to provide user id and secret password to login into system and then provide One Time

Password sent to user's mobile or generates a token through 'OneKey' token which adds an additional buffer of protection.

We can see the advantages of Singapore e-Government that led to the government acceptance or "trust" by the society. At the start of its eGovernment action plan in 2000, Singapore government has taken a substantial number of initiatives for economic development and IT implementation before the launch of its e-Government programs. Singapore stands on first most competitive economy in the world according to "The World Competitiveness Yearbook 2020"[3] which indicates the economic impact. The economic development factor is clearly observed by the fact that Singapore was ranked the second most competitive economy in the world in "The World Competitiveness Yearbook 2020", published by the International Institute for Management Development (IMD) and seventh most competitive economy in the " The Global Competitiveness Index 4.0 2019 Rankings " by World Economic Forum2 (WEF)[1]. (The Global Competitiveness Report, 2019)

3.1.3 Germany

According to Noack & Kubicek (2010) Germany initiated e-Government projects in 2000, by launching a federal government portal and projected to bring all government services online until 2005 (BMI 2006b). This project was led by Ministry of interior Germany. Government passed its third e-Government program in September 2006 and launched online authentication (BMI, 2006a). Also, government announced electronic ID card which was planned to be issued by 2009 and it meant to be the only token for authentication. Law for personal electronic ID was passed in 2009 which was also associated with authorizing Identity Management System (IDMS) to be used for online authentication. Several demo tests of federal portal and e-ID were performed, and the first batch of e-ID was then planned to be rolled out in 2010 (Noack & Kubicek, 2010).

Poller, et. al. (2012) describes that Interior ministry of Germany started issuing its National e-ID cards to the citizens in November 2010 which was measured as one of the most advanced initiatives. Government circulated the advertisements with the slogan that it's the most important card, this e-ID card will provide secured authentication mechanism for both public and private applications and above all, enhanced privacy functions (Poller, et. al. 2012).

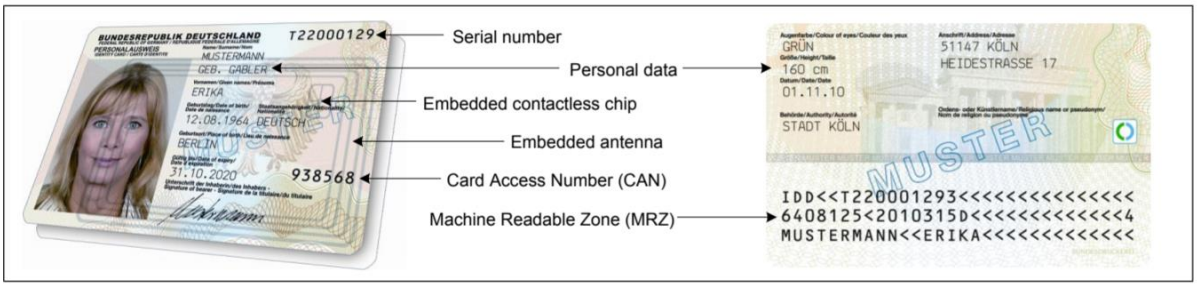

Figure 3. Front and back side of the new German ID card

This e-ID complies with ICAO 9303 standard and it is embedded with contactless chip which interacts with the computer device as per ISO-IEC 14443 & 7816 standards.

German e-ID also complies with token specifications of eIDAS along with complex system architecture.

According to a study, German e-ID chip acts as a layer of protection for the citizen's information stored inside and also provides security protection in the authentication process. E-ID follows two-way authentication mechanism one possession of e-ID and second knowledge (six digit code). Along with personal information of the citizen the chip also stores the secret pin code which completes the authentication session (Overview of German e-ID, 2017).

- Data stored in e-ID

German e-ID chip is embedded with an e-ID application which stores bio data of the cardholder. E-ID application contains the following information that may be exchanged with e-ID server during the process of authentication:

Front side	Back side
Cardholder picture	Date of Issue
Surname	Address
Given name	Height
Gender	Machine readable zone
Date of Birth	
Document number	
Personal code	
Date of expiry	
Citizenship	
Contactless chip	

Table 2. Textual information on German e-ID card

Moreover, this e-ID also provides revocation alert token, in case card is expired and valid anymore. The authentication process of German e-ID checks with the revocation e-ID database of ministry of interior and sends revocation token if the card holder data matches with invalid cards list (Overview of German e-ID, 2017).

- Authentication system

Process of authentication of German e-ID is termed as General Authentication Procedure, which is comprised on cryptographic properties. The technical information can be reviewed in eIDAS token specification (BSI TR-03110).

- PIN Verification via PACE

According to Overview of the German eID system (2017), PACE procedure performs the verification that user knows the PIN code and it generates a session which is encrypted and follows data integrity policy. This session also creates highly secured session keys between e-ID owner and computer device as well as the integrated chip. When PACE protocol established a positive session the exchange of information after the authentication is protected by encrypted channel.

- **Electronic functions of German e-ID card**

The smart card (Figure 4) carries three discrete electronic functions, all of these functions embedded with its data set for protection:

  - *E-Pass function is compulsory for government affairs which contains a digital depiction of the e-ID owner data similarly the information stored in e-passports.*
  - *E-ID function for common applications saves data sets of identification which can only be accessed by those services that are configured or permitted by the card owner. It's all up to the cardholder desire to enable of disable this function.*
  - *A discretionary e-Sign function which permits the owner of the e-ID card to save a private key and the certificate for the purpose of qualified e-signatures*

The function of German e-ID and e-Sign are protected by its assigned PIN code. **Table 3** shows a review of data records and functions (Overview of the German eID system, 2017).

Function	Purpose	PACE Password	Data and Functions
e-Pass (mandatory)	Readout by authorized offline inspection systems	CAN or MRZ	Face image 2 fingerprint images (optional) MRZ data
e-ID (activation optional)	Online applications read data or access functions as authorized	e-ID PIN	Family name, given name Artistic name, doctoral degree, Date and place of birth, Address and community ID, Date of expiry, Age verification, community ID verification, Restricted identification (pseudonym), Revocation feature
	Offline inspection systems read all data, update address and community ID	CAN or MRZ	
e-Sign (certificate optional)	Certification authority installs signature certificate online	e-ID PIN	Signature key and X.509 certificate Create electronic signatures

Table 3. Electronic functions and data of the ID card

- **Applications of e-ID**

The e-ID is embedded in German e-ID cards and the resident permits. It carries a defined set of data elements such as name, date of birth, address etc. In order to access state services online, e-ID is required with a smart card reading device and the client software provided by the ministry of interior. The personal computer plays a intermediary role in the exchange of communication between state portal and e-ID card. However, this e-ID still has shortcomings in terms of flexibility and interoperability among other countries (Nawaz, 2019).

Poller, et. al. (2012) defines the services which will get instant advantages by supporting electronic identity:

- *The public services and transactions which demands authenticated identification of the citizens.*
- *Government services should provide the facility for their citizens to review their personal data. Monetary organizations such as banks and credit card service providers should inform the card holders for accessing their information via online means.*
- *The institutions which saves customers information for the continuation of services like telecom service providers and banks.*

3.1.4 Sweden

Since 17th century, Sweden has testimonies of registering population records which is a long history (Tax Agency, 2009a). Gronlund (2010) states that following the same tradition of registering population records laid the foundation of administrative operations for maintaining population registry of Sweden in 1974. Since then, same citizen's identity code is used for government and private records. Later in 1990s, Sweden initiated the process of electronic services for the public and started rolling out first version of smart identity cards around mid 1990s (Grönlund, 2010).

- **e-ID card**

Grönlund describes that electronic signatures were established with legal framework in the year 2000. While following Swedish rich history, foundation of e-ID derived from the tradition of Swedish administration and data is collected from population registry which is then printed on e-ID card. The bio data contains, personal ID code of 12 digits, family name, given name, gender, date of birth, etc. The suffix and prefix of the ID code represents date of birth, geographical location, gender and checksum. Historically it was managed through the Church of Sweden, but responsibility was delegated to National tax agency in 1991 (tax agency, 2009). The national registration catalogue stores different data sets like name, address, spouse name, parent name, children, care taker, place of birth, nationality, ID code, marital status and migrant or emigration information (Grönlund, 2010).

- **Electronic Identity in Sweden**

According to Kjölberg (2005), electronic identities are legislated by Swedish law 2000-832 which is subject to qualified e-signatures that also enforce the directive of European Union 1999-93. The regulation guides the general meaning and concept of signature however it does not specify electronic identity or any cards. Whereas, two different types are enlisted, 'qualified' for top security standard which verifies that electronic ID is authenticated by qualified certificate and is developed by secured computer device, whereas, the second type is 'advance' which is the used in general electronic identity cards (Kjölberg, 2005).

Eaton, Hedman & Medaglia (2018) states that the initial electronic identity was given in 2003 which also known as Bank ID. While different private banks were using the proprietary user authentication protocols for their banking applications. With the widespread usage of mobile phones, Swedish government introduced Bank ID which was dedicated for mobile. This was launched with the joint venture of two telecom service providers, Telenor and Teliasonera. Later, this Bank ID for mobile was revoked in 2011 and new Mobile based Bank ID was launched for tablets and smart phones. This Mobile bank ID was independent of any service provider or mobile device. Another online payment service was introduced in 2012 which facilitates financial transfers from mobile to another mobile called SWISH which ascended as a successful online payment service (Eaton, Hedman & Medaglia, 2018).

As per Eaton, et. al. (2018) the company named 'Nordea' affiliated with banking ID technology in the year 2011 and begun issuance of Bank ID. Meanwhile, board of e-Identification started the project of introducing e-ID card by 2016. Swedish electronic identity evolution is one of the best case study for public and private sector coordination. In 2015, with the estimate of 1.2 billion transactions recorded through Mobile Bank ID and Bank ID which are the primary e-ID for most citizens (Eaton, et. al. 2018).

- **e-ID service provider**

The process of assigning e-IDs is carried out by Banks and specific telecom service providers. The government of Sweden has signed an agreement in 2008 with private sector service providers for buying the services at commercial prices. These service providers include three banks and one telecom company. All contractual suppliers of e-

IDs are bound to keep the security infrastructure up to date and provide calibration reports to the authorities. Whereas, single sign on and authentication among few services is performed on need basis (Alvik, T., Ølnes, J., & Hansteen, K. 2016). Swedish e-ID infrastructure is equipped by SAML 2.0 which is a security protocol that enables the secured communication between client and the service provider, especially the exchange of information related to authorization and authentication of user (Alvik, et al. 2016).

- **Swedish e-ID services**

In order to obtain public services in Sweden, the acquirer must possess a Swedish resident permit. The e-id can be obtained by certain banks and service providers. Citizens can login on e-ID portal[1] using suitable authentication method and obtain Swedish e-services. Swedish E-identification Board[2] is responsible body for promoting and coordinating electronic identification and signature for public sector services[3].
Various e-services are provided through e-ID in Sweden which are stated below:

- **e-Health**

According to Hägglund & Koch, Sweden has designed its national electronic health management system which serves citizens for their queries regarding health issues, medical advices, medication history, anonymous communication with the health care specialist that is required to respond in seven working days. Swedish health care portal provides citizens to obtain medical appointments, change the appointments as per preferences, acquire prescriptions, requests for renewal, specialist diagnosis requests or change the health care clinic or hospital. Different hospitals and health care centres provide different services, so it's service provider's prerogative to allow number of health care services for the citizens. Citizens can access healthcare portal through e-ID card and ID code. As per studies conducted in 2014, more then two million signed up with Swedish health care portal and Hägglund & Koch states that only in November 2014, around 135000 people created their accounts from overall Sweden (Hägglund & Koch, 2015).

- **Digital post**

More than four million people are using a digital mailbox to where they receive digital mail from the public sector. Digital mail is fast, secure, free, friendly to the environment, and always accessible[2]. Through this digital mail public operator can send mail digitally

to private individuals and companies. It is simple, durable and cost saving. The recipient receives their mail safely and collectively.

- **e-Commerce and e-invoicing**

E-commerce contributes to more efficient purchasing processes and a number of other benefits for both public actors and suppliers. The purpose of e-commerce is to contribute to an efficient purchasing process that enables improved management of purchases towards existing procured agreements for both public and private sectors[2].

- **e-invoicing**

Swedish government requires all purchases to be done electronically in the field of public sector and by law to be electronically invoiced according to EU standards. From April 2019 it is mandatory to send and receive e-invoices which applies to all public procurements, including direct procurements. This also means that all suppliers to the public sector must send e-invoices that comply with the new standard, and all public sector organisations must be able to receive these invoices. The requirement to send e-invoices applies to all suppliers within and outside of the EU[3].

- **Swedish services with Estonian e-ID**

Estonia has become the first EU country whose e-ID can access Swedish e-services[4]. Nordic countries are renowned for digitalization in public sector and this digitalization goes across the international borders to provide safe and secured online transactions. This initiative is bringing more trust in e-services for international communities and other countries are also following this model.

3.2 Iranian e-ID Project

A recent study has been conducted on Iranian e-ID project with the similar research matter which can be very useful in evaluating studies in Pakistan, since Iran is a neighbouring country and there are various geographic, cultural, sacramental similarities in both nations. Therefore, it will be very helpful to review Iranian e-ID project and the associated challenges faced by Iranian government and the stakeholders, as well as the citizen's response to e-ID initiative.

Iranian E-ID project was introduced by National Organization for Civil Registration (NOCR) in 2012 through the pilot project conducted for 10,000 government employees

in Holy city of Qum while considering the fact that the particular province had sufficient IT infrastructure (Shabani, 2017). The Iranian government aimed to finish the replacement of legacy identity cards with e-IDs by 2020, but due to challenges associated with public sector and bureaucracy it's still underway and the outcomes did not meet the expectations. Hamshahri (2019) says, that as per the figures, 62 million citizens were subjected to be issued e-ID card out of which 54 million have been issued and 8 million people still did not receive e-ID card (Hamshahri, 2019).

Government of Iran is still struggling with e-ID project regardless of the fact that the project was launched in 2012. Firstly, according to a news article, NOCR claims that the target of issuing e-ID is not yet completed (BornaNews, 2019). Secondly, technology acceptance seems the major reason from the citizen's side, majority of the public is unaware with e-ID functions, usages and benefits and adaptation failure will also result in loss of government's investment in this national e-ID project.

The studies concludes that Iran has always shown the commitment to introduce technological advancements in public sector for the welfare of citizens, but there are several international limitations which are engaging Iranian government in different geopolitical matters and as a result Iranian government could not accomplish the desired objectives of e-ID and related e-Governance projects. However, the research also indicates that there is very less research work done on Iranian e-ID management system and there is a lot of research potential which must be utilized in future studies.

4 Pakistan's e-ID structure

In previous chapter author discussed state of the art e-ID implementations in which the concept of e-ID and related terminologies were expressed which are closely related to the study. We also illustrated the e-ID projects in few of the world's most recognized and successful countries in e-governance field. This chapter will throw light on Pakistan's e-ID initiative which is led by NADRA (National Database and Registration Authority) under the authority of Pakistan's Interior Ministry. Author distributed the chapter in four segments, first section reviews the background of Pakistan's e-Governance progress and the initiatives by the government. Second section will elaborate National identity cards, third section will explain new e-Governance initiatives, fourth section will elaborate the current status of e-ID and finally e-ID components and specifications.

4.1 Pakistan's e-Governance progress

e-Government introduces an efficient system which provides transparency, accountability and effectiveness delivered by any government by using Information and communication technology. The key success indicator of a developed country is measured on the scale of how much progress a specific country has done in the field of electronic governance. Countries are investing more in e-Governance sector than ever before to meet the development goals. According to 2020 UN (United Nations) E-Government Survey, among the countries with high Online service index (OSI) values Pakistan is particularly worthy of note for their impressive advancements in online services provision despite having middle or low levels of infrastructure development.[1]

Regardless of these advancements, Pakistan has surprisingly declined in e-Governance ranking in last few years, according to United Nations e-Government Development Index (UN EGDI) survey, Pakistan declined from 148 to 153 since 2018-2020, which is a serious concern for the government. However, continuous development in EGDI, OSI, Telecommunication Infrastructure index (TII) and Human capital index (HCI) is appreciable while considering high population and poor economy. United Nations

Electronic Government Survey index obtained from Pakistan in last 5 surveys is given in the following table.

Year	EGDI Level	Rating Class	Rank	EGDI	Online Service Index	Telecommunications Infrastructure Index	Human Capital Index
2020	Middle EGDI	M3	153	0.4183	0.6294	0.2437	0.3818
2018	Middle EGDI	M3	148	0.3566	0.5486	0.1529	0.3682
2016	Middle EGDI	N/A	159	0.2583	0.3261	0.1299	0.3190
2014	Middle EGDI	N/A	158	0.2580	0.3228	0.1174	0.3337
2012	Middle EGDI	N/A	156	0.2823	0.3660	0.1239	0.3572

Table 4. UN EGDI 2012, 2014, 2016, 2018 & 2020

That is why Pakistan is continuously striving to regulate e-governance tools and for this purpose several initiatives have been taken very recently to create a communication medium between government and the citizens. In next section, Pakistan's e-government initiatives are briefly reviewed.

4.1.1 New e-Governance Initiatives

- NADRA portal

Pakistan has been working for the development of e-services by the government since 2002. The government aims to enhance the efficiency of the public administrative and legislative institutes. Government is releasing funds to extend e-government services at national as well as at provincial level. NADRA is one of government's most developed institute and it is compulsory for every citizen of Pakistan to get register with NADRA to have an identity that individual belongs to Pakistan. Also, it is mandatory for every citizen if he/she wants to have a passport, bank account or to work with any organization within the country (Hassan, Madad, Das, Akhtar & Jehan, 2019). NADRA has named it Pak-Identity portal[1] which offers variety of e-services for the citizens, such as online issuance and renewal of national identity card, Pakistan origin card (POC), national identity card for overseas citizens (NICOP), family registration certificate (FRC) and birth certificates. Moreover, this portal is also a gateway to other online services which are offered by the other government organizations.

Along with local initiatives, NADRA is also working on international projects[2] for digital initiatives in Bangladesh, Kenya, Sudan, Nigeria and Fiji. The projects range from digital drivers licensing system, passport issuance control system, electronic passport system,

1- https://id.nadra.gov.pk/
2- https://www.nadra.gov.pk/international-projects/

civil registration system, national identity management system and election management system respectively.

- Pakistan Citizen's Portal app

Pakistan citizen's portal[1] smartphone app is a digital initiative by the government launched in October 2018 which aims to encourage citizen's centric governance system. This portal provides one window solution to the citizens across the country and diasporas to connect with public organizations at all levels for initiating their grievances, compensations and suggestions with public office representatives. It also helps the government to facilitate the environment of assessable performance management system and to make government sector accountable for their designated responsibilities. Until January 2020, 1.5 million complaints were resolved out of 1.7 million complaints by 1.4 million registered members[2].

- E-Tax

Government of Pakistan is providing e-Tax service from quite a long time. Federal board of revenue is the tax collection authority in which is offering tax filling services through a web portal known as FBR tax profiling system[3] since 2007. The motive is to ease the taxation process and to facilitate the citizens for their responsibility of paying the taxes. This portal allows the citizens to review their tax profiles and correlate their information from various data sources, financial assets, utilities and living standards available with FBR records. One can avail this service if citizen holds CNIC or NICOP, possesses Pakistan telecommunication authority (PTA) registered cell number, have paid Rs. 500 PKR, 18 years or older and have an email address for the users living outside Pakistan.

- E-Visa

Geographically Pakistan located one of world's most strategic points. From world's highest mountains to sandy beaches, the country is enriched with all type climates, diversity of cultures and history, which attracts the tourists from all around the world. Therefore, for easing the visa process, government has recently initiated e-visa portal[4] which issues online visas to the citizens of 175 countries. e-Visa can be obtained in few minutes and the applicant can keep the printed copy of visa for immigration. This e-visa portal also provides business visas to 95 countries. This e-visa facilitation has attracted thousands of tourists in last year and according to Forbes and Conde Nast Traveller

1-http://savings.gov.pk/wp-content/uploads/Pakistan-Citizen-Portal-Manual-1.0.pdf2
2-https://dailytimes.com.pk/556475/pakistan-citizen-portal-resolved-over-1-5-million-complaints-senate-told/
3-https://taxnet.nadra.gov.pk/itax/
4-https://visa.nadra.gov.pk/

Pakistan has become top tourist point. Hyams D (2020) says, in recent years the country has been heavily invested in growing its tourism industry. And it is working; Pakistan has been lauded by publications like Forbes and Condé Nast Traveller as a top destination for 2020, and even received a highly publicized visit from Prince William and Kate Middleton last October (Hyams D, 2020). Tourism industry is a huge boost to the country's economy which is struggling over the past few decades.

- I-Voting

Election commission of Pakistan (ECP) in coordination with NADRA has established an online voting portal for overseas citizens. With this portal, overseas Pakistanis can cast their votes in the relevant constituencies as per the voting database. Votes can be casted by using any computer or smart device which is connected to the internet. An overseas citizen who wants to use this privilege must possess the NICOP, a machine-readable passport and a valid email address. Overseas citizens must register first with online voting system in order to cast their votes. To register voter should create an account using NICOP number, email address and mobile number on ECP overseas voting portal[1]. System will verify the voter's eligibility by few security questions, and it will register the voter for election day. It will generate a voting pass which will be used for casting a vote on the designated election day. At the same time, it will remove the voter's eligibility from casting the vote in local polling station. The first pilot test of i-voting was executed in 35 constituencies on 14th October 2018 which was controlled by ECP's Internet Voting Task Force (IVTF). Total of 7419 overseas casted their votes through i-voting portal in 35 constituencies (ECP, 2018).

4.2 Pakistan's National Identity Card

According to the NADRA ordinance 2000, a citizen of Pakistan who has attained the age of 18 must get National Identity Card whether the citizen is resident or non-resident. This card obliges as an identity document to authenticate one's identity for being a Pakistani citizen. Before this, manual identity cards were used as a purpose of identity and data was kept in form of catalogues.

1- https://www.ecp.gov.pk/

Figure 4. National Identity Card Transition in Pakistan

But since 2002, citizens data is stored in centralized database owned and administered by NADRA. Initially, NADRA introduced Computerized National Identity Cards (CNIC) for the citizens and Smart National Identity Cards for overseas citizens or NICOP. However, since 2012 NADRA has been issuing SNIC to local citizens as well. In next section both types of National ID cards are elaborated.

- CNIC - Computerized National Identity Card

Authority started issuing biometric CNICs upon returning the manual National Id cards to NADRA facilitation centres, and in case citizen does not possesses old National Identity cards, the citizen had to provide a certificate from the concerned union council. CNIC is a machine-readable card which has facial, fingerprint information, 13-digit unique ID code, legal name, gender, spouse or parent name, signature, identification mark, address and few security features like hologram, embossed Pakistani flag etc. through which card's originality can be checked. CNIC cards can be used to access any government services in Pakistan such as opening a bank account, enrolling to the college or university, and CNIC is compulsory to obtain other identity documents such as, driver's license, passport and arms license. CNIC is issued only in Urdu text which is Pakistan's national language.

- SNIC Card

In 2012, SNIC was presented by NADRA for the citizens of Pakistan. A microchip is embedded in SNIC which holds encrypted data of cardholder. The SNIC also contains readable information such as: legal name, father or spouse name, date of birth, gender, 13-digit identity number, date of card issuance and expiry, holder's signature, on the front

side one coloured picture and one printed in discrete layer in grey colour and one at back side along with QR code. SNIC card is rooted with outstanding security features and as it complies with ICAO standard 9303 and ISO standard 7816-4 therefore it can be used as a substitute to the international travelling document at the airports. The information on SNIC is also provided in dual languages, English and Urdu. NADRA Chairman stated in the interview with Associated Press of Pakistan that "SNIC will provide the services for card owners to access the entitled cash disbursement programmes, financial transactions, branchless banking, health insurance, life insurance and electronic voting" (APP, 2012). According to the NADRA website, this SNIC also provides accidental death insurance policy and it will facilitate the pensioners who are registered in Employees Old Age Benefits Institution (EOBI). NADRA chairman also claims that the disbursement of rural development and relief funds to the least privileged citizens will be performed by using SNIC cards (UNHCR, 2013).

4.3 Present state of identity management in Pakistan

According to National Identification system (2020), innovating from paper based identity documentation towards state of the art electronic identity management system is great development considering the crises whole country is dealing with. Regardless, NADRA is utilizing all it's potential to issue SNIC to all Pakistani citizens both locally and internationally. Though, in 2012 NADRA aimed to replace CNICs with SNIC across the country but both identity cards are still valid till date and citizens can obtain any of them as per their choice, however, NADRA is constantly encouraging citizens to obtain SNIC. Apparently, the biggest hurdle is the fee requirement for SNIC which is Rs. 750 PKR as compare to CNIC which is Rs. 400 PKR[1], therefore people are reluctant to pay the extra money. Most of such citizens belong to the rural areas of Pakistan who do not have sufficient knowledge of e-ID technologies.

- Biometric Verification Service

According to NADRA website[1], the authorities are striving hard for the integration of private organizations with advanced biometric verification system which will eliminate the odds of discrepancies and also it will help NADRA to accumulate more data and coverage. These private organizations include banks and telecom service providers and few other sectors. To enhance the authentication process, NADRA has introduced

biometric authentication on ATM machines, so far only few banks could implement this however it is expected that all banks will equip their ATM machines with this mechanism (Digitalpersona, 2016).

4.4 Overview of SNIC system components

SNIC embedded with e-ID functionalities such as electronic identification and authentication that enables multiple applications to be used by this one card. This smart ID card can be used for various financial and banking operations and it is manufactured by using latest technology and security features. As per UNHCR article, SNIC is combined with 36 security features in the tangible design of card, which makes it one of the safest ID cards in the world (UNHCR, 2013). Few of SNIC security features can be seen without magnifying glass, as shown in figure 7. According to an article[2], SNIC printing is performed very carefully in different coatings and each coating has a collection of security features and the chip is integrated with an application which stores the citizen's data in encrypted form. SNIC is also integrated with Radio frequency identification (RFID) technology which enables the card to be used RFID enabled devices. NADRA has also developed an applet which allows the citizens to perform remote verifications. Citizens can use NADRA designed card readers, when user inserts SNIC in the card reading device, the device authenticate the reader to the card and in response, card verifies its authenticity to the device. The reading device will prompt for fingerprint impression if both verifications are true. This application of SNIC can be used in the remote regions of Pakistan which has a vast geography, especially in the areas where NADRA service points are not available.

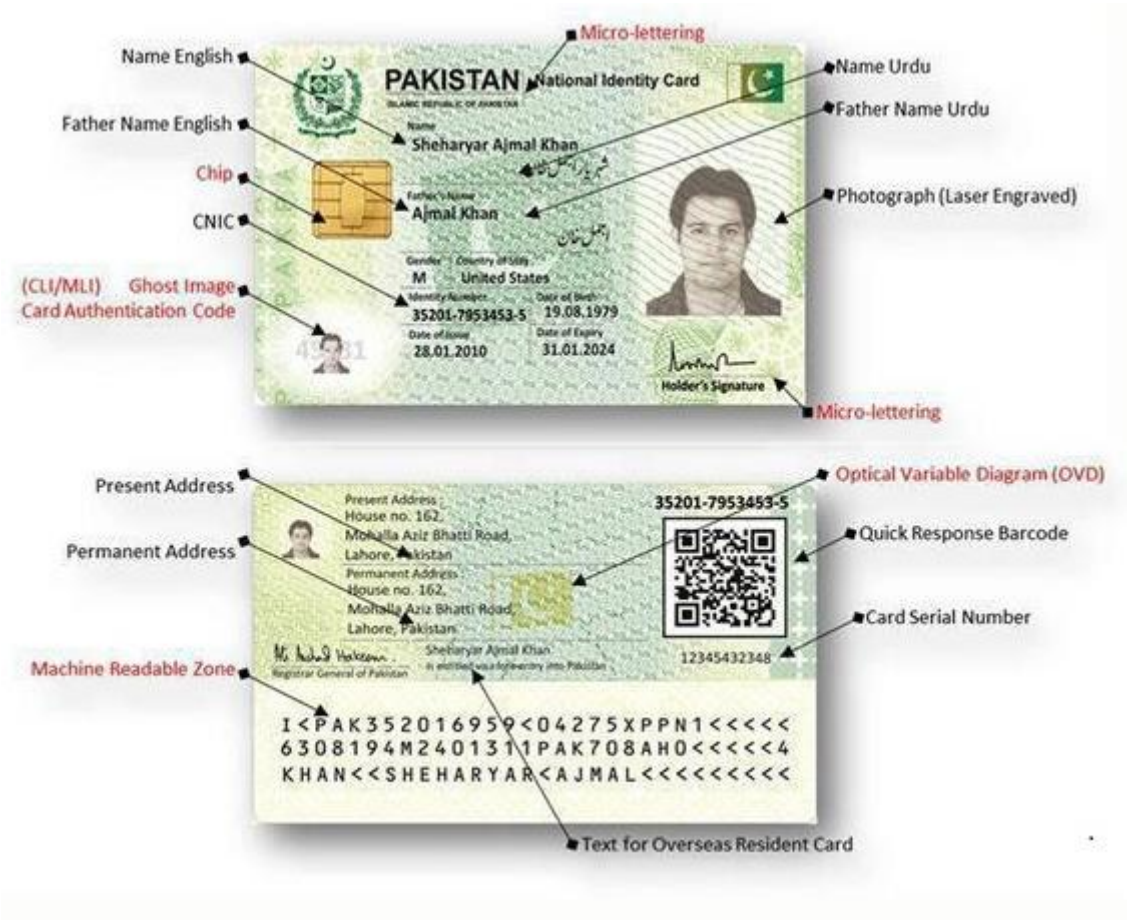

Figure 5. Front and back side of SNIC

Operations of SNIC in Pakistan

- As Smart Card

So far, SNIC digital functions e.g. digital id, digital signatures, electronic authentication etc. is not yet legislated by the government of Pakistan. However, NADRA has developed protype applications and card readers which can be used for using this identity card as an electronic id.

- As an Identity document

Since the e-ID functionality is not fully operational but SNIC holders can use this card as an identity document as well for accessing government services. It contains all primary information of the citizen which is required for physical verification of the citizen at government service points. Citizens presents their SNIC cards at government offices and verify their identity by using fingerprint optical sensing machine. The common services

for which SNIC is used are obtaining driver’s license, registering a new mobile sim card, payment of taxes and utilities, new passport application, opening a bank account etc.

5 Results and Findings

This chapter will discuss analyses and findings derived by quantitative research approach and in this framework two surveys were conducted, one from general public to assess citizen's needs, feedback, expectations and opportunity areas, which are disregarded. Second survey is conducted from NADRA executives to evaluate professional perspective about SNIC project in Pakistan. Analysing both perspectives will provide a true picture behind the slow progress of e-ID and unwillingness of Pakistani citizens towards e-ID adaptation.

5.1 Citizen's perspective, awareness and opportunities

e-Governance aims to serve the citizens via electronic services and e-ID is the fundamental part of accessing and getting these services. For each e-service transaction, start to finish there are two key participants and without these the transactions cannot be completed. These participants are 'Government' and 'Citizens'. For successful e-service operation citizens must possess enough understanding about e-services, no matter how fast and high-end government's e-governance system is, it all relies on the citizen's end, how do they respond to these e-facilities. Otherwise, all efforts can go in vain and it may produce unsatisfactory outputs.

This survey was designed to be conducted from Pakistani citizens from different regions to assess following aspects:

1- Evaluating citizen's knowledge about IT, related technologies especially internet based on age groups and education

2- Citizen's awareness and concept of e-ID, electronic services and electronic governance. In addition, e-services provided by the government

3- The response of citizens in contrast of National Identity card transition from CNIC to SNIC

4- Citizen's opinion about sharing their information with the government, level of trust and insecurity

Survey was dispersed by using social media and messaging groups (e.g. Facebook and WhatsApp) in my social circle with 350+ individuals during the period of June-July 2020, out of which 305 people participated. This survey comprised of 18 multiple choice questions with one question of multiple 'answer key'. However, all questions were compulsory to answer in order to submit the survey. Google forums an open source online surveying tool was used to collect this data.

Survey answers and results obtained are specified below.

Q1 – The participants were asked to specify their age

This question aims to determine citizen's awareness of e-ID according to the age groups. The result shows that 18-30 age group participants are the highest in numbers with 56.3%, whereas 31-40 with 22.7%, 41-50 with 13.8% and 51-60 age group showed least interest in survey participation of 7.2% (see figure 6). These numbers also show the level of interest and technology awareness among different age groups of the society.

Q2 – Survey participants were asked for their province or state of residence

Objective of this question is to find out the service delivery of e-ID by NADRA in different regions of Pakistan. Since, Pakistan has four provinces and two states, with such vast geography makes very challenging and difficult to connect with each citizen. So, participants are asked to choose the region they belong and results show that 66.8% participants belong to Punjab which is highest, followed by Sindh with 10.5%, KPK with 9.5%, Gilgit Baltistan with 5.3%, Baluchistan with 4.6% and Azad Jammu & Kashmir with the least of 3.3% (See figure 7). These numbers also show the population of different provinces, survey participants are higher in numbers from Punjab, so the population is. Same with Baluchistan and Azad Jammu & Kashmir.

Q3 – Qualification and level of the education

This question aims to examine the education level of the respondents. The result shows that 48% of participants have master's degree which is highest in among other participants, followed by 33.6% participant's with bachelor's degree, 10.5% with higher secondary and secondary school education, 3% with under secondary school, 2.6% with

PhD degrees, and 2.1% with technical diploma holders and other qualifications (see figure 8).

Q4 – Respondents are asked for their source of livelihood

This question aims to determine respondent's source of earning and then finding out their opinions for e-ID project. Results show that 47% of respondents are private sector employees, 15.8% are government servants, 14.8% owns private businesses, 5.9% of combined respondents related to pension holders, owner of private company or institute and farming. Whereas, due to limited text additional category 'Other' was also given, just in case any profession is not covered in above options may help the participants to choose this. Which is opted by 16.4% participants. In above results, majority of participants are private sector employees which indicates that private sector covers most of the population (see figure 9). However, the number of government servants and private business owners are almost similar.

Q5 – This question asked the respondents for internet usage in daily lives

The aim of this question is to examine the number of people who have internet facility and how much internet they use in daily routine. The outcomes show that 90.8% of respondents use internet in their daily lives and which stipulates that large number of people have access to the internet. While 6.6% of the respondents use internet 'sometimes' in their routines, 0.7% with very rare usage, 1% respondents which are 3 in numbers wants to use internet but they do not have sufficient skills and 0.3% are regular internet users but the coverage in their area is very limited (See figure 10). The results also help in assessing barriers in accessing internet enough knowledge required to use internet.

Q6 – This question inquiries the respondents for what purpose they internet for most?

According to the results, majority of the respondents use internet for entertainment, social media and web surfing with 52.5% followed by 21.5% with business and work related activities, 11.2% participants chose all options which includes social media, online banking, e-services, reading news, business and work. 6.9% participants chose other,

whereas users of online banking and reading news remain identical with 3.3% which makes 10 users from both groups. 1% participants chose none as their usage and only 0.3 % participants opted public e-services which is 1 in number as their choice for internet usage (See figure 11). Though, the results are obtained from 304 citizens which portrays very small segment of the whole country.

Q7 – Participants were asked for the awareness of electronic services provided by the government

Results show that majority of the participants with 67.4% chose that they are aware of electronic services provided by the government while 32.6% says they are unaware of the electronic services (See figure 12). If we analyse the initial questions regarding education which showed that majority of the participants are highly educated but still 32.6% of them are unaware of online services which is 99 in number out of 304 participants. This indicates that education is not only the essential component of public awareness, government needs to execute extraordinary campaigns to raise citizen's awareness of public services which are associated with the technology.

Q8 – Participants were asked if they experience long awaiting ques while visiting government offices like NADRA, Police Stations, City District Government

To answer this question, participants were given four options. And majority of participants with 35.9% experience long ques at government offices most of the time along with 20.4% experienced it always. These both categories are quite similar and combining them both will make it 55.9% which is a huge number who experience delays at service delivery offices. Whereas, 22.7% participants experience such delays sometimes and 21.1% rarely had such experiences (See figure 13). There are number of factors behind these numbers which can be explored further because all public offices are not equipped with computerized systems, participants with less delaying experience might have visited public service offices like NADRA which has a computerized queuing system and similarly people experiencing long delivery times might have experiences with public service offices like education board or water and power supply departments.

Q9 – In this question, participants were asked for preferred or most used gateway they use to access public electronic services

According to the results, 28.3% participants use Prime minister complaint portal app followed by 27% of participants who were not aware of any government service portal or application, whereas 24.3% participants are aware of government service gateways but they never used it and 20.4% participants uses web portal (See figure 14). The objective of Prime minister complaint portal and web portal is comparable so if we combine both participant's numbers, it makes 48.7% that is a significant number of users who are connected to public service platforms. However, the participants unawareness should be taken seriously by the government authorities and more awareness campaigns should be launched.

Q10 – Participants were asked about the public e-services they have used and provided with given multiple selective options

To answer this question, participants were given a choice to select multiple options. As per responses, the e-services which are used most are related to NADRA, Prime minister complaint portal, e-Tax service and Higher education commission portal with almost 70% of the users. Whereas, 26% participants did not use any e-service. Participants chose other services as well but small in numbers. Figure 15 can be seen.

Q11 – Citizens were asked that do they possess SNIC (Smart National Identity Card)

Result shows that 60.2% participants have SNIC and 36.5% participants did not obtain SNIC yet. However, 3.3% participants have not idea of SNIC (See figure 16). Combining the results from the participants who do not possess SNIC and who do not have enough knowledge are almost 40% which is a flaw at government end. NADRA aimed to replace all CNICs by 2020 but still there is a huge number who is still using CNIC.

Q12 & Q13 – In this question, participants were asked for their preference if they want to replace CNIC with SNIC?

Participants were given with multiple options in this question related to the usage of SNIC. The results shows that 29.6% participants liked the idea of text written in dual languages on SNIC, 18.1% supports the use of electronic services with SNIC, 17.8% think that SNIC is easier to use, 15.8% participants think SNIC looks better, 8.2% do not want to change CNIC with SNIC and with the least number of responses 3.3% participants believe that having SNIC is mandatory (See figure17 & 18).

Q14 – In this question participants were asked if they are aware of any SNIC application

The purpose of this question is to assess citizen's knowledge about e-ID applications. The results in the survey chart shows that 50.3% are unaware of any e-ID applications, whereas 12.8% choose all given options and same number of participants polled electronic authentication. Similarly, participants with the knowledge of digital signatures and internet voting also remain identical as above with 11.5% each. Only 1% of the participants opted national health insurance and e-prescriptions (See figure 19).

Q15 – In this question participants were asked about the usage digital signature

As per the results, 48.4% participants never used digital signature, 28.3% participants used digital signatures, 15.8% says that they do not have information about it and 7.6% participants are interested in using digital signature, but they do not know how to use it (See figure 20). It is worth noticing that in Pakistan digital signatures are not yet initiated and these participants who used digital signatures are mostly living in Estonia and other developed countries.

Q16 – Participants were asked for the usage of SNIC, specifically for what purpose they have used it so far

The results show that majority of participants did not use SNIC so far for any electronic service, 33.2% people used it just for physical verification and surprisingly 20.8% says that they used it for digital authentication at public service delivery points and 1.6% of participants used it for medical records (See figure 21). These results show that quite several participants are uninformed with the concept of e-ID and claim that they have

used SNIC for digital signatures while NADRA has not yet launched digital signature application for public use.

Q17 – In this question participants were asked that would they prefer to use public services online or to visit government offices physically

As per the results, 82.9% showed interest towards using public services online, 9.5% participants have not enough knowledge to use online services and 7.6% still prefers to go government service centres physically (See figure 22).

Q18 – In this question participants were asked about their level of trust in the government departments for accessing personal information inside SNIC

The results indicate that majority of the participants trust the government departments with 66.4% whereas 33.6% participants do not trust the government departments for accessing their information (See figure 23). This result also highlights a very important issue that for successful transmission of public services, citizen's trust is a crucial element.

It can be said that citizens of different age groups, regional and educational background possess very limited knowledge of e-ID and associated e-services. Most participants were young and highly educated but could not comprehend basic e-services concept. Also, many participants hold SNICs, but they do not know the functionalities integrated with it. And there is still a significant number of participants who do not have SNIC cards even few participants still preferred to use the legacy identity cards. However, internet users are high in number as per the results which indicates the future potential of SNIC and online government services.

5.2 Challenges associated to e-ID in public sector of Pakistan

This segment examines e-ID initiator's perspective regarding the challenges that public sector is facing in Pakistan's e-ID project. Since NADRA is leading this project therefore a survey was conducted with NADRA employees working on different positions and in different regions of Pakistan by using Google forms. Total of 53 responses were received. This survey was designed to measure following aspects:

- Problems and hurdles e-ID initiators are facing in government sector of Pakistan
- Government services provisions to the citizen's after the launch of SNIC
- Accessibility of government services through online platforms by the citizens
- Complications involved from public servants and bureaucracy
- Public service employee's own opinion about using online platforms or traditional servicing method

Following questions were asked in this survey:

Q1 – Participants were asked their opinion about SNIC, whether it has eased the citizens in accessing government services or not.

Out of 53 participants, 81.1% NADRA executives believe that it SNIC has not improved or facilitated the citizens in accessing public services online and 15.1% thinks that it has helped the citizens in accessing online services (See figure 24). Unsatisfactory remarks can be observed by most of the NADRA employees.

Q2 – Survey participants were asked to confirm that in current situation, are Pakistani citizens able to obtain online government services by using SNIC

Majority of the participants with 79.2% disagree that citizens can access online government services by using SNIC whereas 21.8% of the survey participants confirms that citizens can obtain online government services with SNIC (See figure 25). It is obvious that online government services are not accessible with SNIC which majority of the participants also believe.

Q3 – In this question NADRA employees were asked that do they think that the use of SNIC has reduced the bureaucratic delays that citizens face in accessing government services

Similarly, like previous response high number of respondents with 86.8% disagree that SNIC has reduced the bureaucratic complications which causes delay in the delivery of government services (See figure 26). It indicates that regardless of huge investment in launching SNIC project, public is still struggling with basic issues in accessing government services.

Q4 – The employees were asked about their preference to use SNIC to use online government services or they would prefer to access government services offline

According to the results, unlike previous responses NADRA employees showed huge interest in using SNIC for accessing government service online with 98.1% positive responses (See figure 27). It can be said that if SNIC becomes operational then majority of NADRA employees will prefer to use e-services integrated with it.

Q5 – In this question, participants were asked their opinion about the challenges and limitations of the government sector to facilitate Pakistani citizens in accessing online government services. To answer this question, participants were given choice of selecting multiple answers.

As per the responses, NADRA employees indicated several issues which are hindering the institutions to provide online government services. Majority of participants think that it is the limited budget of technology upgradation, lack of public access to the internet and coordination between government departments, bureaucratic issues and lack of IT infrastructure. Employee's responses illustrate that there are multiple factors which are obstructing the government to facilitate the citizens (see Figure 28).
In this question, employees were also given the option to express their views about government's progress on SNIC project and related services in 'Other's section', 13 employees added their comments which are given below:

- "The major concern is government's legislation, even NADRA wants to develop e-ID infrastructure in public sector of Pakistan, the ordinance would not be passed by the consensus of political parties. Any such ordinance requires 2/3 majority in

the parliament and opposition parties would not help the government to pass such bills".

- "Till date SNIC is not fully functional".
- "Corruption issue in government departments".
- "The major hurdle is the political parties who do not want to initiate any project which can bring transparency in public service affairs.".
- "Corruption is the root cause behind the delays in SNIC project.".
- "I will definitely use SNIC over traditional services. And I think that political resistance and illiteracy are the core factors behind the delay of SNIC project.".
- "As a NADRA employee, I can say that we have developed online platform for providing public services through SNIC and prototype is also presented to the Ministry of interior, but it is still under legislation".
- "Various services are already provided online with the help of NADRA but, none of them are using SNIC authentication so there is still lot to be done in this project from government side. NADRA has already established a prototype, but it requires government support".
- "Corruption by the political elite, especially the politicians in the opposition currently.".
- "Lack of IT infrastructure and IT trainings, illiteracy and lack of political will from all political stakeholders".
- "Financial issues, Information Technology development issues, and lack of political support".

The NADRA employees give the impression dissatisfaction with the progress of SNIC project. Additionally, employees highlighted other factors as well which are causing delays in prospective output of SNIC project such as government's will, corruption, lack of investment and poor IT infrastructure. Whereas, almost all participants were optimistic and demonstrated their huge interest in using SNIC for accessing future online government services (see figure 29).

6 Recommendations and Conclusion

In this chapter author will provide the recommendations based on lessons learned from developed country's e-ID management systems and quantitative research analyses performed on the results obtained from the surveys conducted from general public and SNIC project stakeholders. Lastly, concluding the thesis work.

6.1 Recommendations

In the previous chapter, author highlighted difficulty areas for SNIC project from public and government side based on the conducted surveys. The results indicated that citizens are unaware of e-ID concept and its usage whereas from government side, it is noticed that the poor IT infrastructure and political involvement are main reasons due to which SNIC project has not been operational yet. Based on these findings and lessons learned from developed countries, author aims to make recommendations to create more opportunities for raising citizen's awareness and to accelerate SNIC project process and to appease the complications involved in it.

- **Recommendations for creating opportunities for the citizens**
    - Government may introduce e-Governance degree programs and certifications for the general public in schools, colleges and universities.
    - Government may include e-ID certifications in KPI's of public servants to get at least intermediate level recognition. Since there are 3 million government servants in Pakistan and this action will be result oriented.
    - Launching country wide awareness campaigns to enlighten SNIC usage.
    - Training programs for the schoolteachers to educate young students with SNIC benefits.
    - Using social media apps such as Facebook, Twitter and WhatsApp to prevail salient features of SNIC and its benefits. Similarly, all government websites can be used for same purpose.

- TV commercials should be broadcasted on Public tv and especially using private media channels which have most audience.

- Government departments and service points should be furnished with attractive banners which presents key benefits of using SNIC.

- Enhancing citizen's portal into full fledge platform by integrating all available digital services, which will eliminate the difficulties of the citizens in accessing different portals for acquiring e-services.

- Pakistan post and other departments which are using paper documentations can advertise awareness messages for all citizens, especially utility bills can be used which are delivered by post to every household.

- Government should assure the citizens by introducing long term policies for public sector development without the influence of politicians. Inconsistent political system motivates the political leaders to spend public money on short term projects so they can retain the power.

- **Recommendations speeding up SNIC project**

    - A recommendation based on lesson learned from the literature review of developed country's e-ID management systems, it is highly endorsed for Pakistani government to affiliate NADRA with private sector organizations, e.g. banks. In this regard, Estonia has organized its e-ID infrastructure with joint venture of public and private sector organizations which are doing a remarkable job in serving their citizens. Similar model can be adopted in Pakistan, since there are large number of private sector banks who have already developed secured online banking systems and government can utilize their channels for providing access to public services.

    - Another recommendation is to make NADRA an autonomous body just like ECP (Election Commission of Pakistan) and NAB (National Accountability Bureau). It will alleviate the hurdles imposed on NADRA by the political parties and NADRA will be able to work with its maximum potential.

- E-Governance degree programs should be introduced by HEC (Higher Education Commission) and it should be compulsory for NADRA, Passport authority, civil aviation authority, ECP and HEC employees to get certified or to have e-Governance degree program for both recruitment and preferments. This initiative will motivate the employees to enhance digital governance skills.

- Though, NADRA is providing Identity management consultancies to other countries, but Government should facilitate more opportunities for NADRA to participate in international project to adopt best practices being adopted in the developed countries.

- Policies to make government departments to cooperate with NADRA for making public service reforms and facilitate flexible funding.

- Human interaction free services should be introduced encouraged for providing public services.

These recommendations require strong political will and sincere leadership. However, it is very unlikely that these reforms will be implemented with the mutual consensus of political parties and certainly these actions will take long time to bring positive outputs. The solution to this problem is to raise the education level of general public so they can elect sincere leadership for establishing the government who can truly signify citizen's need in the house of parliament.

6.2 Future work

Initially, the motivation of this thesis was gained by using e-ID services in Estonia, and after examining e-ID infrastructure of Pakistan it can be said that there is no research or publications done on this topic ever before in Pakistan, even NADRA itself did not publish any literature which can assist the researchers to participate in the improvement of SNIC project. The initial objective was to find out challenges and opportunities of applying e-ID in public sector of Pakistan, but the study indicated new questions which can be addressed in future studies.

- How to develop trust relationship between citizens and e-services?

- How to engage all political leaders for establishing policies for e-Governance infrastructure regardless of their political differences?
- How can Pakistan's government adopt Technology acceptance model proposed by Davis (1989)?

6.3 Conclusion

Pakistan is the 5th largest populated country in the world and due to its strategic location, Pakistani people have suffered due to several external and internal instabilities. The money which was supposed to be spent on human betterment was consumed by wars imposed it, especially after 9/11. Country had lost thousands of lives and resources, but now its striving for public welfare and a peaceful state. Several welfare and peaceful initiatives are taken which indicates the transition towards the larger goal.

Pakistan is also technology loving country and majority of initiatives are taken using latest technologies. Especially in e-Governance perspective, Pakistan has evolved enormously over the past two decades. Several projects have been launched and e-ID is one of these projects. However, its facing difficulties from both public and government sides, therefore in this thesis author first tries to study the challenges and opportunities in e-ID project and then make necessary recommendations to the government.

This thesis implemented the design science research method to examine the challenges associated with e-ID in Pakistan and to study the best practices of e-ID in developed countries and supported by different identity management related theories that form a theoretical background of the thesis. First, quantitative research methodology was adopted to draft a survey to get citizen's opinion about e-ID and to assess their preferences. The results vindicate the thesis proposition that citizens possess very limited knowledge of e-ID and even large number of people never used the e-services provided by the government.

In second phase, the qualitative research methodology was adopted through scheming another survey with open ended questions and the target audience of this survey was NADRA employees working in different cities of Pakistan and on different designations in NADRA service centres. The obtained results show that most of the employees agree that SNIC has not been functional yet. The e-services provided by the government are not

integrated with SNIC due to intense intervention of politicians in e-ID reforms, poor IT infrastructure and corruption. Though, almost all employees preferred to use e-services by using SNIC as compare to traditional government services if provided.

Moreover, e-ID management experiences of developed countries were studied such as Estonia, Germany, Singapore and Sweden to suggest the new initiatives and best practices for the government of Pakistan. Moreover, similar issues related to e-ID were studied from the recent research conducted on Iran which is also a neighbouring country of Pakistan. This study can be very useful in dealing with socio-political issues related to SNIC in Pakistan due to demographic similarities. Since the initial motivation was derived from Estonian e-Governance model therefore core concentration was to learn from Estonian e-ID management system.

Finally, based on the research, analyses and results of surveys helped to form personal viewpoint, suggestions and substantial queries for further research on SNIC project.

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Appendix 1 – Survey Results obtained from citizens

Survey Question 1

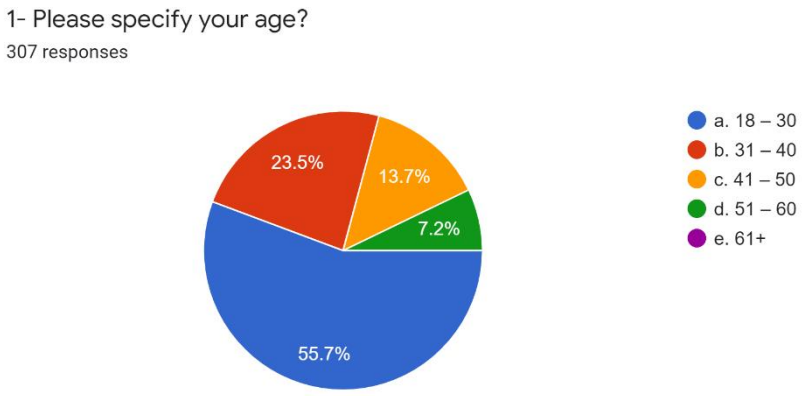

Figure 6. Survey Response to Question 1

Survey Question 2

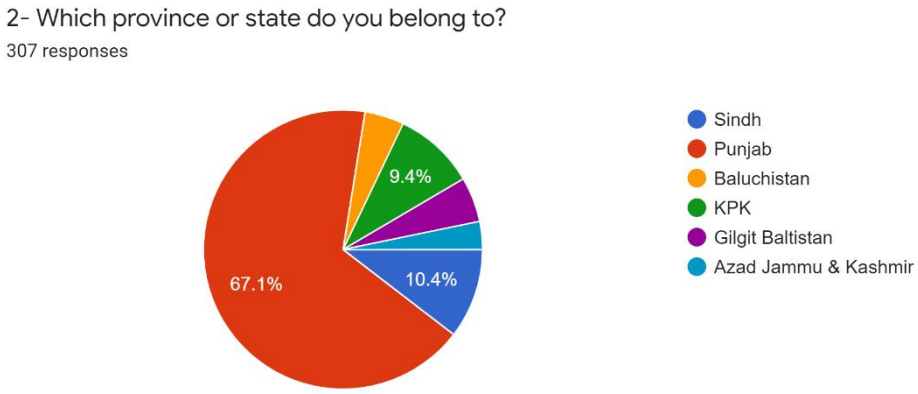

Figure 7. Survey Response to Question 2

Survey Question 3

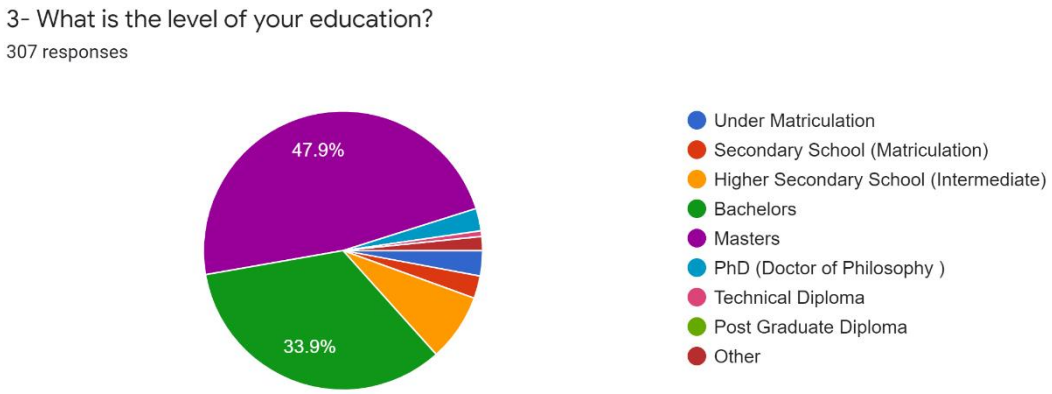

Figure 8. Survey Response to Question 3

Survey Question 4

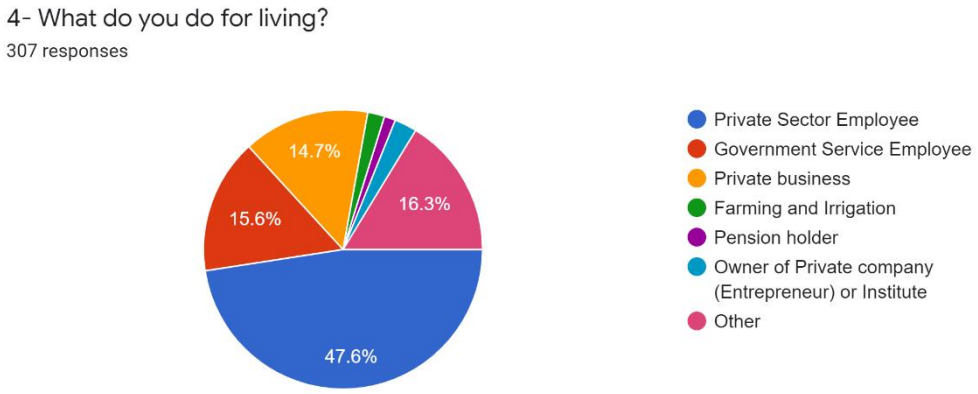

Figure 9. Survey Response to Question 4

Survey Question 5

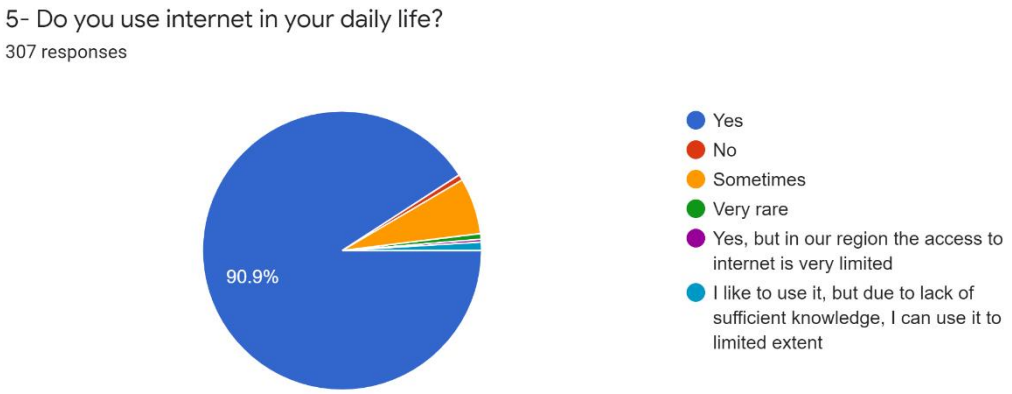

Figure 10. Survey Response to Question 5

Survey Question 6

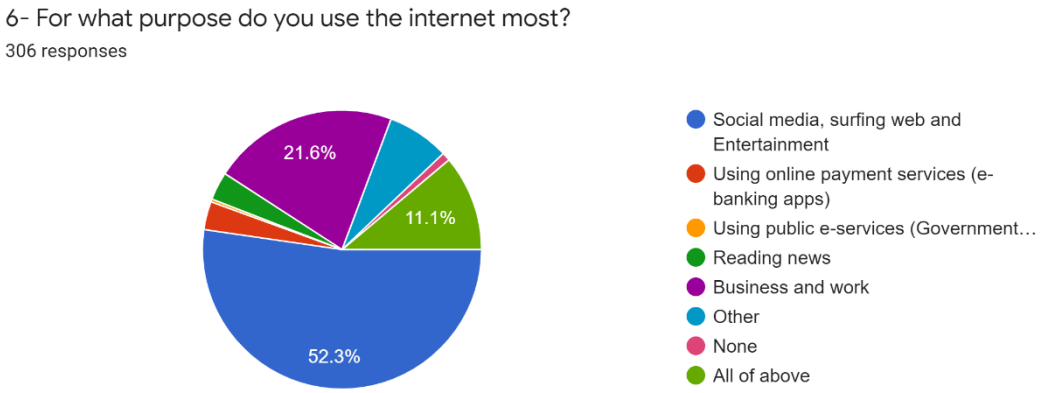

Figure 11. Survey Response to Question 6

Survey Question 7

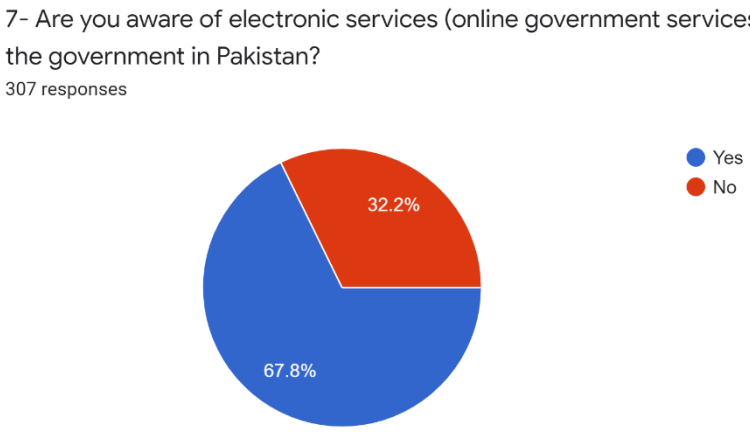

Figure 12. Survey Response to Question 7

Survey Question 8

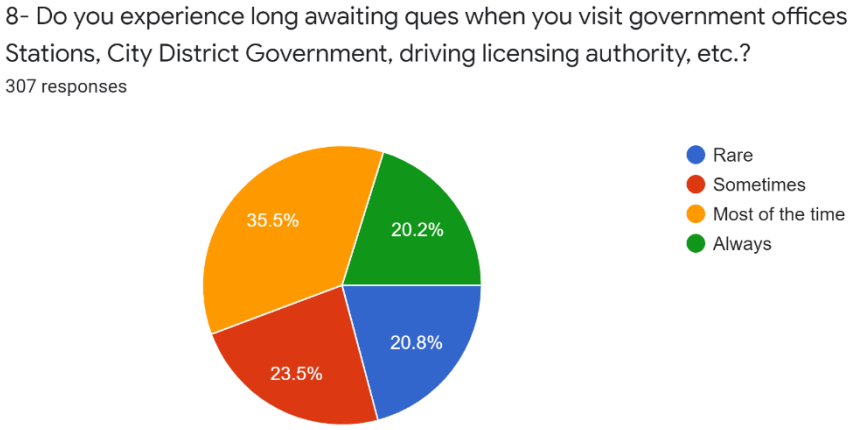

Figure 13. Survey Response to Question 8

Survey Question 9

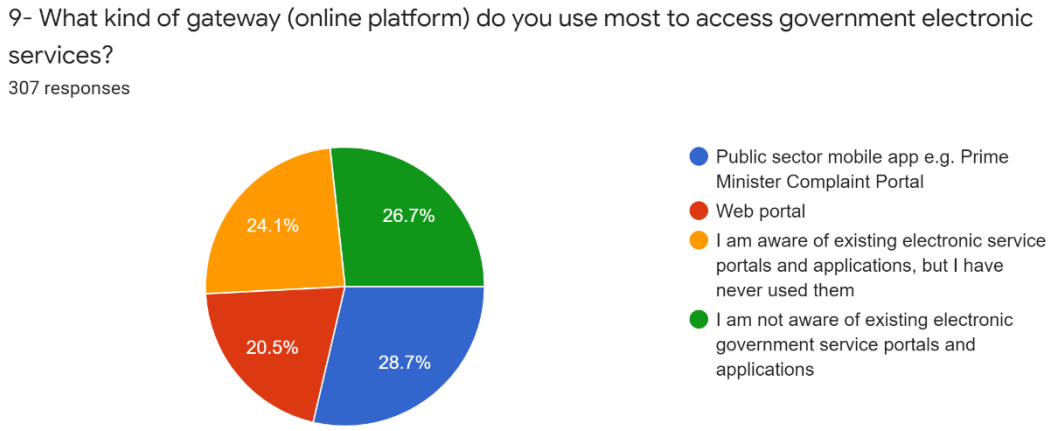

Figure 14. Survey Response to Question 9

Survey Question 10

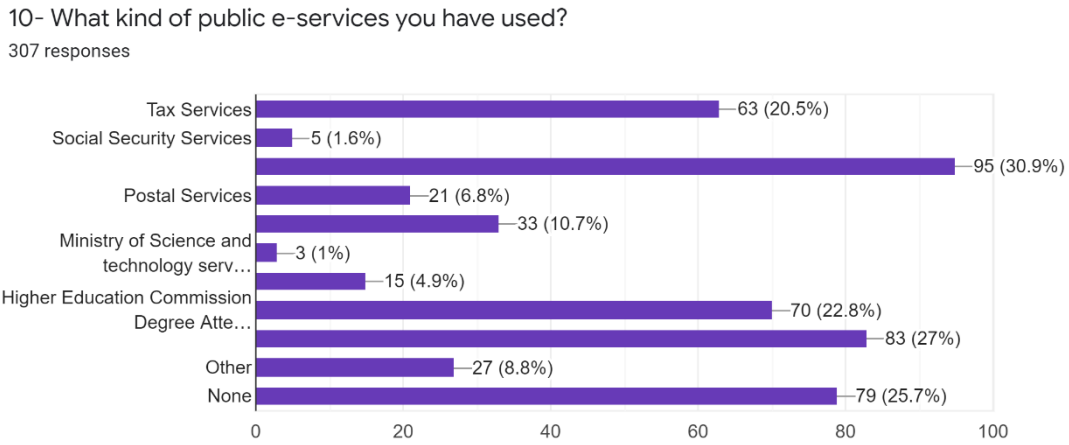

Figure 15. Survey Response to Question 10

Survey Question 11

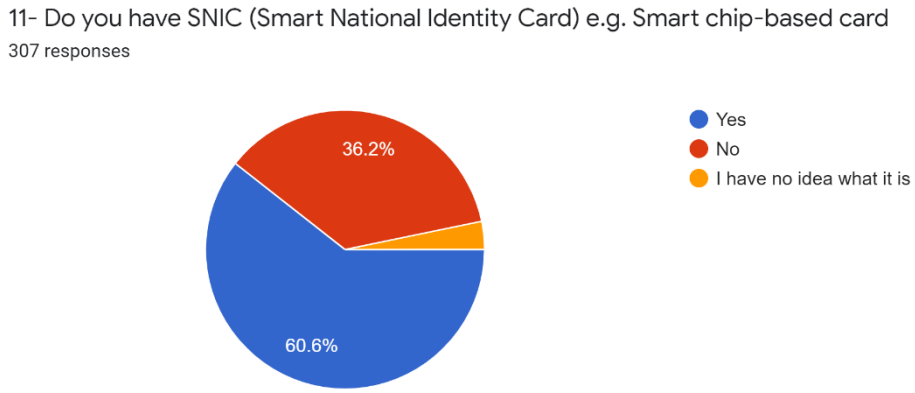

Figure 16. Survey Response to Question 11

Survey Question 12

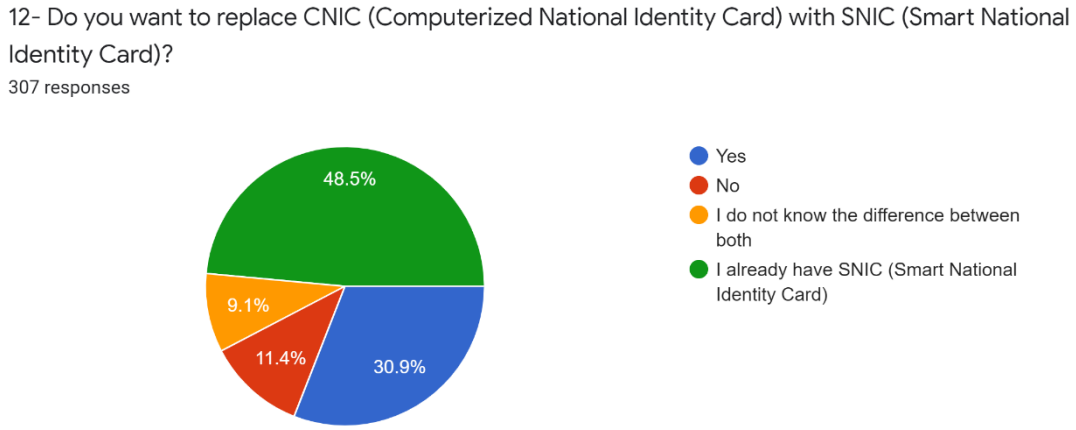

Figure 17. Survey Response to Question 12

Survey Question 13

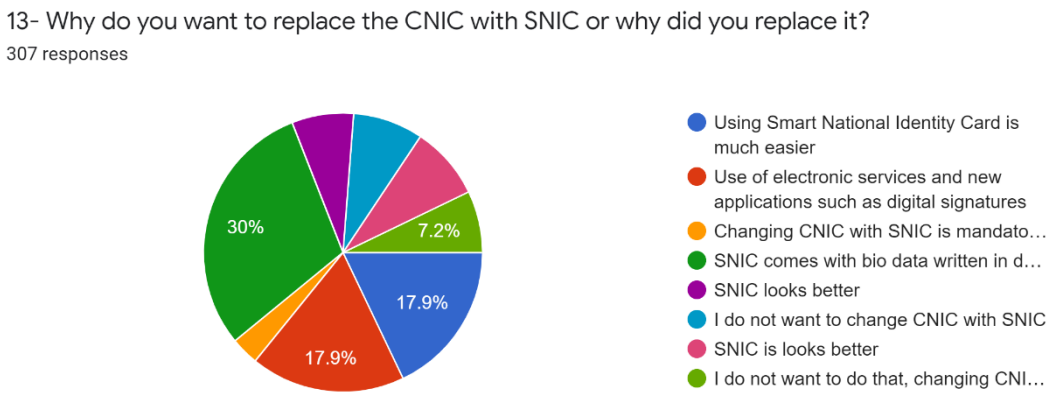

Figure 18. Survey Response to Question 13

Survey Question 14

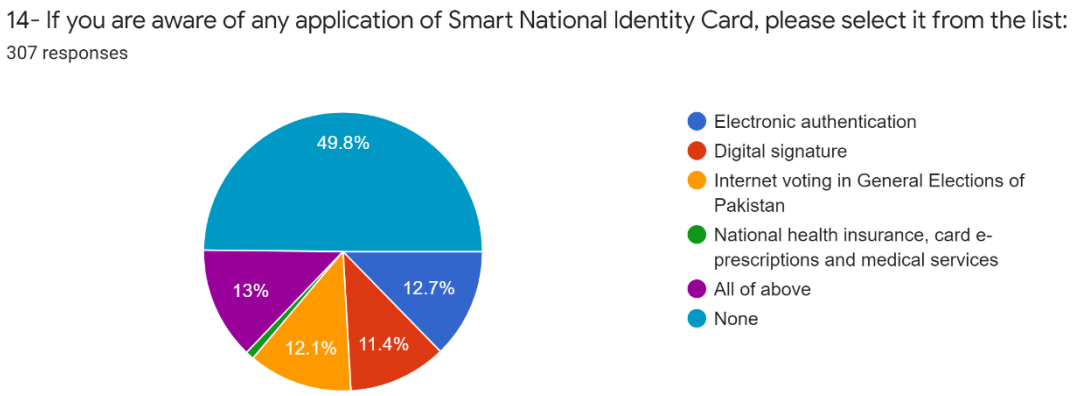

Figure 19. Survey Response to Question 14

Survey Question 15

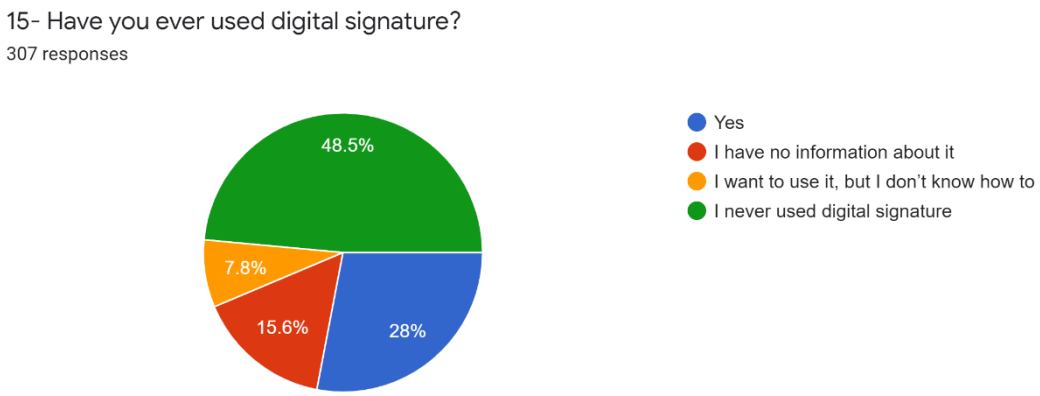

Figure 20. Survey Response to Question 15

Survey Question 16

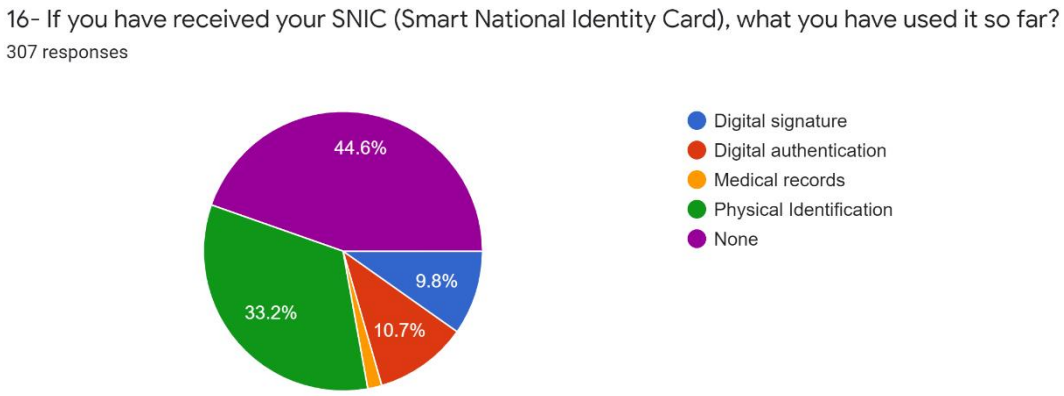

Figure 21. Survey Response to Question 16

Survey Question 17

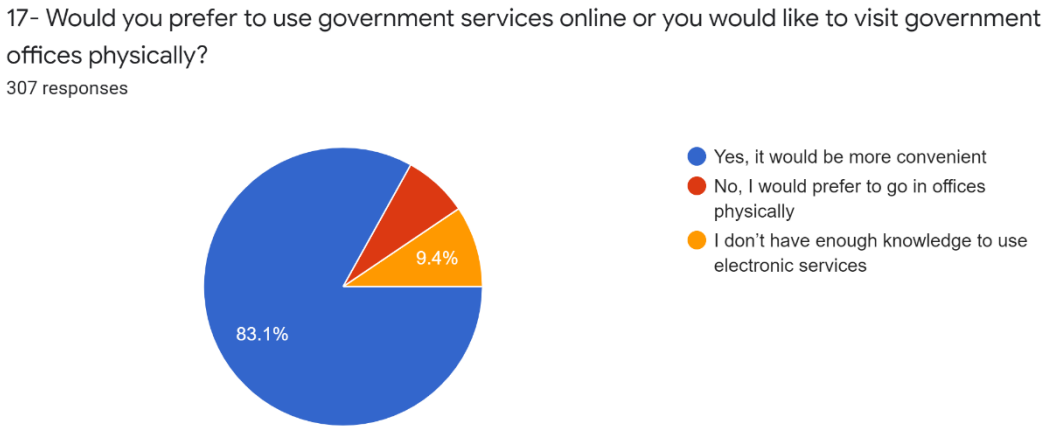

Figure 22. Survey Response to Question 17

Survey Question 18

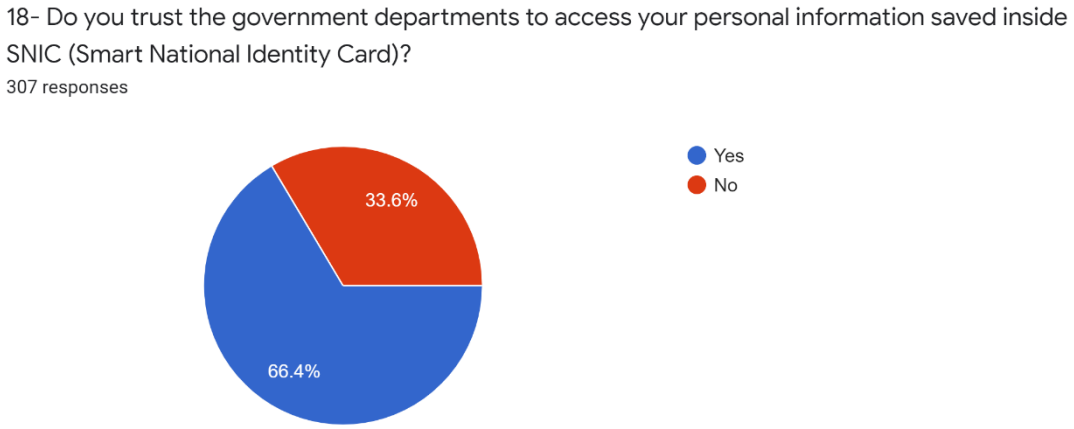

Figure 23. Survey Response to Question 18

Appendix 2 – Survey results obtained from NADRA Employees

Survey Question 1

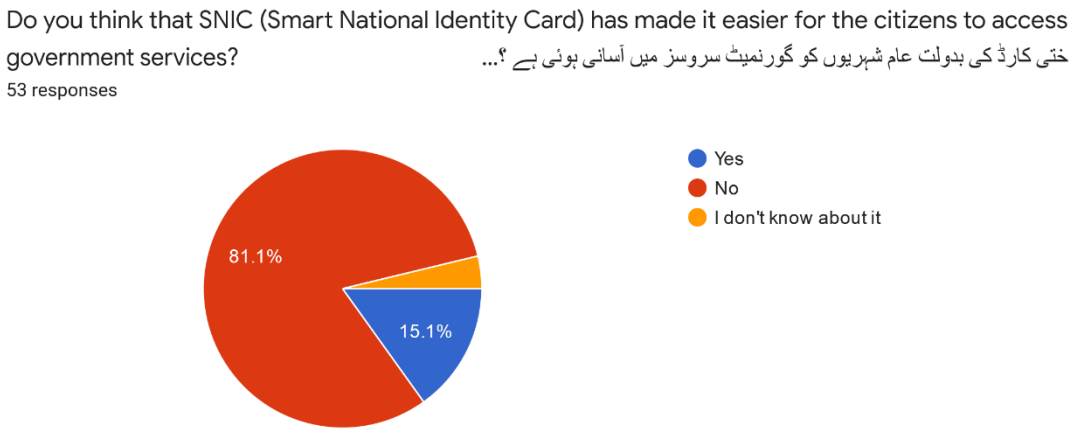

Figure 24. NADRA Employees Survey Response to Question 1

Survey Question 2

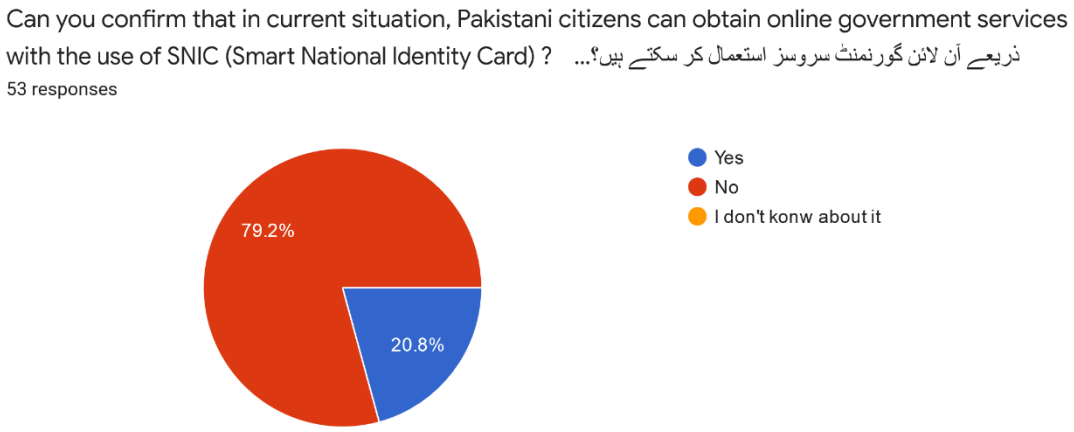

Figure 25. NADRA Employees Survey Response to Question 2

Survey Question 3

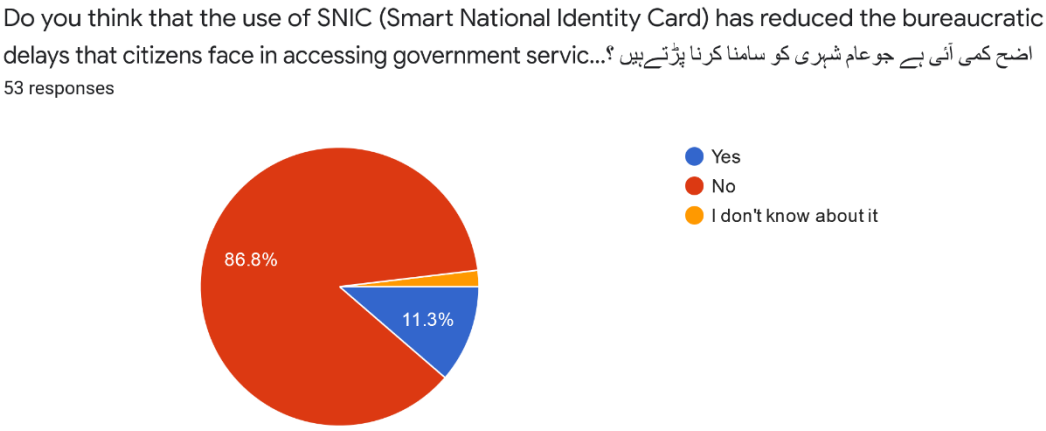

Figure 26. NADRA Employees Survey Response to Question 3

Survey Question 4

Figure 27. NADRA Employees Survey Response to Question 4

Survey Question 5

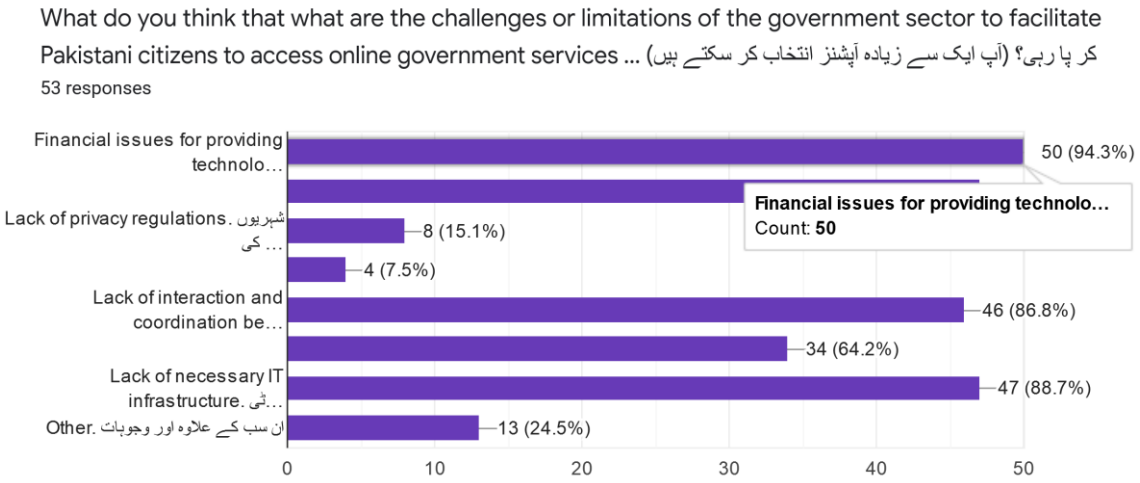

Figure 28. NADRA Employees Survey Response to Question 5

Survey Question 6

If your answer to above question is 'Other' then please write your response below. آپ نے پچھلے سوال کے جواب میں آخری آپشن کا انتخاب بھی کیا ہے تو نیچے دی گئی جگہ میں آپ اپنی رائے لکھیں, اور مزید بھی اگر آپ سمارٹ نیشنل شناختی کارڈ سے مطلق کوئی معلومات شئیر کرنا چاہتے ہیں تو لکھ سکتے ہیں۔

13 responses

Corruption issue govt. Departments
E-voting was introduced by previous NADRA chairmen but it was strongly opposed by the government in power because the political parties knew that if such mechanism is introduced in the general elections then political candidates cannot do rigging on elections day. Similarly, politicians are bringing hurdles for e-ID as well. NADRA is capable enough for initiating and administering this project but politicians would never support it.
Lack of IT infrastructure and IT trainings, illiteracy and lack of political will from all political stakeholders.
Corruption by the political elite, especially the politicians in the opposition currently.
Financial issues, Information Technology development issues, and lack of political support
Various services are already provided online with the help of NADRA but, none of them are using SNIC authentication so there is still lot to be done in this project from government side. NADRA has already established a prototype but it requires government support.

Till date SNIC is not fully functional

Corruption is the root cause behind the delays in SNIC project.

The major hurdle is the political parties who do not want to initiate any project which can bring transparency in public service affairs.

I will definitely use SNIC over traditional services. And I think that political resistance and illiteracy are the core factors behind the delay of SNIC project.

As a NADRA employee, I can say that we have developed online platform for providing public services through SNIC and prototype is also presented to the Ministry of interior but it is still under legislation.

The major concern is government's legislation, even NADRA wants to develop e-ID infrastructure in public sector of Pakistan, the ordinance would not be passed by the consensus of political parties. Any such ordinance requires 2/3 majority in the parliament and opposition parties would not help the government to pass such bills.

Figure 29. NADRA Employees Survey Response to Question 6