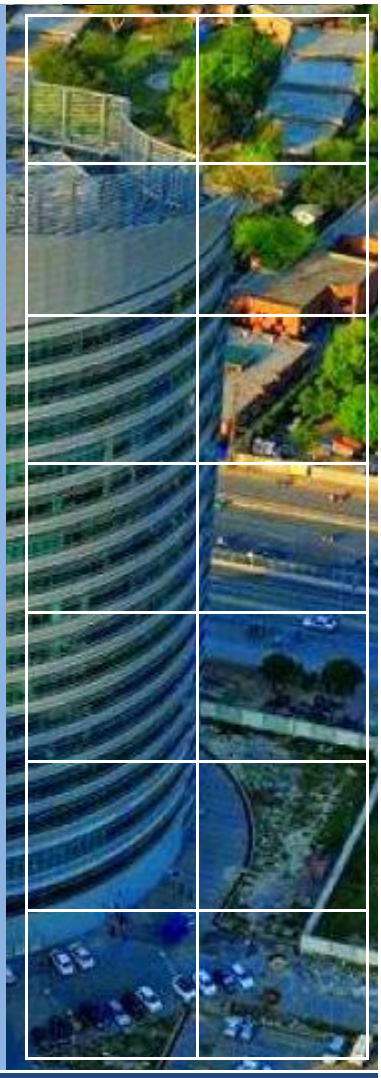
Punjab Digital Policy (Draft Version)

2021-2025



Punjab Information Technology Board
Government of the Punjab

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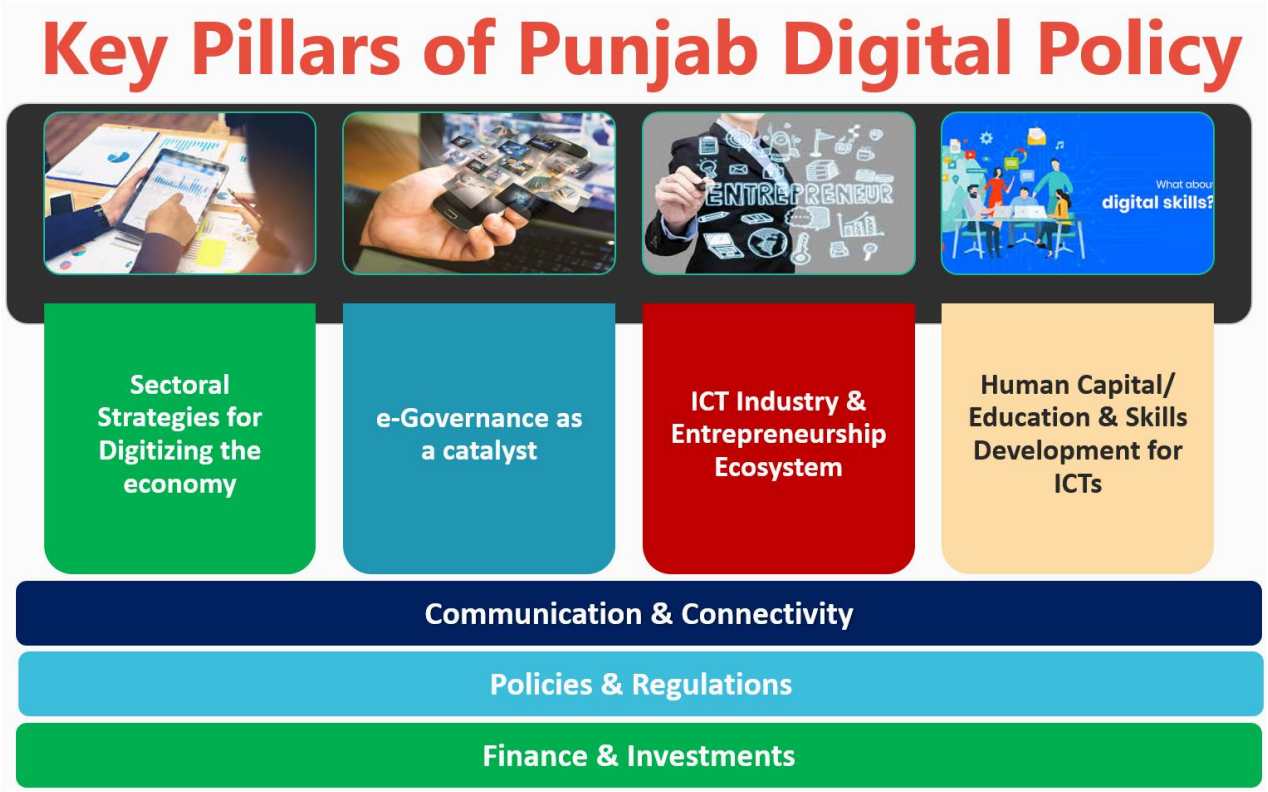
Executive Summary

The potential of the digital technologies, along with the disruption caused by the Covid-19 pandemic, highlights the importance of promoting digital technologies across all sectors. With this background in mind, there is a need to formulate a comprehensive digital policy which can steer Punjab towards digital transformation and prepare the province for the fourth industrial revolution. The Punjab Digital Policy 2021-2025, which identifies 4 vertical (Digitizing the Economy, e-Governance, ICT Industry & Entrepreneurship Ecosystem, Human Capital/Education & Skills Development for ICTs) and 3 cross-cutting (Policies and Regulations, Communication & Connectivity, Finance & Investments) key pillars, has been drafted with the aim of doing just that. It builds upon the momentum generated by the previous initiatives and covers the gaps, including the role of shared economy, digital identity, e-procurements, artificial intelligence and machine learning, in the existing policy frameworks.

Accordingly, the Punjab Digital Policy 2021-2025 sets forth the following overarching policy goals:

i. Leverage digital technologies to contribute significantly towards GDP;
ii. Harness the potential of digitalization for creation of new jobs;
iii. Promote financial and digital inclusion;
iv. Encourage the growth of local ICT industry;
v. Enhance efficiency, transparency and accountability in governance through the use of digital technologies;
vi. Accelerate the process of ICT human capital development in the province;
vii. Improve the productivity and efficacy of social sectors in Punjab;
viii. Provide an enabling regulatory environment for digitalization.

This policy is a part of the provincial government's overall efforts to lead to a more empowered society and complements the national and provincial level initiatives which include, but are not limited to, Digital Pakistan Initiative, Ehsaas Program for Poverty Alleviation, Prime Minister's Kamyab Jawan SME Lending Program, Presidential Initiative for Artificial Intelligence & Computing (PIAIC), National Payment Systems Strategy 2019, Punjab Growth Strategy 2023 and the RISE Punjab plan.


Key Pillars of Punjab Digital Policy
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INTRODUCTION

Digital technologies play an essential role in social progress and development of a country. They facilitate the economic growth through creation of new jobs and businesses and lead to an improvement in the standard of living through advancements in important aspects of our lives such as governance, education, healthcare, agriculture and security. The impact of ICTs on global economy is evident from the transformation of global businesses over time. With only one technology company (Microsoft) among the top five most valuable companies in 1997 to completely dominating the list in 2019, technology-based companies have excelled exceptionally and have claimed top spots amongst the most valuable brands in the world.[1] In terms of cumulative valuation, these companies make 43% of the total brand value of top hundred brands – only three companies have brand values of over USD 100 billion and all three (Apple, Google and Microsoft) are in technology. Moreover, the most valuable technology brand (Apple – USD 205.5 billion) is worth approximately four times more than the most valuable non-tech brand (Coca Cola – USD 59.2 billion).[2]

Acknowledging the potential of digital technologies, smaller countries such as Singapore, Belarus and Estonia have transformed various socio-economic segments digitally and are now ranked amongst the most technologically advanced countries. Singapore, which is usually referred to as the digital capital of Asia, is contributing 7% to the global exports of ICT goods.[3] Similarly, Belarus has witnessed a growth of nearly 11% in ICT sector's value addition as a share of GDP and has over 1000 IT companies with a total of over 30,000 employees while Estonia is known for its digital public service delivery and ranks 9th in the EU Digital Economy and Society Index 2018.[4] [5]

Although the rate of technological transformation varies, all countries are being affected by digital technologies. This has significant implications for the implementation of the United Nations' Sustainable Development Agenda 2030 to which Pakistan has reaffirmed its commitment time and again.

Pakistan has introduced several initiatives for the promotion and adoption of digital technologies in multiple domains. With 176 million cellular subscribers, 91 million 3G/4G subscribers and 93 million broadband subscribers, Pakistan has a teledensity of 82.34%, 42.43% penetration of 3G/4G services and 43.5% penetration of broadband services.[6] Although the internet penetration in the country is still relatively

[1] Financial Times
[2] https://www.forbes.com/powerful-brands/list/#tab:rank
[3] https://unctad.org/en/PublicationsLibrary/der2019_en.pdf
[4] https://investinbelarus.by/upload/pdf/IT%20industry%202018.pdf
[5] https://www.export.gov/article?id=Estonia-IT-Services-and-Equipment
[6] Pakistan Telecommunication Authority – December 2020

low, it is nearing a tipping point. These estimates are expected to increase further during the next five years. Despite a high teledensity and reasonable number of broadband and 3G/4G subscribers, there is still room for much more to be done in this regard.

The Global Competitiveness Report 2019 shows that Pakistan lags behind other regional powers in terms of various ICT components and is ranked 104 in E-Participation, 131 in ICT Adoption, 126 in cellular subscriptions, 131 in internet penetration and 79 in innovation capability out of a total of 141 countries.[7] Moreover, Pakistan is placed 148 in E-Government Development Index and 115 in the E-Participation Index.[8]

At the provincial level, the Multiple Indicator Cluster Survey (MICS) Punjab 2017-18 shares some insights on ICT adoption and digital skills in the province: 95.6% of the households have a mobile phone, 16.5% of households have a computer and 26.3% of households have access to the internet at home. Disaggregating these estimates over gender, MICS report suggests that 5.4% of women have used a computer at least once a week during the last 3 months, 39.1% are in ownership of a mobile phone and 10.1% have used internet at least once a week during the last 3 months. While for men, these estimates are higher: 13.1% of men have used a computer at least once a week during the last 3 months, 86.6% are in ownership of a mobile phone and 25.5% have used internet at least once a week during the last 3 months. As far as the basic ICT skills are concerned, 5.1% of women had performed at least one of the nine listed computer related activities[9] whereas 14.4% of men had done the same. These estimates clearly show the gender disparity which exists between men and women when it comes to the use of ICTs. Moreover, the disruption caused by the Covid-19 pandemic has highlighted the importance of promoting and switching to digital technologies across all walks of life. With this background in mind, there is a need to formulate a comprehensive digital policy which can steer Punjab towards digital transformation and prepare the province for the fourth industrial revolution.

The Punjab Digital Policy 2021-2025, which identifies 4 vertical and 3 cross-cutting key pillars, has been drafted with the aim of doing just that. It builds upon the momentum generated by the previous initiatives and covers the gaps, such as the role of shared economy, digital identity, artificial intelligence, machine learning and role of ICTs in social sectors, which were left untouched in the preceding IT policies.

[7] Global Competitiveness Report 2019

[8] UN E-Government Knowledgbase – Rankings are out of a total of 193 countries.

[9] Copied or moved a file or folder; Used a copy and paste tool to duplicate or move information within a document; Sent email with attached file such as a document , picture or video; Used a basic arithmetic formula in a spreadsheet; Connected and installed a new device, such as a modem, camera or printer; Found, downloaded , installed and configured software; Created an electronic presentation with presentation software, including text, images, sound, video or charts; Transferred a file between a computer and other device; Wrote a computer program in any programming language.

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This policy is a part of the provincial government's overall efforts to lead to a more empowered society and complements the national and provincial level initiatives which include, but are not limited to, Digital Pakistan Initiative, *Ehsaas* Program for Poverty Alleviation, Prime Minister's *Kamyab Jawan* SME Lending Program, Presidential Initiative for Artificial Intelligence & Computing (PIAIC), National Payment Systems Strategy 2019, Punjab Growth Strategy 2023 and the RISE Punjab plan. In fact, the action plan for the Punjab Digital Policy 2021-2025 will be iterative in order to reflect the ever-changing situation due to Covid-19 pandemic, rapid development of technologies and the dynamic manner in which the policy implementation will change models for social and business interactions.

VISION

The Punjab Digital Policy 2021-2025 aims to transform Punjab into a hub of Information Technology that is a globally competitive digital society where significant and sustainable improvements in economic, social and governance sectors are achieved through the efficient & effective deployment of digital technologies in partnership with the private sector.

DIGITIZING THE ECONOMY

OVERVIEW

Pakistan is considered as an emerging economy due to the huge potential that the country's economy possesses[10]. While, the country was witnessing a phase of slow economic growth with the growth rate of 5.5 % in FY 2018 and an annual average growth rate of 4.7 percent for years 2014 to 2018[11], the situation has further worsened after the onset of Covid-19 as the real GDP growth rate has contracted by 1.5% in FY 2019[12]. Hence, the Covid-19 pandemic and the ensuing lockdowns have further impeded the economic prospects of the country. This is coupled with rising inflation and current account deficits.[13] [14] The deceleration in the economic growth is expected to continue during the FY 2020 and 2021 as per the World Bank's and IMF's estimates.

Under such circumstances, ICTs can play a significant role as a catalyst to facilitate the economic activities in the country (and the province). More so important is ICTs' ability to assist with the trickle down of the economic benefits to reduce the inequalities in the society. A study by Overseas Chamber of Commerce and Industry (OCCI) lends support to this statement. According to this report, digitalization of Pakistan's economy can lead to the creation of approximately 5 million direct/indirect jobs while

[10] MSCI Emerging Markets Index 2019
[11] http://www.finance.gov.pk/survey/chapters_19/1-Growth.pdf
[12] http://www.finance.gov.pk/survey/chapter_20/01_Growth_and_Investment.pdf
[13] https://www.worldbank.org/en/country/pakistan/overview
[14] http://www.sbp.org.pk/reports/quarterly/fy19/Third/Complete.pdf

also adding a remarkable 40 to 50 Billion US dollars in country's GDP by 2025.[15] Likewise, a 2016 report by McKinsey Global Institute suggests that the expansion of digital financial services in Pakistan can deliver a boost of 36 Billion US dollars in GDP and add up to 4 million new jobs in the economy during 2016-2025.[16]

Punjab is well-positioned to benefit from the digital economy as its economy is well-suited for digitalization. Besides, Punjab is also the most populous province of Pakistan (110 million population- 40 million in urban) with a large part of its population comprising of youth. This youth bulge can be used to generate demographic dividend.

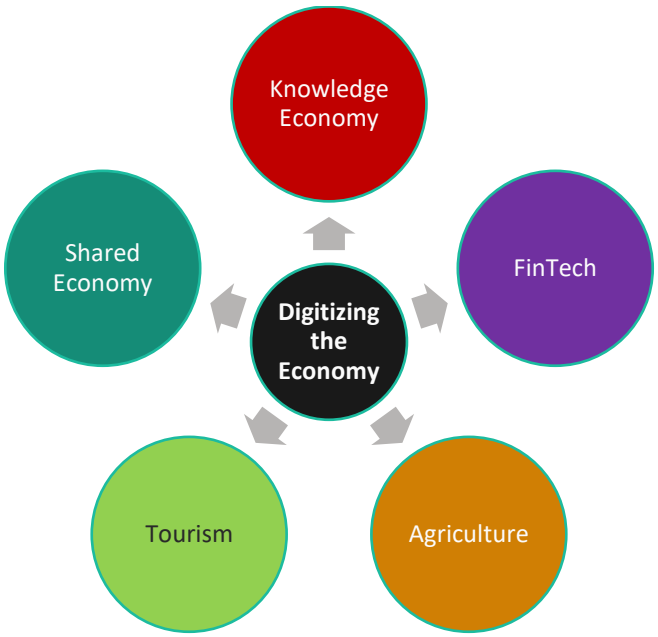
The Punjab Digital Policy 2021-2025 identifies following policy objectives in this regard:

i. To double ICT sector's share in provincial GDP by 2025;
ii. To accelerate the use of knowledge-based economy in order to reach its full potential in Punjab;
iii. To stimulate the economy through the use of digital technologies for the creation of direct and indirect jobs;
iv. To establish Punjab as a preferred destination for ICT investments in the region;
v. To promote financial inclusion by encouraging the use of digital financial services;
vi. To improve the productivity and efficiency of the economy (especially agriculture and tourism sectors) for greater economic benefits;
vii. To provide conducive business environment for digital businesses to flourish.

In line with these objectives, this section outlines the context for the digitization of Punjab's economy with a focus on Knowledge Economy, Shared Economy, FinTech, E-Commerce, Agriculture and Tourism.

[15] https://www.oicci.org/wp-content/uploads/2018/12/Recommendations-on-National-Program-for-Digital-Transformation.pdf

[16] Mckinsey Global Institute - Digital Finance for All: Powering Inclusive Growth in Emerging Economies - https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/How%20digital%20finance%20could%20boost%20growth%20in%20emerging%20economies/MGI-Digital-Finance-For-All-Executive-summary-September-2016.ashx



KNOWLEDGE ECONOMY

Digital technologies are perceived as an important factor of production in modern economies. Several studies have established a link between the use of digital technologies in a knowledge economy[17] and the positive impact that these have on the economic growth[18]. The innovations in ICTs usually play their role in rapid technological progress and productivity growth. This, in turn, leads to the economic development.

According to the Punjab Growth Strategy 2023, human capital formation, deployment of ICTs and knowledge accumulation show huge dividends as an increase of 10% in ADP allocation will lead to a growth of 1 % and will create 1 million jobs over the 5-year period. This, however, cannot be materialized without creating robust systems for education and training; development of a dynamic information infrastructure; economic and policy incentivization for digital technologies; and innovation systems to not only tap into global knowledge base, but adapt and localize the accumulated knowledge as well.

Advancement of the knowledge economy is one of the main target areas of this policy and is a recurring theme of this document without which the economic progress within Punjab cannot accelerate. Therefore, the government shall endeavor to:

[17] A knowledge economy is an economy in which the production of goods and services is based primarily upon knowledge-intensive activities.
[18] http://www.lse.ac.uk/business-and-consultancy/consulting/assets/documents/the-evolving-role-of-ict-in-the-economy.pdf

i. Promote Knowledge Economy in the province through advancements in four pillars of the knowledge-based development[19]:
   a. Skilled Labor Force
   b. Adequate IT Infrastructure
   c. Effective Innovation System
   d. Enabling Institutional Regime

SHARED ECONOMY

The notion of shared economy has gained popularity during the past decade as people have moved towards the idea of collaborative consumption and sharing of value from an under-utilized skill or resource. It refers to the peer-to-peer based activity of obtaining, giving, or sharing access to good and services. Globally, the sharing economy is expected to increase from a modest 14 billion US dollars in 2014 to $335 billion in 2025.[20] This shows the immense potential of this sector and the sort of impact that it can create for developing countries such as Pakistan where ownership of goods and services may not be feasible due to lack of affordability. Moreover, the shared economy also leads to an improvement in the quality of life and reduction in wastage of resources. Hence, Pakistan can immensely benefit from this sector both socially and economically.

Despite being a relatively new phenomenon in Punjab, there are multiple shared economy platforms operating in the province. These platforms are further contributing to the rise of the shared economy in Punjab. With the companies ranging from billion-dollar companies such as UBER and Careem to start-ups at a nascent stage, shared economy is thriving in the province.

Currently, the ride-sharing platforms such as UBER, Careem and Bykea; and online delivery service Cheetay are employing over 120700 people. Estimates show that with appropriate policies, this figure can increase to 300000 by 2025.[21] The actual number of people engaged in the shared-economic activities are expected to be much higher than the aforementioned figure as it only account for the employee-base of the four companies.

In addition to this, Pakistan is also among the fastest growing markets of freelancers with an annual revenue growth of 47% (Ranked 4th - 300000 Freelancers).[22] 77.3% of

[19] https://openknowledge.worldbank.org/bitstream/handle/10986/6853/411720PAPER0Kn101OFFICIAL0USE0ONLY1.pdf?sequence=1&isAllowed=y
[20] https://www.pwc.com/us/en/technology/publications/assets/pwc-consumer-intelligence-series-the-sharing-economy.pdf
[21] Respective Organizations– Number of Employees available for UBER, CAREEM, BYKEA (Lahore & Karachi) and CHEETAY (Lahore).
[22] Payoneer – Gig Economy Index 2019

these freelancers are within the age group of 18-34 years which reflects the potential of the youth population. Punjab, alone, has over 100000 freelancers who are providing freelancing services all across the world. As per the estimates, the number of freelancers in Punjab can almost double by 2025 as the province offers a sizeable talent pool and low labor costs.[23] National Freelance Training Program and e-Rozgaar program are expected to contribute significantly towards the development of a skilled workforce of freelancers. So far, over 30000 individuals have been trained under these two programs who have earned over 3.88 Billion PKR.

ICTs are transforming the ways of production and consumption and with the widespread use of smart devices in the province, there are opportunities to gain from shared economic activities. These opportunities, however, do not arise without challenges: safety of consumers and suppliers, appropriate regulatory framework and skilled future workforce. To address these challenges and to facilitate the growth of shared economy in the province, the government shall endeavor to:

i. Improve the shared economy ecosystem in the province through suitable regulatory environment and interventions.
ii. Promote freelancing in the province.

FINANCIAL TECHNOLOGY (FINTECH)

Financial Technology (FinTech) is widely recognized as a powerful tool for financial inclusion which, in turn, provides support in poverty reduction, gender equality and inclusive economic growth. For consumers, FinTech offers a variety of choices, secure and efficient payment methods, accessibility to financial services and transactions which can be done over mobile devices.

Pakistan constitutes 5.2% of the unbanked population in the world as the country has over 100 million adults who lack access to formal financial services.[24] While this is an alarming situation, it offers a unique opportunity to gain from the use of FinTech. As mentioned above, Pakistan has over 176 million cellular subscribers and around 91 million 3G/4G subscribers. This potential has resulted in over 37.3 million branchless banking accounts till 2017 which is an encouraging sign.[25] Yet, it shows the extent of financial exclusion that still needs to be dealt with.

For this reason, Pakistan is considered as an emerging market for FinTech as it offers an attractive market for FinTechs to grow, a favorable regulatory regime to function

[23] Payoneer & Upwork
[24] Karandaaz – Policy & Regulatory Bottlenecks for Digital Financial Services in Pakistan
[25] Branchless banking Quarterly Newsletter Oct-Dec 2017

under the State Bank of Pakistan, booming e-commerce businesses and widespread smartphone and 3G/4G penetration. Moreover, the biometric verification of SIMs has paved way for digital wallets to become a reality.

Majority of the FinTechs are combining financial services with additional activities which are associated with e-commerce, big data analytics and sharing-economy businesses, thus adding value to the conventional services.

Currently, only a few FinTechs are operating within the country and are focusing on the urban centers. This sluggish growth of the FinTech sector is primarily due to the challenges that the sector is facing in Pakistan: lack of investment; lack of financial inclusion; intellectual property rights; data security; availability of skilled staff, technology integration, physical infrastructure and uncertainty with regards to future regulations. Policies to encourage FinTech and cashless society (as envisioned in the National Payment System Strategy 2019) will help in the documentation of the economy, increase in the tax net, creation of an enabling environment for e-commerce industry and startups while also assisting the government in service provision such as disbursement of scholarships and pensions. To do so, the government shall endeavor to:

i. Provide enabling regulatory frameworks for FinTech in collaboration with the relevant stakeholders.
ii. Increase financial inclusion.
iii. Encourage the use of electronic payments for all government transactions.

AGRICULTURE[26]

Almost 70 million people of Punjab's total population of 110 million reside in rural areas. Regardless of this, only 20% of province's economic structure is made up of the agriculture sector which reveals the inefficiency of the sector. Also, high transportation, transaction and operational costs describe why agricultural markets are not functioning well as small farm holders are not integrated into these markets due to farmers' lack of ability to timely deliver consistent, quality and large volumes of produce. As a result of this, the agriculture sector in Punjab is growing at a meagre rate of 2%. This necessitates the use of digital technologies to empower the rural population for improvement in agricultural practices and growth of the sector. The Punjab Growth Strategy 2023 provides estimates for the economic impact of agriculture sector's

[26] Agriculture sector also includes Livestock and Fisheries segments.

growth: "1 percent growth in the agriculture sector leads directly plus indirectly to over 0.4 percent growth in the overall economy of the Punjab".[27]

Thus, the importance of agriculture in the economy of the province is multifold. Understanding the importance of the agriculture sector, PITB has implemented projects in collaboration with the relevant departments for the inclusion of ICTs in the agriculture sector. These include Agriculture E-credit Scheme and AgriSMART app, among others. The successful implementation of these initiatives provides us with evidence for the need to scale-up the existing projects and setting up of new ones. To do so, following challenges need to be tackled: Information asymmetry among farmers and businesses; poor ICT infrastructure in rural areas discourages the digitization of agriculture sector; Inadequate ICT literacy skills in rural areas and lack of integrated approach in the roll of ICTs and other social services infrastructure in rural areas. To deal with these challenges, the government shall endeavor to:

i. Improve productivity and competitiveness of the agricultural sector through the use of digital technologies.

TOURISM

Tourism has a lot of potential which can be exploited through the integration of ICTs. This sector has also been among the top priorities of not only the provincial government, but of the federal government as well. Hereof, Punjab boasts of several ancient cultural heritage sites including those belonging to the Indus Valley civilization, Gandhara civilization, Ghaznavids, Mughal empire, Durrani empire and Sikh empire, architectural master pieces, hilly areas, lakes, valleys, rivers and important religious sites.

Tourism industry has a multiplier effect for the economy of Punjab. Through ICTs, tourism can be promoted which will directly lead to job creation and improvement in the economic situation of the province. In this regard, the Punjab Economic Report 2017 states that tourism industry of Punjab has the potential to generate approximately 2 Billion US dollars in income and over 350000 jobs through domestic and religious tourism. Therefore, the government shall endeavor to:

i. Promote tourism in the province by incorporating digital technologies in the sector.
ii. Establish platforms for marketing and information on tourism products.

[27] Punjab Growth Strategy 2023

E-GOVERNANCE

OVERVIEW

Integration of ICTs and digital technologies in governance enhances the delivery capabilities of government and leads to an increase in efficiency, transparency and accountability. As a result of this integration, the public service becomes closer to the society and enterprises, therefore improving the government's decision-making processes.

Punjab has been steadily moving towards responsive, accountable and transparent approach in e-governance over the course of the last decade. There is a diverse range of initiatives which have been undertaken by the government in the past years, some of which are: Citizen Facilitation & Service Centers, eStamping, e-Payment Gateway, Punjab Public Management Reform Program, Punjab Job Portal, Business Registration Portal, Citizen Feedback Monitoring Program, Domicile Management System, WASA Online Duplicate Billing System, e-Filing and Office Automation System in public sector, Smart Monitoring of Development Projects, Punjab Online Procurement System, Anti-Corruption Case Management System, computerization of all police stations in Punjab; creation of Police Khidmat centres in all 36 districts of Punjab; automation of Criminal Record Office; introduction of Hospital Management Information System (HMIS) in DHQs/THQs; verification of attendance of doctors and paramedics through biometric attendance system; supervision of the health, education, agriculture, livestock and irrigation field staff through SIM enabled phones

and tablets; improvement of the vaccination coverage from 22% to 97%[28] across Punjab under eVaccs; compilation of real time feedback from monitoring staff for 52,394 schools in Punjab; collection of government receipts in a transparent and accountable manners; computerization of land records under land record management information system and e-Transfer system. As already mentioned, several government processes have been digitalized and technology is being used to gather and process data for effective decision-making.

It is, nonetheless, necessary that the government continues on this trajectory to establish itself as one of the leaders in e-governance and service delivery in the region. Equally important is to deal with the challenges that e-governance in Punjab is facing. These challenges include lack of supportive institutional level frameworks for deployment of e-governance systems, inadequate ICT infrastructure in rural areas, lack of skilled IT workforce in the public sector, information security and lack of horizontal and vertical connectivity among the government departments.

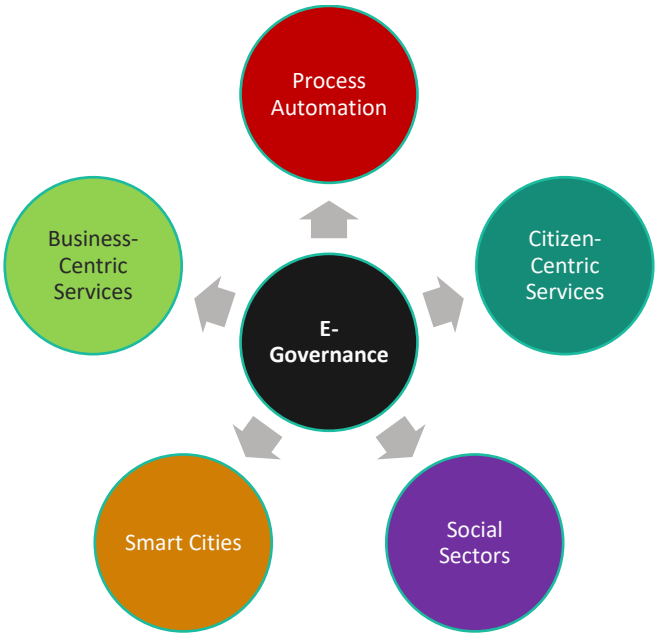
Government of the Punjab will continue to automate its processes in order to ensure transparency, efficiency and accountability using Artificial Intelligence and Big Data. Under this policy, online government services will be made more accessible through mobile-friendly applications, smart devices and websites. Government's technological capabilities will be enhanced in accordance with the latest developments in artificial intelligence, machine learning and big data analytics among others.

Accordingly, the Punjab Digital Policy 2021-2025 identifies the following policy objectives for e-governance in the province:

i. To establish Punjab as a leader in good governance and efficient public service delivery in the region;
ii. To position Punjab as a preferred destination for businesses by providing favorable ease of doing business mechanisms;
iii. To digitalize the government for increased accessibility to quality public services;
iv. To develop capacity of the government departments in using technology and data-driven evidence for informed decision-making;
v. To promote information symmetry regarding government's services for all entities including citizens and businesses;
vi. To improve the urban quality of life using sustainable integrated solutions in smart cities;
vii. To encourage the use of electronic payments for all government transactions.

[28] https://open.punjab.gov.pk/evaccs/ - January 2021

In line with these objectives, this section provides the context for the following sub-sectors of the E-Governance pillar.



PROCESS AUTOMATION

Process automation leads to numerous benefits across various government functions. Some of these benefits include more efficient processes, lower operating costs, lesser errors and less wastage of resources. Therefore, the aim of effective and efficient e-Governance cannot be achieved without at-scale process automation. As per the general estimates given by Mckinsey, even partial automation of a government's HR, finance and application processes (60% to 80%) can potentially lead to a reduction of 30% in its total cost.[29]

Moreover, the gains from automation can be achieved relatively quickly as most of the solutions can be developed on existing IT systems without significant additional costs. It is also important to realize that process automation facilitates citizens and businesses to avail the government services online and connect with the providers of services easily.

Government of the Punjab has already made significant efforts for process automation. The next stage is to use automation at scale in order to digitalize the government departments to their core. Government of the Punjab can, then, harness the power of

[29] https://www.mckinsey.com/industries/public-sector/our-insights/how-governments-can-harness-the-power-of-automation-at-scale

automating its processes for greater benefits. Thus, the government shall endeavor to:

i. Promote transparency and accountability in the public sector.
ii. Move to a paperless regime in the public sector during the next 5 years.
iii. Build ICT-related capacity of all government entities and of the respective human resource.
iv. Incorporate evidence-based decision-making in its processes through the use of data and modern tools etc.

CITIZEN-CENTRIC SERVICES

Government to Citizen (G2C) e-governance services can enhance the relationship between the government and the citizens through the provision of accessible, faster, cheaper, transparent and accountable services to the public. According to various estimates, global investment in IT by governments is expected to reach 476 Billion US Dollars by 2020.[30] Most of these investments have been made in the modernization of core IT-systems for better service delivery.

To keep pace with the global trends in the provision of citizen-centric services through e-governance, it is important that Punjab also invests in the digital transformation of its G2C services. An increasing number of citizens expect responsive, transparent and easily accessible services from the government today. Digitalization of G2C services in Punjab can meet these expectations. The provincial government can take measures to improve G2C interactions by updating its philosophy on citizen experience and adopting modern technology. Moreover, the digital transformation of the provincial government departments will also add value in the form of improved efficiency and effectiveness of their services which will become more convenient and tailored to the needs of the citizens.

Since the Government of the Punjab is deeply invested in improving the quality of its service delivery, the government shall endeavor to:

i. Provide all services digitally through end-to-end automation.
ii. Enhance the outreach and citizens' access to public services.
iii. Establish digital platforms for improved citizens' interaction and experience with the public sector.

[30] https://www.bcg.com/en-ca/publications/how-governments-can-get-technology-transformations-right.aspx

BUSINESS-CENTRIC SERVICES

A healthy private sector is indispensable for a booming economy as flourishing local businesses create jobs and income. With the deployment of ICTs, Government to Business (G2B) services become convenient and accessible for businesses. However, effective business regulations which promote ease of doing business are required for effective integration of ICTs in G2B services. Pakistan has recently been performing well on this metric as reflected in the World Bank's Ease of Doing Business Index 2020 where Pakistan has jumped to the 108th place from 136th place out of a total of 190 countries. This improvement of 28 places in Pakistan's ranking is being attributed to the use of ICTs in G2B services as Pakistan was among the top 10 reformers with regards to ease of doing business. Some of the improvements which have been made by Pakistan include increased functionality of the online one-stop shop for starting a business, introduction of online tax payment system for corporate and value-added taxes.

Despite this, Pakistan still lags behind some of the other countries in region (China, India, Nepal, Bhutan, Sri Lanka) in ease of doing business. Thus, there is a need to further digitalize the G2B services in the province so that the ease of doing business can be ensured. Moreover, it is important to make use of ICTs to facilitate the businesses operating in the province and to satisfy their needs in a systematized manner. The government shall endeavor to:

i. Improve ease of doing business in the province through digitalization of all business-centric services.
ii. Provide a strong, effective and stable regulatory regime.

SMART CITIES

The idea of smart cities has gained much traction in the wake of the discourse on sustainability issues. It is a status which is given to a city that integrates ICTs to enhance the performance and quality of urban services such as energy, clean water and transportation. This can be useful in reducing costs, resource consumption and wastage. Punjab, with an urbanization of 36.7% and an urban population of 40.4 million, is urbanizing faster than various south Asian countries which ranges from 18.4% in Sri Lanka to 35.1% in Bangladesh.[31] Estimates suggest that over 50% of Punjab's population will be living in urban areas by 2030.[32]

This rapid and unplanned urbanization has resulted in deteriorating quality of life (half of the urban population in Punjab is hosted by only 5 major cities) and is bound to

[31] Punjab Growth Strategy 2023
[32] https://www.sdpi.org/publications/files/Internal-Migration-and-Urbanization-A-Case-Study-from-Semi-arid%20Regions-of-Pakistan(W-163).pdf

further overburden the already limited resources. Moreover, it is leading to negative outcomes such as housing shortage; lack of infrastructure; poor public services delivery (water, sanitation, transportation etc.); food insecurity; decrease in agricultural and forest lands; increased demand for energy and urban encroachment.

Punjab can tackle the present and future problems arising due to urbanization in a cost-effective manner by transforming its cities into Smart Cities. Some of the benefits of doing so include energy conservation, waste reduction, efficient and adequate public services, streamlined governmental operations, evidence-based decision making and improved well-being. The digital transformation will also assist with the economic development of the province.

Smartification of cities in Punjab will deal with smart energy, smart water, smart waste management, smart transport, intelligent traffic management, city & regional planning and disaster & risk management through IoTs, AI and machine learning. For this purpose, the government shall endeavor to:

i. Encourage smart solutions for urban issues.
ii. Set up at least 5 smart cities in the province.

SOCIAL SECTORS

ICTs have the power to be a social good and transform the society. Due to this reason, ICTs play a key role in each of the United Nations' Sustainable Development Goals. The growing use of various ICTs has led to the exploration of how these technologies can be deployed effectively to serve socioeconomic and development priorities of the society. The innovations in ICTs have important implications due to their role in introducing and diffusing the concepts of knowledge sharing, community development, equality, reducing the digital divide and inclusion. Moreover, ICTs can also be used to promote equitable participation in social, political, and economic spheres, access to education and health, and breaking barriers of marginalization.

Cognizant of the importance of ICTs in social development and the role that efficient social sectors play in economic progress and community development, Government of the Punjab is committed to transform the social sectors digitally. In this regard, Government of the Punjab has introduced several initiatives in the realms of education, health and law and order. Some of these interventions are: tablet-based students' learning assessments, school information system, online college admission system, eLearn Punjab, disease surveillance system, dengue activity tracking system, electronic medical record & hospital information management system, hospital watch, case flow management system at high and district courts, complaint management system for police, electronic FIR, criminal record management system, law portal and automation of Lahore High Court.

The digital transformation of social sectors in Punjab, however, does pose some challenges. These challenges include low ICT literacy and skills especially among women, high cost of technology acquisition for public, financial and technological resource constraints for the government, shortage of teachers with sufficient ICT skills, need to improve ICT infrastructure to support basic communications and specialized applications such as telemedicine, inadequate ICT skills among health professionals and lack of proper ICT hardware and recycling technologies, among others.

Health

Punjab is currently going through a phase of population explosion which makes the existing healthcare facilities inadequate to meet the demands of the 110 million population. According to the Punjab Development Statistics 2017, Punjab has 373 hospitals, 74507 registered doctors and dentists, 63251 nurses and 13087 lady health workers. The increase in these healthcare facilities has not been able to keep pace with the population growth as only 452 beds in hospitals/dispensaries, 654 doctors, 69 dentists and 614 nurses are available for 1 million people. Consequently, the province has 1 bed for over 2200 patients and 1 doctor for 1529 patients. Therefore, Punjab is facing acute shortage of healthcare professionals and facilities. Furthermore, the difference in the quality of treatment also varies regionally such that better healthcare facilities are available in urban centers such as Lahore relative to rural or peri-urban areas. Thus, the burden to provide healthcare to a major part of population is transferred to the hospitals in bigger cities.

Adequate healthcare does not only relate to the physical wellbeing, but also contributes to the social wellbeing and reduction in infant mortality rate. The Punjab Growth Strategy 2023 states that an increase of 1% in the ADP capital stock will lead to an increase of 0.3% in social sector's value addition.

For these reasons, digital technologies are ideal in providing healthcare facilities to individuals and communities through innovative and efficient ways of communication, access, storage of information, diagnosis and treatment. They also improve health system efficiencies and reduce medical errors. In view of this, the Punjab Digital Policy 2021-2025 taps into the potential of ICTs to transform the healthcare provision in the province through which people residing in rural and remote areas will be able to get telemedicine services at their door step and will not have to travel to bigger cities for diagnosis. Hence, the government shall endeavor to::

i. Provide quality healthcare services to all citizens of Punjab by using digital technologies.
ii. Build capacity of the public sector healthcare departments and professionals in ICTs.

Social Protection

Punjab's 38.8% population (headcount) is multi-dimensionally poor as per the statistics of the Punjab Economic Report 2017.[33] Government of the Punjab can make the provision of social protection services more effective and less costly by employing the ICTs.

The integration of ICTs in social protection is driven by the demand for more efficient and accessible service by both public and the service providers. Digitalization of social protection services improves data management, reduces workload, equip the decision-makers to make evidence-based decisions, provides convenience and better security for the beneficiaries, makes processes transparent, empowers beneficiaries and increases coverage of the programs. From the supply side, ICTs facilitate during surveys, recording and updating of information pertaining to poor families. Equally important is ICTs role in the disbursement of payments which makes it possible for the programs to reach the remote areas.

While the increasing teledensity and penetration of 3G/4G and broadband services in Punjab offers a timely opportunity to integrate digital solutions in implementing social protection programs, issues such as lack of digital literacy and cyber security slow down the deployment of ICT solutions. This results in higher transactional and operational costs.

Social protection is among the top priorities of the Government of the Punjab and is well-reflected in the budget for FY 2020-2021. Moreover, the government has also launched the Punjab Ehsaas Programme for protection of the poor and marginalized segments in the province and plans to employ ICTs for its implementation. Furthermore, several social safety nets have been introduced by the government in the aftermath of the Covid-19 pandemic.

Punjab Information Technology Board has been working closely with the Punjab Social Protection Authority for the digital transformation of the social protection sector in the province. The government shall endeavor to:

i. Promote the use of digital technologies in social protection.
ii. Encourage digital disbursements of all social protection payments.

[33] https://peri.punjab.gov.pk/system/files/PER2017.pdf#overlay-context=reports

Environment

While climate change and environmental challenges are releasing havoc at a global level, Pakistan is more vulnerable to these issues. The Global Climate Risk Index 2019 ranks Pakistan at 8th number in the list of countries that have been most severely affected by the climate change during 1998-2017.[34] Another report by the Asian Development Bank shows that the annual mean temperature in Punjab has increased by 0.52°C from 1960 to 2007.[35] If this trend continues, the annual mean temperature in Pakistan is expected to rise by 3°C to 5°C by the end of this century. This increase in mean temperatures is going to be joined by increased variability in rainfall, rising sea levels and decline in the yields of basmati rice and wheat. The air quality in Punjab is also deteriorating as the Air Quality Index showed a hazardous level of over 500 AQI in Lahore, the provincial capital, during October/November 2019. This is significantly greater than the safe AQI of 0-50.

On that account, the threat of climate change is real for the province and steps need to be taken forthwith to address this alarming situation. ICTs play a vital role in environmental protection and sustainability. They help in environmental data collection, planning, trend analysis, forecasting and implementation of remedial interventions to cater to the environmental crisis. Thus, it is necessary to use ICTs to minimize the environmental damage and to plan for the future. The government shall endeavor to::

i. Use latest digital technologies in environmental management.

Law & Order

Security challenges in the province are multi-dimensional in scope and nature. Traditionally, departments responsible for law & order have operated largely in a human-intensive manner. This has resulted in delays in the sharing of critical information. With the dawn of the information age, latest technologies are increasingly being used in criminal activities. More importantly, electronic crimes are also on the rise. Due to these reasons, it is important for the provincial law enforcement agencies to be equipped with and skilled in ICTs to counter the crimes. They also need to deal with the potential threats and risks of criminal activities preemptively using ICTs by efficiently gathering, sharing and disseminating information.

The provincial justice system can also benefit greatly from greater and rapid integration of ICTs in its processes. Punjab was found to be the worst-performing

[34] https://germanwatch.org/sites/germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf
[35] https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf

province with 1,168,782 pending cases at the district judiciary level as reported by the Law & Justice Commission of Pakistan for the first quarter of 2018. Lahore High Court, alone, had over 150,000 pending cases. A majority of these relate to commercial disputes. Besides, the pendency of the cases is only one challenge. The time and cost that it takes to seek justice are also significant.

Although Punjab has integrated some of the digital technologies to improve the law and order situation and to expedite the judicial process in the province, the digital transformation requires more efforts. Thus, the government shall endeavor to:

i. Develop the capacity of law enforcement entities in ICT technologies.

ICT INDUSTRY & ENTREPRENEURSHIP ECOSYSTEM

OVERVIEW

Over the course of last decade, the IT sector in Pakistan has been flourishing: there are 9500 registered IT firms in 2020 which reflects a percentage increase of over 298% from the number of registered firms in 2011.[36] This rapid expansion of the IT sector has translated into an increase in IT revenues during the fiscal year 2019-20. During the FY 2019-20, Pakistan's IT and ITeS exports have exceeded USD 4.1 billion including USD 1 billion in export remittances and USD 500 million contributed by micro enterprises, independent consultants, and freelancers. The annual domestic revenue also exceeds USD 1 billion.[37] According to the Pakistan Economic Survey 2019-20, the IT &ITES-BPO remittances have been growing consistently with a compound annual growth rate of 19.5 percent, over the last five years. This is the highest growth rate in comparison to all other industries in the country and the highest one for IT & ITES-BPO remittances in the region. These figures show the potential of IT industry to further contribute towards the economic development of the country. With over 23000 IT graduates[38] joining the skilled workforce every year, the ICT sector is only expected to expand.

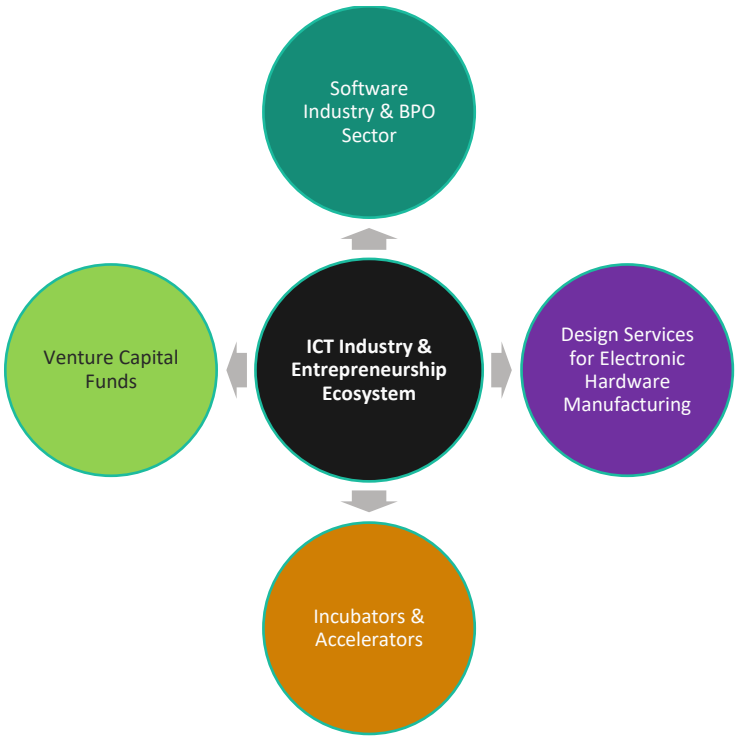
Similar trends have been observed at the provincial level. Government of the Punjab is aware of the importance of ICT industry and Entrepreneurship and is committed to create a conducive environment for their functioning. Various steps including

[36] Annual Reports 2011 to 2020 – Securities and Exchange Commission of Pakistan
[37] Pakistan Economic Survey 2019-20
[38] Pakistan Software Houses Association

payment of government taxes; ease of doing business initiatives, acquiring hassle-free warehouse construction permits from e-Khidmat Markaz and One Window Centers of LDA; construction of technology parks and knowledge parks; and facilitation in setting up a new industry in any of the industrial zones in Punjab through One Window Service Centers (OWSC) have already been taken in this regard. The Punjab Digital Policy 2021-2025 identifies following policy objectives for the growth of ICT industry and entrepreneurship in the province.

i. To strengthen the local IT industry through favorable regulations and incentives;
ii. To enhance the export potential of the local IT industry;
iii. To set up the foundations of the chip design services in Punjab;
iv. To encourage entrepreneurship through an enabling environment and access to finance.

In line with these objectives, this section specifies the context for the following sub-sectors of the ICT Industry & Entrepreneurship Ecosystem pillar.



SOFTWARE INDUSTRY & BPO SECTOR

Software industry and the Business Process Outsourcing sector are the backbone of the IT industry in Pakistan and have contributed predominantly towards country's IT revenues. As already mentioned, Pakistan is currently exporting USD 4.1 billion worth of IT & ITES-BPO services. Main markets for country's exports in IT sector include USA (approx. 50% of exports), UAE (9% of exports) and European Union (8% of exports).

Despite the multibillion dollars in IT exports, Pakistan's share in the international IT-BPO exports has only been 0.1% by 2017. This is below the share of Pakistan's regional competitors: India, Philippines and Sri Lanka had a share of 34%, 3% and 0.5% in the global IT-BPO market, respectively. Moreover, Pakistan's exports are primarily based on low-value-added services such as software maintenance and voice-based customer support within the IT outsourcing (87% of total IT exports) and BPO (13% of total IT exports) segments.[39]

Nonetheless, Pakistan's software and BPO sectors are expected to grow in years to come due to sizeable labor pool, low labor costs, decent telecommunication infrastructure and ease of doing business initiatives by the government. The total employment in IT industry in Punjab is also expected to increase.. Thus, the potential growth is apparent. Considering this, the government shall endeavor to::

i. Facilitate the software industry and BPO sector through incentivization and regulatory changes.
ii. Steer the IT-BPO exports towards high-value-added services.

DESIGN SERVICES FOR ELECTRONIC HARDWARE MANUFACTURING

Electronic hardware is among the world's largest and fastest growing industries. However, the Electronic Hardware Manufacturing (EHM) and the relevant design services are fragmented and almost non-existent in Punjab. The products which are currently being produced are based on rudimentary technology and do not contribute much to country's economy. Therefore, Pakistan has become dependent on other countries (primarily china) to meet its consumers' demand for hi-tech electronic products. Although National Institute of Electronics (NIE) has been established at the federal level, R&D in EHM lacks significantly. Furthermore, the on-going struggle for technological dominance between China and US has resulted in China moving away from the technology developed in US and relying on either its own or on the technology developed by friendly nations to fill the gap.

Special focus is placed on the establishment of semiconductor/chipset design industry in Punjab in this document as chipsets are an essential component for electronic hardware manufacturing and are used in almost everything from cellphones and provision of financial services to defence infrastructure. Since China is now in need for partners for chipset designing and manufacturing, the time is right for Punjab to start investing in this domain and to produce chipset designs within the province. With the global semiconductor industry valued at USD 500 Billion and with China and South Korea's projected demands for engineers to reach 500,000 engineers, Pakistan's economy and talent pool are uniquely placed to take full economic, technological and

[39] https://gvcc.duke.edu/wp-content/uploads/PakistanOffshoreServicesGVC.pdf

strategic advantage of the situation. In addition to this, Pakistan relies wholly on the chipsets designed and manufactured in other countries and thus faces a tangible threat to its sovereignty and security. This risk can only be mitigated through self-sufficiency in the said field as evident from governments' financial support to the local semiconductor industry in China, India and USA.

To help with the establishment of an organized chip design industry in the province, the government shall endeavor to:

i. Provide a comprehensive set of incentives and an enabling environment for design services in the province.
ii. Introduce trainings, courses and necessary changes in universities curriculum for design services.

INCUBATORS & ACCELERATORS

Startups aid in increasing the level of economic activities which is required for the expansion of the economy to accommodate new job seekers. In addition to this, Startups are useful in improving the technology advantage of a nation for future development and growth of the economy.

Government of the Punjab is committed to promote entrepreneurship in the province. Accordingly, Plan 9 incubator, which has created thousands of direct and indirect jobs since 2012, was established. In addition to the creation of jobs, the 195 plus graduated startups are valued at over USD 77 million.[40] The tremendous results generated through Plan 9 has also paved way for the establishment of several other incubation centers in the province. This shows the potential of the entrepreneurial sector in Punjab.

Realizing this potential and the need to instill entrepreneurial spirit among masses, Government of the Punjab plans to launch a large-scale program for establishing technology incubation centers in all 9 divisional headquarters of Punjab in collaboration with local public sector universities. e-Earn is another such forthcoming initiative which provides a co-working space for freelancers under a Public Private Partnership Mode in all districts of the province. As a result of these initiatives, approximately 71000 new jobs are expected to be created. To further facilitate start-ups and entrepreneurs, the government shall endeavor to:

i. Provide a conducive regulatory environment for the startup ecosystem to flourish in the province.
ii. Promote entrepreneurship in the province through establishment of incubators and training programs.

[40] https://plan9.pitb.gov.pk/plan9_at_glance - September 2020

iii. Ensure local startups' access to the international markets and investors.

VENTURE CAPITAL FUNDS

Venture Capital Funds have an important role to play in the creation of sustainable startups and MSMEs. Besides, such funds provide the startups and MSMEs with the much-needed seed funding without which innovation cannot take place adequately. Realizing the need for VC funds, the government shall endeavor to:

i. Extend financial support to start-ups/businesses with potential ideas.
ii. Attract foreign investors to the province through facilitation and outreach activities.
iii. Encourage local banks to introduce credit schemes for startups and local IT industry.

HUMAN CAPITAL/EDUCATION & SKILLS DEVELOPMENT FOR ICTS

Quality human capital formation is the key to economic growth and social progress. As already mentioned, investments in the education sector offer significant returns: a 10% increase in current ADP allocation will lead to 1% growth in economy and will create 1 million jobs over the fiver-year period in Punjab. Nevertheless, the structure of our education system, including technical and vocational education and training (TVET), needs to be revamped in order to reap these benefits. The need exists for a structural reform so that the workforce in Punjab may move from low cost labor to highly productive workers with strong employability.

Over the years, Punjab has invested heavily to make education accessible for all. Despite this, over 40% of children within the age group of 5-16 years (primary to secondary) are out of school. [41] Majority of these children belong to the 10 to 16 years age-group[42] as the combined number of lower secondary and upper secondary level schools (14963) is significantly lesser than that of primary schools (36321) in Punjab. In addition to the issue of accessibility, challenges of retention and poor learning levels are also present.[43] In such a situation, ICTs can be employed to enhance access to quality education in the province by filling the gap between supply and demand of education. In addition to this, using ICTs to provide education will also result in digital literacy which is a valuable skill for the consumers (students) and their parents.

At the tertiary education level, over 500,000 students graduate from Pakistani universities annually including 23000 IT graduates on average. However, only 5000 are employable in their respective fields.[44] Similarly, 551,063 students were enrolled in public and private universities in Punjab during the academic year 2018-19.[45] Yet, an overwhelming majority of these students lack employable skills. These figures are a manifestation of drastic differences in market demands and the skillsets with which the students are being equipped in our education system.

[41] Pakistan Education Statistics 2016-17. Other sample based surveys such as MICS Punjab 2017-18 and ASER Pakistan (Rural) 2018 provide varying estimates for number of OOSC in Punjab
[42] https://www.wilsoncenter.org/sites/default/files/2019-07-why_cant_pakistani_children_read_nadia_naviwala.pdf
[43] ASER Pakistan
[44] Pakistan Software Houses Association
[45] Pakistan Economic Survey 2019-20

This results in the shortage of technologically skilled ICT workers who can adopt, implement, innovate and maintain new information technologies. The reason for this gap in supply and demand of IT graduates is the mismatch between the required skillsets and the skills which majority of these graduates are equipped with in universities. The tertiary education system in the country has been unable to update its curriculum based on the dynamic needs of the evolving digital technologies. The only exception to this statement has been the Tier-1 universities.

Some of the reasons for the mismatch in skillsets are the lack of coordination in academia and industry, lack of capacity of faculty members with respect to latest ICT skills, inadequate knowledge of industry needs, excessive theoretical mode of instruction, absence of quality assurance systems and low exposure to practical knowledge.

To deal with these issues, digital technologies can be used in providing skills, TVET, adult literacy and specialized educational programs, all of which contribute directly to the formation of a knowledge economy and employable IT workforce. Thus, the government shall endeavor to:

i. Build a resilient IT workforce in the province by enhancing the knowledge, skills and competencies of existing and upcoming IT graduates.
ii. Enhance the IT-related capacity of public sector employees.
iii. Introduce necessary changes in the school and university curriculums.
iv. Engage local IT industry for human capital development and bridge the industry-academia gap.

COMMUNICATION & CONNECTIVITY

Seamless connectivity and efficient communication systems are at the core of digitalization. Currently, there are 176 million cellular subscribers, while the penetration of 3G/4G services and Broadband services stand at only 42.43% and 43.5% respectively.[46] Furthermore, the quality and speed of internet varies significantly by region. This situation requires immediate policy-level action. Therefore, following interventions are proposed for improving the connectivity and communication in the province:

i. Encourage the private sector to invest in the ICT infrastructure.
ii. Encourage the use of ICT infrastructure and facilities as shared resources.
iii. Setup & strengthen Punjab Data Center at PITB (with adequate DR site) as a common, shareable, secured, centralized hosting infrastructure for all public sector applications.
iv. Incorporate telecommunications infrastructure, as an in-built feature, in public infrastructure such as new roads and electricity grids.
v. Introduce/adopt a Right of Way Policy in collaboration with all relevant stakeholders.
vi. Support telecom companies in expanding the outreach of broadband connectivity to the entire province by facilitating in Right of Way and other administrative challenges.

[46] Pakistan Telecommunication Authority – December 2020

POLICIES & REGULATIONS

Punjab Digital Policy 2021-2025 has set out comprehensive goals and policy objectives for the digital transformation of various sectors and facilitation of the ICT industry in the province. This is expected to have a wide-ranging impact on the quality of life, efficiency of public services and empowerment of the private sector. To optimize the impact of these changes, the Punjab Digital Policy 2021-2025 outlines following policies, regulations and guidelines which cut across all sectors and are essential for the successful implementation of this policy:

i. **Digital Identity** - Digital Identity[47] has become an important aspect in several domains including online transactions, e-Commerce, e-Governance and healthcare. It can mitigate the risks related to identity theft and can be used to help the stakeholders with the protection of critical infrastructure, secure remote logins and security of entities' information. That, however, is not without concerns over security and privacy of the information. Therefore, it is important to provide effective measures through which the challenges faced during the deep-adoption of digital identities can be reduced. National Database and Registration Authority (NADRA) shall be engaged with during the formulation process of the digital identity framework. The created digital identities will be linked with personal citizen records (stored in digital lockers) and digital signatures.

ii. **Digital Signatures** - Mechanisms will be developed in collaboration with all relevant stakeholders for the acceptance of digital signatures as a form of valid verification and identification.

iii. **Digital Lockers** - Regulations pertaining to digital lockers will be devised in consultation with experts to eliminate reliance on paper-based documents. Through this, all government departments will be able to access citizens' and businesses' documents digitally, if and when needed.

iv. **Data Protection** - Data Protection Regulations shall be introduced/adopted to deal with concerns related to the security of online data and information in both public and private spheres. Moreover, Master Data Management Systems shall also be implemented across all public sector entities.

v. **Data Sharing** - Data sharing Guidelines will be developed/adopted for safe and secure sharing of data and information in public and private sectors.

vi. **Open Data** - Government will implement an "open by default" data policy through which all public data will be made available online for increased accountability, transparency and research.

[47] A digital identity is an online or networked identity adopted or claimed in cyberspace by an individual, organization or electronic device.

vii. **IT/ITeS/Tech Startup Special Economic Zones** – A framework will be developed/adopted to facilitate the establishment of special economic zones and special technology zones for IT/ITeS/Tech Startups in the province in order to unleash the export potential of the local industry.

FINANCE & INVESTMENTS

Government of the Punjab is fully cognizant of the fact that technological reforms are often cost intensive and require significant financial investments to be made. Nonetheless, these investments are not without returns as already mentioned. According to the Overseas Chamber of Commerce and Industry (OCCI), digitalization of Pakistan's economy can lead to the creation of approximately 5 million direct/indirect jobs while also adding a remarkable 40 to 50 Billion US dollars in country's GDP by 2025.[48] Likewise, McKinsey Global Institute suggests that the expansion of digital financial services in Pakistan can deliver a boost of 36 Billion US dollars in GDP and add up to 4 million new jobs in the economy during 2016-2025.[49]

With the Covid-19 pandemic, ensuing economic slow-down and contracting fiscal space because of it, innovative solutions are required for financing the implementation of this policy document. In this regard, it is proposed that the private sector shall be heavily engaged with for the implementation of the proposed initiatives, under PPP mode or as a JV, whereby government will strive to provide a conducive business environment for the local companies through its ease of doing business initiatives. Establishment of a globally competitive domestic ICT industry cannot be achieved without partnerships and cooperation between public, private, multilateral, civil society organizations, community and financial stakeholders. Such partnerships help in mitigating risks, demonstrating market potential, enhancing capacity and stimulating demand for ICTs.

Furthermore, all government departments/entities will be required to align their ICT investments with the Punjab Digital Policy 2021-2025. Consequently, budgetary requirements shall be ascertained at the project approval stage and funds will be allocated accordingly.

[48] https://www.oicci.org/wp-content/uploads/2018/12/Recommendations-on-National-Program-for-Digital-Transformation.pdf

[49] Mckinsey Global Institute - Digital Finance for All: Powering Inclusive Growth in Emerging Economies - https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/How%20digital%20finance%20could%20boost%20growth%20in%20emerging%20economies/MGI-Digital-Finance-For-All-Executive-summary-September-2016.ashx

ANNEXURE 1: ACTION PLAN FOR DIGITIZING THE ECONOMY

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Knowledge Economy	i. Introduce Short Courses on emerging disciplines such as Artificial Intelligence, Machine Learning, IoT, Cloud Computing and Big Data etc. ii. Launch Bootcamps to train the IT graduates in employable skills. iii. Establish forums to promote academia-industry linkages and exchange of ideas. iv. Update curriculum of IT and IT-related degrees in line with latest market needs. v. Make it necessary for all ICT-based solutions to be piloted and scaled-up only based on credible research/evidence. vi. Provide trainings on e-Commerce platforms to the MSMEs in the province.	i. Setup special technology zones/parks in the province to promote innovation. ii. Establish centers of excellence in emerging digital technologies. iii. Encourage and incentivize private sector's involvement in setting-up IT infrastructure for private and government sectors. iv. Offer investment tax credits to local companies for implementing digital solutions. v. Realignment of sectoral policies to encourage digitalization.

Shared Economy	i. Devise a regulatory framework for the shared economic activities in the province. ii. Engage with the State Bank of Pakistan to simplify the process of recording income by freelancers as export income and not remittances. iii. Facilitate the shared-economy start-ups by providing ease of entry into the market and considering tax rebates for all such start-ups.	i. Establish coworking spaces in all districts of the province. ii. Devise a crowd funding, crowd sourcing and Peer-to-Peer lending framework in collaboration with the State Bank of Pakistan and other relevant stakeholders to simplify the process.
Financial Technology	i. Incentivize financial inclusion. ii. Form a working group to identify the FinTech needs and suggest incentives for different sectors (especially the retail sector). iii. Devise strategies for safe and secure usage of blockchain technology for legal purposes. iv. Engage with the State Bank of Pakistan for a conducive FinTech regulatory environment. v. Devise/adopt strategies to ensure the security of consumers' data.	i. Digitalize the collection and disbursement of all G2C, G2B, G2G, C2G, B2G payments like pensions, taxes, scholarships, levies etc. ii. Establish FinTech Hubs in the province. iii. Based on working group's recommendations, provide incentives to relevant sectors for incorporation of FinTech. iv. Incentivize the service providers to accept payments through electronic modes in collaboration with the relevant stakeholders v. Engage with federal authorities to provide 3G/4G/5G network coverage to all citizens through the telecom companies. vi. Require the FinTech services to be adapted in local languages and disability-friendly formats.

Agriculture	i. Encourage the establishment of digital marketplaces for shared farm equipment. ii. Encourage the establishment of online sales platforms for farmers. iii. Pilot the digitalization of markets/mandis in at least one divisional headquarter of the province. iv. Formulate necessary policy measures to integrate ICTs into the operations and activities of the agriculture sector. v. Form a working group for long-term guidance on automation of value chains and supply chains of the agricultural inputs and outputs	i. All markets/mandis to be digitalized in Punjab. ii. Promote the usage of precision farming in agricultural practices for productivity enhancement. iii. Complete automation of value chains and supply chains based on the inputs from the working group. iv. Use digital technologies for produce estimation, estimating cost of production, aggregate production estimates with supply networks and availability of produce to different markets through robust and self-operating supply chain systems, based upon assurance of fair value to the growers and consumers with marginal profits for middlemen and retailers.
Tourism	i. Market tourism products through digital platforms. ii. Establish information portal for tourism destinations and products.	i. Establish platforms for end-to-end tour planning services (similar to “Trip Advisor”) and integrate these platforms with the existing international ones such as “Trip Advisor” and “Airbnb” etc.

ANNEXURE 2: ACTION PLAN FOR E-GOVERNANCE

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Process Automation	i. All government entities to make IT a part of their sectoral policies and prepare '5-year IT plans' in consultation with PITB with yearly deliverables. ii. Embed ICT training modules in all provincial training institutes. iii. Introduce IT Cadres for operational functioning of IT interventions at departmental and district levels. iv. Implement a "cloud-first" adoption strategy in which cloud will be the preferred option for delivering IT services. v. Implement a "digital-first" strategy under which all government services are to be offered digitally as well to increase outreach and citizens' access. vi. Make data management and data analytics (including BI) as core functions of all public	i. Digitalize the collection and disbursement of all G2C, G2B, G2G, C2G, B2G payments like pensions, taxes, scholarships, levies etc. ii. All government entities to move to a paperless regime. iii. Fully automate HR functions in all public sector entities. iv. Implement BPR to simplify and automate government processes. v. Implement e-procurement. vi. Introduce mandatory digital record keeping for all government transactions and bring changes into laws where necessary. vii. Promote e-culture in G2G and provide legal cover for electronic communication.

	sector entities to improve efficiency and encourage informed decision-making. vii. Implement data protection/sharing guidelines. viii. Setup & strengthen Punjab Data Center at PITB (with adequate DR site) as a common, shareable, secured, centralized hosting infrastructure for all public sector applications and platforms. ix. Make necessary amendments in the secretariat manual and rules of business for implementing paperless regime.	
Citizen-Centric & Business-Centric Services	i. Identify, develop and provide at least 75 e-Services through digital platforms. ii. Consolidate all public e-services on a single digital platform for improved citizens' and businesses' interaction and experience with the public sector. iii. Increase the scale, scope and outreach of existing digital and OTC services. iv. Provide a single touch point to citizens and businesses by integrating all provincial government helplines	i. Introduce a single sign-on digital platform for all public services. ii. Provide all public services digitally through end-to-end automation. iii. Ensure the availability of all government e-services and online content in local languages and disability-friendly formats.

	and complaint channels.	
Smart Cities	i. Form a working group to develop a Smart City Strategy. ii. Conduct feasibility study for transformation of one city into a smart city. iii. Pilot test some of the urban services for smart solutions. iv. Enhance government's preparedness for emergencies and disasters through the use of ICTs.	i. Establish at least 5 smart cities in the province.
Social Sectors	i. Introduce a digital platform for provision of healthcare services. ii. Use ICTs (especially artificial intelligence and machine learning) in the management and treatment of diseases and pandemics. iii. Provide ICT training and skills development to public sector healthcare professionals. iv. Establish a social protection database/registry for all social protection initiatives. v. Devise environmental standards relating to IT industry and develop tools and	i. Establish EMR Registry which shall contain patient information and records. ii. Digitalize all public sector healthcare facilities. iii. Ensure digital disbursement of all social protection payments. iv. Develop and institutionalize an integrated platform for criminal justice system.

		mechanisms to mitigate social and environmental effects of IT. vi. Build capacity to use latest digital technologies in environmental management. vii. Employ water-saving technologies (such as smart metering etc.) and modernize irrigation infrastructure. viii. Use Big Data Analytics and Artificial Intelligence to predict the crime incidence and identify crime pockets. ix. Build capacity of IP officers and legal fraternity on IT-specific laws and disputes through trainings.	

ANNEXURE 3: ACTION PLAN FOR ICT INDUSTRY AND ENTREPRENEURSHIP ECOSYSTEM

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Software Industry & BPO Sector	i. Build the capacity of MSMEs to bid for government projects. ii. Revise PPRA rules to allow for procurement of ICT services from MSMEs and local vendors. iii. Offer incentives to enterprises so that they may register and come under the tax net. These incentives may include: lower GST on services, Industrial rate electricity and space in industrial/special zones. iv. Efforts shall be made to ensure that Call centers are considered as a part of the IT & IT Enabled Services (ITES) Industry and are subjected to similar taxation. v. Establish a one-window facilitation	i. Establish dedicated Special Technology Zones (STZs) for IT industry in Punjab. ii. Establish a Center of Excellence for showcasing of public sector digital interventions/ideas and for connecting industry with academia. iii. Establish a Market Access Fund for companies based in Punjab that are bringing in export revenue.

	center for IT industry (visa, registration etc.) vi. Introduce trainings/bootcamps to build human capital in line with industry's needs.	
Design Services for Electronic Hardware Manufacturing	i. Introduce specialized courses on chip designing, EDA tools and semiconductors for engineering students through necessary changes in the curriculum. ii. Provide Academic EDA Tools to public sector universities for training of relevant engineering students. iii. Introduce Faculty-Development Programs on SoC. iv. Negotiate with the EDA tools providers for country-level discounts on academic and commercial EDA tools. v. Provide tax credits and other incentives to design companies. vi. Introduce training-to-recruitment programs for fresh graduates (engineering background) on SoC in	i. Designate specific areas in STZs for design services. ii. Offer free of cost land in STZs to large national and international firms which are interested in establishing design centers and/or FAB facility in the province.

	collaboration with the private sector. vii. Establish a Punjab Integrated Circuit Investment Fund to financially support SoC. viii. Facilitate (through trade attachés and other mediums) the private sector to reach out to foreign companies in order to create awareness about the incentives and resource pool available in Pakistan for chip designing.	
Incubators & Accelerators	i. Plan/convene Startup Summits in key overseas markets where Pakistani startups can pitch their ideas to foreign investors. ii. Introduce Applied Entrepreneurship Training Program, with free trainings for managements of incubators and accelerators. iii. Provide a special package of incentives to startups that launch in smaller cities and towns. iv. Launch incubators and accelerators in all districts of the province. v. Provide awareness and support to entrepreneurs in universities e.g. identification of	i. Facilitate linkages of local startups in key overseas markets and with international entrepreneurial stakeholders e.g. Google Accelerator, Ycombinator, Tech Valley Makkah, China Accelerator etc. ii. Support linkages among local incubators and accelerators through a single government-backed platform.

	problems that need to be solved in the country with a connection to mentors and resources. vi. Encourage practical FYPs instead of theoretical ones in the undergraduate engineering programs. vii. Provide platforms to startups and students for networking with successful national/international entrepreneurs, investors, domain specialists etc.	
Venture Capital Funds	i. Launch Punjab Innovation Fund in collaboration with SBP and financial institutions. ii. Facilitate and invite foreign investors to form Venture Capital Funds in Pakistan. iii. Encourage an ecosystem of investors who understand the importance of investing in technology.	i. In order to promote lending to local start-ups and local IT industry, a portfolio protection scheme for banks be introduced in collaboration with SBP.

ANNEXURE 4: ACTION PLAN FOR HUMAN CAPITAL/EDUCATION & SKILLS DEVELOPMENT FOR ICTS

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Human Capital/Education & Skills Development for ICTs	i. Design and introduce trainings and boot camps for IT graduates to bring their skillset at par with the global standards and market demands ii. Gap analysis to identify industry-academia gaps and devise suggestions to bridge the same. iii. Introduce courses on emerging technologies at school and college levels (including TVET and non-formal education) with the aim to inculcate a culture of problem solving and innovation. iv. Enhance the IT skillset of all relevant public sector employees through trainings. v. Provide freelancing trainings. vi. Introduce e-learning/blended learning initiatives and incentivize private sector's involvement in the	i. Provide trainings in emerging technologies to colleges/universities faculty under the "Teaching the Teachers" and/or Faculty Exchange programs. ii. Encourage collaborative research, R&D projects and knowledge transfer partnerships between universities/ research institutions and industry following the triple helix model. iii. Provide free basic digital skills training to adults who lack such skills. iv. Improve accessibility and infrastructure in public and private schools /colleges/universities by promoting the concept of shared facilities e.g. shared labs. v. Facilitate the development/ adoption of Educational Management Information Systems within the private educational institutions. vi. Establish digital public libraries to digitize the already existing written, audio and video content in local languages and make it available online.

	same to reach the most marginalized. vii. Develop a School ICT Strategy in collaboration with the provincial school education department. viii. Launch Punjab Innovation Challenge at school, college and university levels to encourage students to develop innovative ideas. ix. Introduce ICT trainings for school teachers in collaboration with the school education department. x. Connect universities with the incubators and accelerators in order to promote entrepreneurship.	

ANNEXURE 5: ACTION PLAN FOR COMMUNICATION & CONNECTIVITY

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Communication & Connectivity	i. Encourage the private sector to invest in the ICT infrastructure. ii. Encourage the use of ICT infrastructure and facilities as shared resources. iii. Setup & strengthen Punjab Data Center at PITB (with adequate DR site) as a common, shareable, secured, centralized hosting infrastructure for all public sector applications.	i. Incorporate telecommunications infrastructure, as an in-built feature, in public infrastructure such as new roads and electricity grids. ii. Introduce/adopt a Right of Way Policy in collaboration with all relevant stakeholders. iii. Support telecom companies in expanding the outreach of broadband connectivity to the entire province by facilitating in Right of Way and other administrative challenges.

ANNEXURE 6: ACTION PLAN FOR POLICIES & REGULATIONS

Themes	Action Plan	
	Short Term to Medium Term	**Long Term**
Policies & Regulation	i. Data sharing guidelines will be developed/adopted for safe and secure sharing of data and information. ii. Data Protection Regulations shall be introduced/adopted to deal with concerns related to the security of online data and information in both public and private spheres. iii. Government will implement an "open by default" data policy through which all public data will be made available online for increased accountability, transparency and research. iv. A framework will be developed/adopted to facilitate the establishment of special economic zones and special technology zones for IT/ITeS/Tech Startups in the province in order to unleash the export potential of the local industry.	i. Digital Identity framework will be devised and National Database and Registration Authority (NADRA) shall be engaged with during the formulation process. ii. Mechanisms will be developed in collaboration with all relevant stakeholders for the acceptance of digital signatures as a form of valid verification and identification. iii. Regulations pertaining to digital lockers will be devised in consultation with experts to eliminate reliance on paper-based documents. iv. Implement Master Data Management Systems in the province.

	v. Introduce a Master Data Management System Framework.	

ANNEXURE 7: DIGITAL IDENTITIES, LOCKERS AND SIGNATURES

A successful information society is one that extracts a strong value out of the use of online applications. It involves facilitating economic transactions, handling of government affairs, end-user online services and more. Government of the Punjab has been involved in modernizing IT based systems for public sector departments and services which are widely being used by different mix of users including but not limited to general public, officials of relevant departments, law enforcement agencies, courts etc. Although the systems or apps use some sort of registration of users while interacting online with public systems, the mechanism is not sufficient to uniquely identify the individual or an internet user. This requires online users to have a solid, secure, and convenient way of identifying themselves online – a digital identity.

Moreover, with the increasing provision and use of e-services, new forms of authentication are needed. Modern information management requires the automated exchange of information, which in turn requires the existence of strong authentication system for personal identification and authorization. From the perspective of a government administration, identity management is the administration of information associated with persons that can be identified uniquely in order to enable their use of government services.

In a digital society, citizen interacts with public system are identified using a trusted, reliable, and robust Digital Identity Management System (DIMS). The digital identity management system can identify a person sitting behind the machine. With the development of large number of mobile applications where a citizen living in Punjab may access citizen services, pay online, make transactions using IT based system, log a complaint against any individual or official, this all can be based on digital identities which are irrefutable and backed by legal & technological regime using a powerful Identity Management Infrastructure possibly Blockchain based models.

With this background in mind, a comprehensive Digital Identity Management System (including digital identities, digital lockers, digital signatures, legal and technical framework) has been proposed to be developed under the World Bank-supported

"Punjab Resource Improvement And Digital Effectiveness (PRIDE) Program". All relevant regulations and frameworks will, thus, be developed under the project.

ANNEXURE 8: DATA PROTECTION

The Ministry of IT & Telecom has drafted a "Personal Data Protection Bill 2020". Since this bill extends to the whole of Pakistan, the same will be adopted at the provincial level after approval. Moreover, the following guidelines are prepared for guidance on collection, storage, usage and processing of personal data.

Guidelines on Collection, Storage, Usage and Processing of Personal Data

1. Purpose

The Government of Punjab has embarked on a journey of digital transformation to boost the economy, facilitate the citizens, and improve & monitor government's performance. During this process, a lot of data is being generated from the IT systems of various sectors. This data can serve as a gold mine for the government if it is analyzed effectively to generate actionable insights and predict future for better governance. In addition, useful trends and conclusions can be drawn by the academic and research organizations if the data is shared with them.

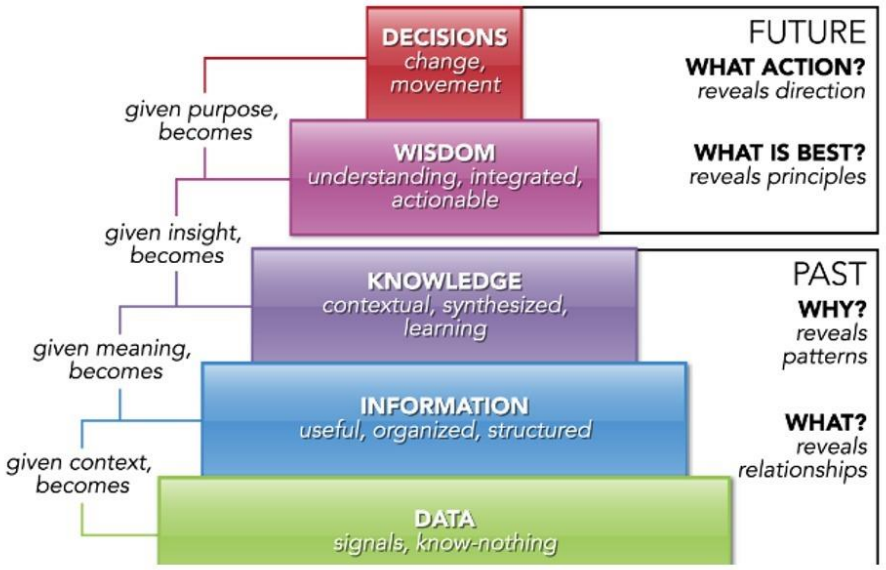


Figure 1: The journey of data, from raw to usable forms

This data is sensitive as it holds personal information of citizens, employees and departments. Furthermore, since this data is collected independently across departments, there is a lot of duplication of effort. The needs for privacy and confidentiality, even for the exacts same data, are catered for differently. As the growth rate of this data is exponential, the need to extract information and insights from it also grows, which is hindered by the fact that the mechanisms to sift through the disparate data sets are not aligned. Hence there is a definite need for comprehensive guidelines, which are implemented uniformly across the board and which define how data is collected, managed, secured and used.

2. Scope

The scope of these guidelines extends to the entire province of Punjab.

3. Pillars

This data policy focuses on four main pillars of data management:

i. Data Access and Usage
ii. Data Anonymization and Confidentiality
iii. Data Integrity and Integration
iv. Data Security and Backups

3.1. Data Access & Usage

This section provides the guidelines with reference to data categorization, access and usage. These rules will ensure that personnel will have appropriate access to the data and that the data is used in an ethical manner, without being misused or abused in any way.

3.1.1. Definitions

3.1.1.1 Government Entity

Any Provincial Government Entity that has in its possession Data relating to the citizens of Punjab, or its own internal processes.

3.1.1.2 Private Entity

Any for-profit or non-profit non-governmental legal entity, including sole proprietorships.

3.1.1.3 Person

A natural person or a private legal person, including, without limitation, individuals; sole proprietorships.

3.1.1.4 Data Providers

The Government Entities, Private Entities and Persons that provide Data.

3.1.1.5 Data

A collection of organized or unorganized information, facts, concepts, instructions, observations, or measurements, in the form of numbers, letters, symbols, images, or any other form, that are collected, produced, in possession of, or processed by Data Providers.

3.1.1.6 Open Data

The data which may be disseminated without restrictions or with the relevant minimum restrictions prescribed by Government of the Punjab.

3.1.1.7 Shared Data

The data which is exchanged among parties (government entities) in accordance with the relevant conditions and rules determined by the Government of the Punjab.

3.1.1.8 Confidential Data

Shared Data whose disclosure to the public or to third parties may cause limited damage to the public interest or to Persons.

3.1.1.9 Sensitive Data

Shared Data whose disclosure to the public or exchange by government entities on other than a "need-to-know" basis may cause significant damage to the public interest or to Persons.

3.1.1.10 Secret Data

Shared Data which is classified as secret and whose disclosure to the public or exchange by government entities on other than a "need-to-know" basis may cause very serious damage to the public interest, to national security, or to Persons.

3.1.1.11 Personal Data

Data that is related to a Person, including personally identifying information, and which may not be available to the public without that person's consent.

3.1.1.12 Sensitive Personal Data

Personal Data that reveals information about or is, directly or indirectly, related to a Person's family; racial, ethnic, or social origin; affiliations; political views; religious or philosophical beliefs; criminal record; membership in unions; health; or personal life.

3.1.1.13 Private Entity's Data

Any Data which is related to a Private Entity and which is available to the public and can be used to identify the name, the objectives, and the legal status of that entity.

3.1.1.14 Private Entity's Sensitive Data

Any Data which is related to the business of a Private Entity and which is not expected to be made available to the public, including information relating to its officials or employees; revenues or profits; customer lists; or technical know-how, or relating to any of its Intellectual Property Rights.

3.1.1.15 Data Inventory

The list of the data elements that are in the possession of any government entity, including any data produced or controlled by that entity.

3.1.1.16 Data Classification Process

The process for classifying data into Open Data or Shared Data; and for classifying Shared Data into Confidential Data, Sensitive Data, or Secret Data.

3.1.1.17 Data Collection Sprint

The sequential ingestion of Data into an electronic software system.

3.1.1.18 Access Permission

An approval/permission given to personnel, authorizing a Person to access Shared Data in accordance with the conditions and procedures adopted by the government.

3.1.1.19 Authorized Person

Any Person or Government Entity that is authorized by another Government Entity to access Shared Data.

3.1.2. Classifying the Data

1. Data Set will be classified as Open Data where its dissemination is in the public interest, provided that:
    a. Its dissemination does not conflict with any legislation or policies
    b. It does not compromise the safety of individuals or society
    c. It does not result in disclosure or misuse of any Personal Data
    d. It does not infringe any intellectual property rights
    e. It does not adversely affect security and administration of justice.
2. All Data that is not classified as Open Data will be deemed Shared Data.
3. Shared Data will be classified into the following sub-categories (based on definitions):
    a. Confidential Data
    b. Sensitive Data
    c. Secret Data

4. Shared Data will be deemed Confidential Data where its disclosure to the public or third parties may cause limited damage to the public interest or to Persons. This includes:
    a. Disclosing Personal Data (excluding Sensitive Personal Data) for a purpose other than that for which it is collected.
    b. Adversely affecting the ability of a government entity to perform its duties.
    c. Causing limited damage to the assets of a Person or causing him a limited financial loss.
    d. Causing a limited negative impact on the reputation of a Person or a Private Entity.
    e. Adversely affecting a Private Entity by limiting its competitiveness; or
    f. Adversely affecting public safety or justice.
5. Shared Data will be deemed Sensitive Data where its disclosure to the public may cause significant damage to public interest or to Persons. This includes:
    a. Disclosing Sensitive Personal Data, such as information on a person's health condition, or Private Entities' Sensitive Data, for a purpose other than that for which the Data is collected.
    b. Directly threatening a Person's life, freedom, or safety.
    c. Infringing any Intellectual Property Rights without the right holder's permission.
    d. Causing significant damage to the assets of a Government Entity or a Person, or causing that Person significant financial loss.
    e. Causing a negative impact on the reputation of a Person or Government Entity.
    f. Causing significant damage to a Person or Private Entity that may lead to loss of cognitive and intellectual advantages or incurring financial losses.
    g. Causing significant damage to the ability of a Government Entity to perform its duties.
    h. Causing significant damage to the operational effectiveness of highly valuable security operations.
    i. Causing significant damage to diplomatic relations with any country or international organization.

j. Causing significant damage to the safety, security, or prosperity of Pakistan; or any other country, by affecting its commercial, economic, or financial interests.
k. Causing significant damage to the security of critical national infrastructure.
l. Causing significant damage to the operational effectiveness of the police authorities or military forces of Pakistan in a way that causes them to encounter, in the course of performing their duties, the following situations:
    i. Inability to use their present or future capabilities.
    ii. Loss of life.
    iii. Damage to their facilities, rendering them unusable.
    iv. A negative impact on the administration of justice, including the ability to investigate crimes or prosecute perpetrators.

6. Shared Data will be deemed Secret Data where its disclosure to the public or exchange within the Government on other than a "need-to-know" basis is illegal and may cause very serious damage to the public interest, to national security, or to Persons. This includes:
    a. Causing heavy loss of life.
    b. Causing a significant or noticeable negative impact on the public interest or national security of Pakistan.
    c. Compromising the domestic stability of Pakistan.
    d. Causing disruption and tension in international relations.
    e. Causing very serious damage to the capabilities or security of Pakistan or its allied forces, leading to their inability to perform military duties.
    f. Causing very serious damage to relations with friendly nations or recognized international organizations.
    g. Causing very serious damage to major security or intelligence operations.
    h. Causing long-term damage to the economy of the Pakistan.
    i. Causing very serious damage to the ability of any of the Local Government Entities to perform its duties or to its assets, or adversely affecting its reputation leading to loss of public confidence in that Local Government Entity.
    j. Causing very serious damage to a Private Entity that has a vital and strategic role in the national economy, resulting in heavy financial losses, bankruptcy, or loss of its leading role.

k. Seriously compromising the safety and lives of certain personnel of the police, security, or military authorities; or of witnesses in critical court cases.
l. Adversely affecting security and the administration of justice, or obstructing investigations into serious crimes or prosecution of perpetrators.

3.1.3 Rules & Regulations

1. All personnel must adhere to the following principles, when handling Personal Data, Private Entities' Data, or Private Entities' Sensitive Data; or granting Access Permissions related thereto:
a. Transparency: by informing individuals and Private Entities of which Government Entity will collect their Personal Data or private Data.
b. Purpose: by using the collected Data for specific and explicitly stated purposes.
c. Proportionality: by ensuring that the type of Data collected is the minimum required to achieve the purpose for which it is collected.
2. All personnel must have the minimum possible access to data, i.e., the minimal possible access that is required to perform their tasks.
3. For all the datasets, a process of data inventory and data classification must be conducted in order to determine which data elements are available and the category for each of them, which can then be used in dissemination and sharing.
4. Data must always be shared via software platforms among data producers and authorized consumers, in order to ensure its provenance and integrity.
5. No Person may access Shared Data without first obtaining appropriate Access Permission.
6. The entities and Persons governed by this Document must not disclose, or otherwise classify as Open Data and disseminate, any Personal Data, Private Entities' Data, or Private Entities' Sensitive Data.
7. Data which is encumbered by third party Intellectual Property Rights may not be disseminated as Open Data or exchanged as Shared Data without the consent of the owner of these rights.
8. Disseminating, exchanging, or sharing Secret Data through any electronic system is prohibited.

9. Shared Data must be reclassified as Open Data, in the event of making it available to the public.
10. A government entity can share data with external government entities only after permission from the owner of the data, via a software system.
11. Government entities must ensure that Open Data is made available to the public through the Electronic Platform.
12. PITB is to support government entities in all matters related to data ingesting Data Sprints into the Electronic Platform and updating the same.

3.2 Data Confidentiality & Anonymization

The data generated by the government departments and citizens must have a minimum amount of personal data for achieving any purpose. Similarly, secondary uses of personal information must not breach government's obligations of confidentiality and respect for private and family life. This section details how the government entities shall use Anonymization and Pseudonymization in respecting this confidentiality while still fulfilling their obligations. Anonymization and Pseudonymization enable the organization to undertake secondary use of personal data in a safe, secure and ethical way.

Government of the Punjab has developed various IT systems for departments and the public that have confidential information. Information collected is likely to include data such as CNIC, name, address, date of birth and so on. However, if identifiable details are removed, information can then be used for secondary purposes such as generating reports, analytics and research without fear of breaching the privacy.

This process is called anonymization. By removing the personal information elements, it allows the organization work with the required data with fewer restrictions and less fear of breaching data protection safety protocols. Anonymization and Pseudonymization will enable the government to undertake use of personal data in a safe, secure and legal way.

3.2.1 Definitions

3.2.1.1 Personal Identifiable Information (PII) is any information that can identify an individual. This could be one piece of information, or a collection of information, for example CNIC, name, address and date of birth. List of all such data elements is mentioned in Schedule-I (Annexure-A). All PII must be anonymized before sharing and for analytics.

3.2.1.2 Primary use refers to the use of information for the purpose of delivering government services to individuals. This also includes relevant supporting administrative processes and audit/assurance of the quality of services provided. Primary use requires information at the person identifiable level.

3.2.1.3 Secondary use refers to the use of information about individuals for research purposes, audits, service management, analytics and reporting. When PII is used for secondary uses the information should be limited and de-identified so that the secondary use process does not enable individuals to be identified.

3.2.1.4 Anonymization is the process of removing, replacing and / or altering any identifiable information (identifiers) that can point to the person(s) it relates to.

3.2.1.5 Aggregation is an anonymization technique in which information is only presented as totals, so that no information identifying individuals are shown. Small numbers in total are a risk here and may need to be omitted or 'blurred' through random addition and subtraction. Wherever possible data must be aggregated and then shared for analytics and research.

3.2.1.6 Pseudonymization is the technical process of replacing the identifying information to protect the individual's identity whilst allowing the recipients to link different pieces of information together. It is the de-identification of individual level information by attaching a coded reference or pseudonym to each record that allows the information to be associated with a particular individual without the individual being otherwise identified. If the same system of pseudonyms is used across different datasets, then these datasets can be combined for analytical purposes without revealing the identities of individuals. A nickname is an example of Pseudonymization,

although other identifying information such as age, ethnicity, gender or specific medical condition may also be changed to prevent identification.

3.2.1.7 Re-identification or de-anonymization is where anonymized information is turned back into personal information using, for example, data matching or combining. Where anonymization is being undertaken, the process must be designed to minimize the risk of re-identification.

3.2.2 Techniques

There are various methodologies that can be used to anonymize the data. One or more of these can be used to anonymize the data. The owner of the system who is sharing data for analysis or research purposes should be responsible for anonymizing data prior to sharing.

3.2.2.1 Data Masking

Hiding data with altered values. A mirror version of a database is created in which data is hidden by applying modification techniques such as character shuffling, encryption, and word or character substitution. Data masking makes reverse engineering or detection impossible

3.2.2.2 Pseudonymization

A technique in which private identifiers are replaced with fake identifiers or pseudonyms, for example replacing the identifier “Alpha” with “Alan”

1. Preserves statistical accuracy and data integrity, allowing the modified data to be used for training, development, testing, and analytics while protecting data privacy.
2. If pseudonyms are preserved the process can be reversible

3.2.2.3 Generalization

Deliberately removes some of the data to make it less identifiable, for example, House number in an address can be removed while keeping the road name. Purpose is to eliminate some of the identifiers while retaining a measure of data accuracy

3.2.2.4 Data Swapping

A technique in which the dataset attribute values are rearranged so they don't correspond with the original records

1. Also known as shuffling and permutation
2. Swapping attributes (columns) that contain identifiers with other identifiers in the data
3. Adding random noise to the data while keeping the range of values in proportion to the actual values. A small base may lead to weak anonymization while a large base can reduce the utility of the dataset for example – a base of 5 for rounding values like age or house number can be used since it is proportional to the original value. However, if a house number is multiplied by 15 its value may retain its credence, but the age values may seem fake.

3.2.2.5 Synthetic Data

Algorithmically manufactured information that has no connection to real events. It involves creating statistical models based on patterns found in the original dataset. Standard deviations, medians, linear regressions, or other statistical techniques are used to generate the synthetic data

3.2.2.6 Range Identifiers

Using identifier ranges, for example: age ranges instead of exact age, partial address e.g. street and town instead of full address that includes house# as well, age at activity event instead of date of birth etc.

3.2.3. Use of Identifiable Information

If records are viewed in an identifiable form for other purposes than normal service delivery, then the reasons and usage of the information should be fully documented, and approval is required from the relevant authority within the department.

Relevant services should set up an appropriate tracking tool, e.g. an Excel spreadsheet, to capture this activity. The key items to be documented are:

- Who has accessed each database containing identifiable information;
- Date and time of access;
- The reason for the access;
- The output from the access.

A structured log (mentioned in schedule-II) of accesses should be kept to enable queries and audit. The log of accesses must be regularly audited via sampling of users or subject matter to check for unusual patterns of access.

3.3. Data Integrity & Integration

Data integrity refers to the validity, reliability and accuracy of the data, while data integration refers to the fact that data sharing between electronic components of different entities is done in an efficient and scalable manner. The following items need to be considered for this:

3.3.1. Guidelines for Integrity

1. Appropriate input validation rules must be employed on all electronic systems.
2. The entered data must be periodically reviewed to check for anomalies. This must be done via a different mechanism that was employed to collect the data in the first place.
3. Duplicate data across multiple systems must be minimized.

3.3.2. Guidelines for Integration

1. The different datasets must be shared among systems easily, with minimal replication and with effective communication.
2. The flow of data between different systems must be managed to ensure consistency across applications.
3. Software systems built for managing data sets must be done by ensuring robustness, stability, scalability, so that changes in the data structures in one application has little to zero impact on related applications.

3.4. Data Security & Backup

The Data security aspect of the guidelines aims to define the rules and regulations for data encryption, password protection, intrusion detection and access controls. Access to data must not only be restricted, but it should also be logged. The main objective is to increase awareness among the personnel of the organization about the importance of data, to avoid accidental data leaks and to ensure malicious breaches.

3.4.1. General

1. Open data of government entity will be visible publicly without any username/password credentials.
2. Everything other than the open data will be visible only after logging in. Each user of a software system shall be identified by a unique user ID so that individuals can be held accountable for their actions.
3. The use of shared identities is permitted only where they are suitable, such as training accounts or service accounts. Other than that, they should not be used.
4. Records of user access may be used to provide evidence for security incident investigations.
5. Access shall be granted based on the principle of least privilege, which means that each program and user will be granted the fewest privileges necessary to complete their tasks.

3.4.2. Passwords

1. Passwords should have a minimum length of 8, and must necessarily be a combination of uppercase characters, lower case characters, numbers and special characters.
2. Passwords must have an expiry period, which should be enforced.
3. Multiple incorrect password entries must be logged and must disable user access.

3.4.3. Network Access

1. All staff and external users who have remote access to internal networks shall be authenticated using the VPN authentication mechanism only.
2. Segregation of networks shall be implemented as recommended by the PITB's network security research. Network administrators shall group together information services, users and information systems as appropriate to achieve the required segregation.
3. Network routing controls shall be implemented to support the access control policy.

3.4.4. User Responsibilities

1. All users must lock their screens whenever they leave their desks to reduce the risk of unauthorized access.
2. All users must keep their workplace clear of any sensitive or confidential information when they leave.
3. All users must keep their passwords confidential and not share them.

3.4.5. Access logs

1. Access logs must be kept for each data set of government department on the following two levels:
    a. On the application level, to see keep track of the activities that users are performing on the data.
    b. On the database level, to keep track of each DB level access (read and write) to ensure that there is no behind-the-scenes tampering of the data.

2. The size and timeframe of the access log to keep should be defined for each of the data set.
3. Access logs must be periodically reviewed to ensure that there are no illicit activities taking place that can corrupt the data.

3.4.6. Intrusion Detection & Reporting

1. High-priority incidents discovered by the IT Security section/department shall be immediately escalated; the relevant section at PITB should be contacted as soon as possible.
2. The IT Security department shall also produce a monthly report showing the number of IT security incidents and the percentage that were resolved.
3. Periodic scans for vulnerabilities should be done by the network team.
4. Software patches and antivirus definitions must be kept up to date.

3.4.7. Security Practices for Web Applications

1. Passwords must be kept encrypted in the database.
2. Applications must be used with an SSL certificate.
3. Captcha must be used on logins screens.

3.4.8. Security Practices for Mobile Applications

1. All secret keys must be kept in the NDK file to increase security.
2. Code obfuscation techniques should be used to discourage reverse engineering.
3. Sensitive data must be kept in an encrypted form in the device database.

3.4.9. Data Backups

1. The time period and frequency for taking data backups should be clearly defined.
2. The backup generation and restoration mechanism should be controlled, and all access logs to the backup creation and restoration processes must be kept.
3. Only a small number of employees must have access to creating and restoring backups.

4. Backups must be created in off-peak hours.

4. Implementation

These guidelines will become effective immediately after approval from relevant forum.

5. Monitoring and Review

These guidelines will be monitored by PITB and will be reviewed every two years or when there are changes in legislation.

Annexure - A

Schedule-I: List of Data Elements to be anonymized before sharing

Sr.#	Data Element
1.	CNIC
2.	Name
3.	Date of Birth
4.	Address
5.	Phone Number
6.	Email
7.	Staff Appraisal
8.	Salary related details (salary, increment %, bonus etc.)

Annexure - B

Schedule-II: Log of Access

Sr.#	**Information**
1.	System Name
2.	Personal Identifiable Fields
3.	Name of Person who has access to these fields
4.	Date/Time of access
5.	Reason for access
6.	Output of access

ANNEXURE 9: PUNJAB MASTER DATA MANAGEMENT FRAMEWORK

1. Executive Summary

The amount of data being generated is rapidly increasing world over as automation picks up. In one of the recent estimations, the amount of data generated was calculated to be around 2.5 quintillion bytes and consumption of space by this data at around 40 trillion gigabytes. Public service delivery in Pakistan and especially in Punjab is also moving towards automation; growing numbers of software systems and mobile applications are producing massive amount of data. While this data provides massive opportunities for analytics, data science, machine learning and AI it gives rise to inherent problems like data security, privacy, silo systems, duplications etc.

These problems can be overcome by building Master Data Management (MDM) Systems. Master data is the consistent and uniform set of identifiers and extended attributes that describes the core entities of the enterprise/department including customers, prospects, citizens, sites, hierarchies and chart of accounts. These systems consolidate all the data in single Master Data Repo without any significant changes to the source systems. Many public sector organizations world over like US Department of Education, Australian Post, Government of Singapore have already implemented MDM systems.

In the past decade public departments in Punjab have rapidly moved towards automation. Nearly every department has deployed multiple systems which help in automating the processes, brings traceability, helps in monitoring, and increases efficiency. This rapid automation has also increased data generation manifolds. Though most of these systems work in silos lacking the ability to provide a holistic picture of province wide key performance indicators, this is the usual life cycle of automation. First step is to bring the departments on board to show the benefits of automation, the next logical and evolutionary step is the development of an MDM for each department to consume this data for analysis and policy making. This data can also be exposed to public and data scientists who can extract valuable information and perform analysis which can be shared back with the department for improvement in service delivery.

2. Introduction to MDM

Master Data Management (MDM) framework can help in overcoming all the problems faced by the public and private sectors today with the massive increase in data generation because of automation. It defines a robust framework that has solutions to managing and consuming data efficiently without changes to underlying systems. MDM is defined as:

"Data shared across teams and IT applications that define key information of an organization, company or public sector department such as assets, locations, reference codes, financial hierarchies, products, customers or suppliers."

MDM define rules and policies for data governance, data anonymization and data consumption, creating an efficient mechanism. MDM usually consists of 8 core steps:

- **Identification of Data Sources**: In first step all the datasets available with an organization/department are identified.
- **Data Cleansing, Conflict Resolution and Profiling**: Here cleansing and profiling of data is done. Conflicts in data if any are also removed here. Data is profiled into different types and categories for efficient management.
- **Internal Master Data Repo**: During profiling, data is classified into three main categories shareable, data commons and sensitive. These categories are saved together in a repository called Internal Master Data Repo (IMDR) for internal consumption.
- **Data Anonymization**: Security of the data is the utmost priority when defining any system related to data. It is important to ensure that data classified as shareable is anonymized before loading into External Master Data Repo (EMDR) so that no personal or sensitive information is identifiable.
- **External Mater Data Repo**: After anonymization, anonymized data and data commons (reference data) is saved in a repo for external consumption called External Master Data Repo (EMDR). Big numbers (Total teachers, no of e-khidmat marakaz transactions, daily e-PAY transactions etc.) aggregated from master data can also be stored separately for consumption.
- **Data Service Bus**: In addition to direct access to EMDR, data consumer can also subscribe to receive periodically updates through a service bus called Data Service Bus.
- **Access Control Layer**: The security protocols related to sharing and access of the data with the external sources based on an access control mechanism is part of this step.
- **Meta Data (Data Catalog)**: Meta data is information about the available data. This layer includes catalog of available datasets.

3. International Best Practices and Case Studies

Many public sectors entities in developed countries like USA, UK, Singapore and Australia now have Master Data Management frameworks in place. Data collected and consumed follow SOPs based on these frameworks. Below are few public sector case studies from around the world:

3.1. US department of Education's Statewide Longitudinal Data Systems

The Statewide Longitudinal Data Systems (SLDS) under the US department of Education helps states and territories make informed decisions to improve student learning and outcomes by designing, building, maintaining, and expanding early childhood through workforce longitudinal data systems. These systems follow the 12 key elements defined in the American COMPETES act some of which are unique identification for every student and staff, student enrollment history, demographics characteristics etc., mapping of student's data with staff, information on student's, students progression history, a system of auditing data for quality, validity, and reliability. 96% (nearly 52) of the states and territories have systems linked with reliable data and access policies in place. This has provided an interlinked Master Data Repository that can be accessed by authorized persons from all over USA whenever required.

3.2. Australia Post's single view of customer through "Golden Record"

Last year Australian post processed close to 2.8 billion items delivered to 19 Million customers from nearly 10,000 access points around the country. These 19 Million records have been sourced from 48 million de-duplicated records available in different systems such as SAP CRM, Salesforce, Amazon Prime and Mail redirection services. These 48 Million records have gone through a transformation phase and are now available in a single master data repository that can be accessed by any system as needed.

3.3. Singapore's Government Data Strategy

Singapore Government introduced Government Data Strategy (GDS) in 2014 but in first phase it was more about automation of the processes in different departments. In 2018 a new GDS was introduced that is centered on the public Sector re-organizing itself around a new Integrated Data Management Framework (IDMF). The IDMF establishes a new operating concept for managing and using data across a 5-stage lifecycle: (1) Problem Statement, (2) Acquisition, (3) Fusion, (4) Access and Distribution and (5) Exploitation. A new Government Data Office was setup to oversee this strategy. Out of the 4 core pillars of this strategy following 3 are related to Master Data Management,

- Data Architecture: which is to enable quick and secure access to quality data
- Digital Infrastructure: provide infrastructure to digitally industrialize the management, governance, and use of data, to support and scale data transformation initiatives
- Data Education: to equip all public officers with the knowledge and skills to use this data.

4. Case for deploying MDM in Public Sector.

Punjab is the largest province in Pakistan in terms of population. There are nearly 48 departments and tens of autonomous bodies attached with these departments. It also deploys the largest cadre of public sector employees. Every department has taken giant steps in automation and hundreds of automated systems are now deployed in these departments and bodies. But there has been no planning or comprehensive automation policy that could have been followed which would have saved time and redundancy both in efforts and data collected through these systems. There is no single repository aka Master Data Repo (MDR) (an integral part of an MDM) from where different systems and public can access data, answer queries and perform required analytics. Further, sensitive information like Computerized National Identity Card (CNIC), contact numbers, individual's health information, and criminal records are kept without anonymization because of no data anonymization policy. With lack of a data governance policy, there are no set rules defined regarding who has access to data, what data is being accessed by whom, how to enable/disable access, when to allow and why to allow. All these short comings can potentially lead to data inconsistency, inaccuracy, and unidentified access. Basing policy decisions on such a data lacks any substance improvements overall.

It is envisioned that each department will have an MDM where data from all the primary systems used by the department will be available in a single master data repository ready for consumption. Single Central Repository Architecture (SCRA) will be used to implement the MDM. The advantages of using SCRA is that it guarantees data consistency and ensures data integrity as there is only one copy of master data and the primary sources does not store copies of any master data. This single copy of the master data is called Master Data Repository (MDR), if we consider MDM as human body then MDR is both heart and brain that calls the shot and runs the whole system. There are 2 types of MDR proposed in the MDM the Internal MDR (to be used for internal consumption by the department) and External MDR (to be made available for use by the external users). The datasets in each department consists of data from different domains belonging to both transactional and non-transactional types. Below is a sample list of expected available datasets:

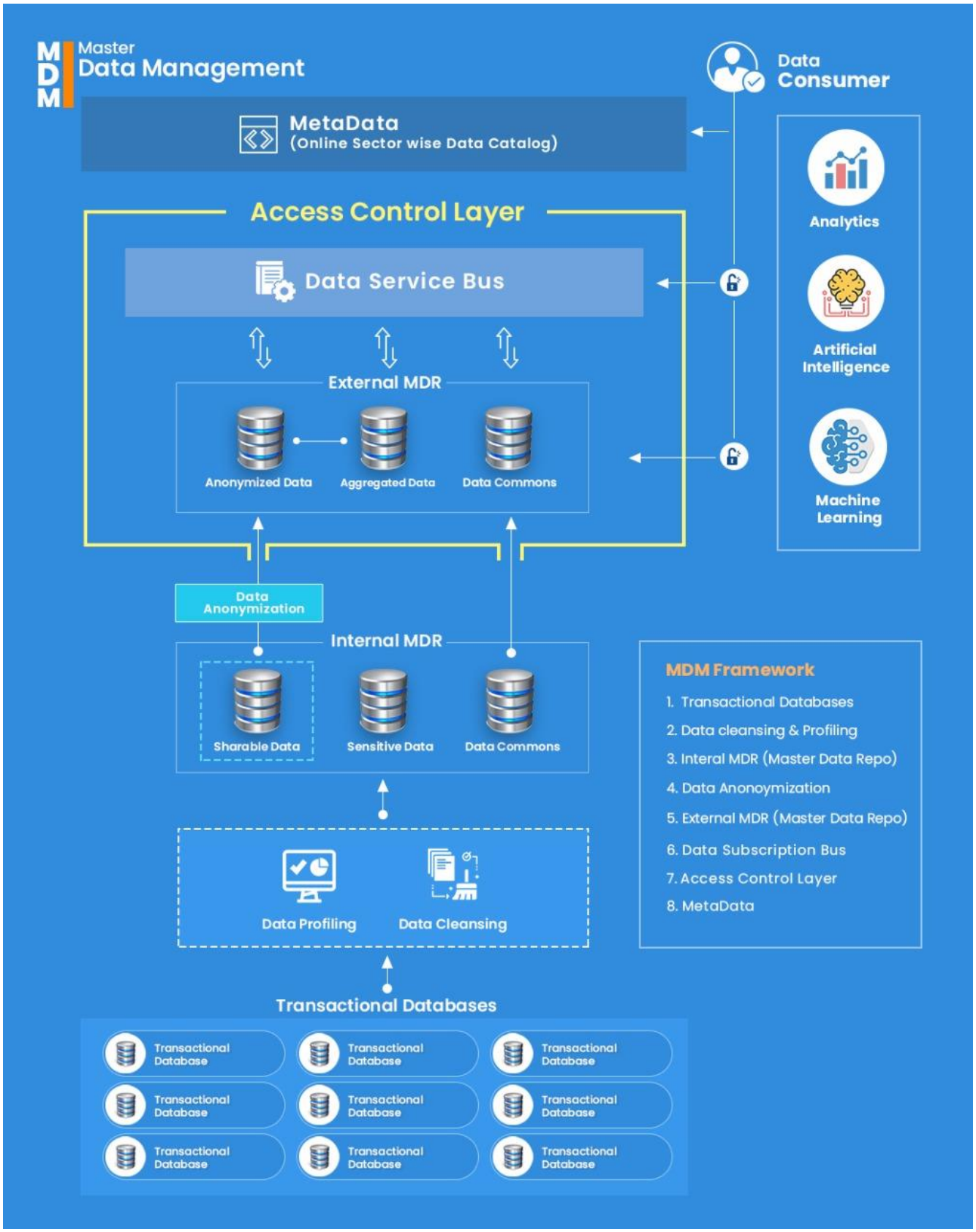
- Student Information from School Information System (e.g. Student basic info, students schools information)
- Information on registration of vehicle.
- Domicile information with home addresses.
- Patient information in the dengue tracking system.
- Financial transaction information in the e-pay system.
- Iris records of the employees of the Waste Management Company.
- Transfer history of the land in the land record system.

- Financial information of the individual development scheme.
- Basic health profile of each student.

Each MDM will be based on the enterprise architecture as it has both operational (transactional) and non-operational (analytical) data. As the primary function of the MDM is to provide comprehensive access to data from multiple sources in a single place for analytical and data science purposes the design of the database will be robust so that it can accommodate future changes and requirements. At the time of business process orchestration the schema of the database will also be discussed and finalized. There are 2 main components of the enterprise architecture:

- Source Data Integration Service: All source systems that are integrated with the MDR are connected through this service. All the rules, workflows and guidelines to save orchestrated or profiled data in the MDR are defined here. This service follows below two steps:
  i. Each source system will be connected with MDM on network level.
  ii. The data from the source systems will be updated daily.
- Data Transformation: Data pulled from the source systems will go through the data transformation and anonymization (required for loading data into EMDR) step before it is saved in the MDR. According to data sources the transformation rules are defined and data is loaded in the MDR. These rules are defined based on the data mapping activity (individual fields are mapped, modified, joined, filtered, aggregated etc.) that takes place when a new dataset is added in the system.

The MDM framework will be based on 8 core pillars as discussed earlier, and also shown in the following diagram:


Master
Data Management
MDM
MetaData
(Online Sector wise Data Catalog)
Data
Consumer
Analytics
Artificial
Intelligence
Machine
Learning
Access Control Layer
Data Service Bus
External MDR
Anonymized Data
Aggregated Data
Data Commons
Data
Anonymization
Internal MDR
Sharable Data
Sensitive Data
Data Commons
Data Profiling
Data Cleansing
MDM Framework
1. Transactional Databases
2. Data cleansing & Profiling
3. Interal MDR (Master Data Repo)
4. Data Anonoymization
5. External MDR (Master Data Repo)
6. Data Subscription Bus
7. Access Control Layer
8. MetaData
Transactional Databases
Transactional Database

4.1. Identification of Primary Data Sources

The first step for building a successful Master Data Management (MDM) framework is to identify all the primary sources from where data can be extracted. In this phase meetings and interviews will be conducted with the stakeholders in the each department to find all available data sources.

4.2. Data Cleansing, Conflict Resolution and Data Profiling

Conflicts are the inconsistencies and irrelevancies in data from various data sources corresponding to a single entity. It is quite common to have conflicts when data is loaded in a MDR from multiple silo systems. This step will help comprehend data quality issues and build guidelines for rectification of defected data. This will also give us the capability to examine the future business impact which will become the basis of transformation and standardization of data. Conflict resolution is further divided in two steps:

- Conflict Identification: First step is to identify the data related to a single entity in multiple sources. For a reference this could be districts. Nearly all systems use districts to further divide data, the ids and names of a district in different systems could be conflicting.
- Resolution: Next step is to resolve the identified conflict. Continuing with the district example, the best strategy in our case will be to have a single table for districts in MDR and refer the district ID from this table wherever the district is used.

After data cleansing, profiling of the data is done. Data can be classified in to three primary types; Sensitive Data, Public Data and Data Commons.

- Sensitive Data: This type of data is usually sensitive for a department and they may deem to keep it protected and not share with the outside world (e.g. criminal records, financial transactional, teachers leave history).
- Shareable Data: Data classified as shareable data will be loaded into the IMDR. To efficiently load data into MDR, public data can be further organized into 2 categories i.e. transactional data (e.g. daily attendance, daily visits by monitoring officers) and master data (e.g. students, LWMC staff, hospitals etc.), secure data (CNIC, Phone numbers etc.) will be anonymized before loading into EMDR.
- Data Commons: Data commons also called Reference data is a subset of master data that is common throughout the organization or department and is used to classify, categorize or bring context to other data. Some of the examples of data commons that can be profiled from the source different datasets are districts, tehsils, designations, list of services etc.

4.3. **Internal MDR (IMDR)**

It is important to set aside a copy of cleansed and profiled data for internal consumption. Systems working in silos are a common scenario in public sector departments that result in operational inefficiencies. Having an IMDR can be a game changer for the decision makers. If the data produced by these systems is consumed together it can help in:

- Real Time Access to Information: Getting information from systems working in siloes can be time consuming and reporting based on this data is prone to errors. Having an IMDR provides instant and real-time access to all data with fewer chances of errors as reporting is done from a single source.
- Improve decision making: Access to data from multiple sources presented in an easy to digest format will provide with invaluable acumen, uncovering opportunities and identifying potential bottlenecks before they occur. Having an access to a unified view of the data will also give more visibility and holistic view to the decision makers.
- Adopting right policies: Inaccurate, inconsistent and unclear data can lead to adopting policies that have unintended consequences and are more harmful then helpful. Having an internal MDR where data across department is available in a single source can lead to adopting right policies.
- Streamline operations: Improvement in processes can streamline operations and increase productivity. With access to right data and information, gaps in processes can be identified and steps can be taken to fill these gaps and being improvements in operations.

Data loaded in the IMDR will update daily from the source systems through the MDM synchronization services.

4.4. **Data Anonymization**

Another core pillar of the MDM is the Data Anonymization. Public sector departments have increase responsibility to protect data they collect and adhere to different privacy protection rules. Data collected by source systems also includes sensitive data like Computerized National Identity Card (CNIC) numbers, personal phone numbers of individuals and full names which are part of Personally Identifiable Information (PII). This data can be used to identify and track an individual if accessed by unauthorized person. Following best practices will be followed to secure and anonymize the data.

- Classification:
  i. Level of confidentiality required for each data element will be found.
  ii. Integrity of every PII will be measured.

iii. Question like how important is to have the data available all the time will also be answered here and accordingly data availability matrix will be defined. This matrix is the first step for defining the data sharing matrix outlined in the External Master Data Repository (EMDR).

- A Privacy Impact Analysis (PIA) will be conducted for information that is classified as PII to determine:
  i. How this data will be stored in EMDR.
  ii. What level of privacy is required i.e. is it only required to make the information HIPAA (Health Insurance Portability and Accountability Act) compatible which has a narrow scope and only applies to data that falls under Protected Health Information (PHI) or make information GDPR (General Data Protection Regulation) compatible which has broader privacy requirements. In this phase only the part of regulations related to storing the data will be implemented, requirements related to sharing of the data is covered Data Service Bus.
- Anonymization:
  After the PII or PHI are identified and level of privacy are set. Anonymization algorithm is applied on the classified data. After extensive reviews of the available anonymization algorithms Pseudonymisation technique has been finalized, which is also encouraged by the GDPR. In this technique original data is replaced with realistic fictional data, it also maintains the referential integrity and statistical accuracy of the data. This is important because it does not hinder the business process, development and testing, trainings etc.

4.5. **External MDR (EMDR)**

After shareable data is anonymized, anonymized shareable data and data commons will be loaded in an EMDR for consumption by the citizens. By providing access to data and encouraging the use, reuse and distribution of datasets:

- Government fulfills its obligatory duty of providing access to citizens according to the “Right to Information” act.
- Government promotes transparency, accountability, business creation and innovation.
- Citizen participation in government creates opportunities for economic development.
- Promotes evidence-based decision and policy making in both the private and public sectors.

- By having access to data, citizens can help generate insights on how to improve government performance and create environment for social inclusive service delivery.

The whole exercise of creating an EMDR and giving access to citizens will become meaningless with lack of coherence in data sets from the source systems. Therefore EMDR will regularly synchronize data from the IMDR. The syncing mechanism will be seamless and it will be made sure that the new data sources and datasets are instantly available and existing's are regularly updated in EMDR for consumption by the citizens. EMDR will also have aggregated data aka. Big Numbers (e.g. total student enrollment, daily transactions in e-khidmat markaz, daily financial transactions amount in e-pay etc.) available for consumption.

4.6. **Data Service Bus**

As data regularly updates in the EMDR instead of polling for data, consumers will be able to subscribe for updates through Data Service Bus (DSB). DSB will use WebSub protocol, which is based on industry standard PubSub (Publisher-Subscriber) model to push updates using webhooks. There are three main entities involved in the WebSub protocol:

- Publisher: In our case publisher is the EMDR which pushes the data for consumption.
- Hub: DSB works as the hub through which consumers can subscribe on a topic (topic is an API endpoint or URL for every dataset).
- Subscriber: A consumer of data who subscribes on topics.

The flow of the DSB envisioned to work as following:

- Each dataset will have a topic in the hub.
- Consumer will discover available dataset (topic) through the data catalog.
- When Consumer will subscribe on a topic the standard WebSub verification protocol will be initiated. More details are provided in the ACL section.
- After verification subscription is created and the subscriber will get the updated content through the callback URL provided at the time of subscription via POST method.

4.7. **Access Control Layer**

One of the most important building blocks in creating a successful MDM system is to define a robust Access Control Layer (ACL) that safeguards and secures the data. Data Governance includes policies, standards and protocols that ensure data is shared or is used by only trustworthy systems or users. When designing the MDM system, security

remains the primary concerns of all stake holders. PITB already has the following basic security protocols in place:

- The data center in PITB is Tier 3 standard with high security environment and is already hosting hundreds of mission critical applications and systems. So at this end things are pretty much secure.
- All the communication between source and external system also takes place on SSL layer which brings an added layer of security.

The EMDR will be used by consumers to extract information and insights which can assist in defining policies that helps in improving the overall governance landscape. Consumers will pass through powerful Access Control Layer in order to get access to the EMDR. This layer will authenticate the user and also confirm the validity of the request using the WebSub verification protocol. Below steps are followed to authenticate and provide access:

- External sources will request for granting an access and will provide list of datasets and fields on which the access is required.
- Based on the approval process which includes the consent from the departments, user and credentials are created and access levels are set. All the access levels for external users and systems are read only.
- Whenever an external request is received the authentication protocol is initiated. With the standard WebSub request verification protocol, the credentials provided to consumer at the time of registration are also verified.
- After the credentials are verified, a random generated code is send back to a call back URL provided by the subscriber. Subscriber then replies back with a confirmation header and this random code in the body, which is then again verified by the hub.
- Based on the access level granted at the time of registration, data is shared with user in the reply otherwise error is thrown.

4.8. **Meta Data (Data Catalog)**

A Data Catalog is a collection of metadata, combined with data management and search tools that help consumers to find the data that they need and serves as an inventory of available data. A data catalog focuses first on datasets (the inventory of available data) and connects those datasets with rich information to inform people who work with data. Below is the list of few benefits of having a data catalog:

- Improved data efficiency
- Improved data context
- Reduced risk of error
- Improved data analysis

Two important features MDM data catalog will have are:

- Dataset Searching: Robust search capabilities will include search by facets, keywords, and business terms. Ranking of search results by relevance and by frequency of use will particularly be useful and beneficial feature.
- Dataset Evaluation: Choosing the right datasets depends on ability to evaluate their suitability for an analysis use case, without needing to download or acquire data first. Important evaluation features will include capabilities to preview a dataset, see all associated metadata, see user ratings, and view data quality information.

ANNEXURE 10: DATA SHARING GUIDELINES

Punjab Data Sharing Guidelines

1. Introduction

1.1.1. This document outlines the guidelines for sharing data/information among the departments of the Government of the Punjab.

1.1.2. Government entities collect and produce large amounts of data. However, in order to harness the value of this data, it must be more effectively shared both publicly and between the government entities.

1.1.3. Government entities which are providing services to the public have a responsibility to ensure that their use of personal data is lawful and that an individual's rights are respected. The key challenge in information sharing is to find the right balance between the need to share data for the provision of quality services and the need to ensure protection of confidentiality.

1.1.4. Linking and sharing government data will help to solve various social, economic and environmental problems in an inter-connected digital environment.

1.1.5. It is expected that specific information sharing arrangements between some entities will be developed separately. These will specify precisely what data is to be shared, how it will be shared and stored and to whom that data will be given for a particular area of activity. Responsibility for producing these arrangements rests with the entities that are involved in an information sharing requirement.

2. Coverage of the Guidelines

These guidelines apply to all Government of the Punjab's entities which interact with the public that includes citizens and commercial establishments. Moreover, all types of data sharing are to follow these guidelines.

3. Legal Responsibility for Sharing Information

3.1. Entities need to adhere to prevalent laws and regulations.

3.2. Any exceptional reason for not sharing data needs to be discussed with the relevant government body (PITB) along with adequate justification for an appropriate decision.

4. Purposes for Data Sharing

4.1. Data shall only be shared for lawful purposes. The specific range of purposes will be identified within the separate and specific information sharing arrangements between the entities.

4.2. Departments, which are using the shared data, shall make use of data in an anonymized manner where such data will suffice.

4.3. All entities should ensure that data is shared on the principle of 'need to know' basis. This means that staff will have access to data only if they need this for the fulfilment of their respective role. It may not be necessary to disclose all data and only such data that is relevant for the purpose for which it is disclosed should be passed under the information sharing agreement.

4.4. As part of evaluation of any information sharing request, departments should consider the risks to individuals in the collection, use, sharing and disclosure of personal information.

5. Guiding Principles for Systematic Data sharing

5.1. The potential benefits and risks to individuals and/or society of sharing or not sharing should be assessed.

5.2. Records must be kept of decisions and the reasons for it - whether it is to share data or not. If the decision is to share, then it must be recorded as to what has been shared, with whom and for what purpose.

5.3. It must be ensured that the data that is shared is necessary for the purpose for which it is being shared and is shared only with those people who need to have it. Furthermore, following questions shall also be kept in mind: Is it accurate and updated? Is it shared in a timely fashion? and is it shared securely?

5.4. For any data sharing requirement, it must be assessed if there is a legal obligation to share data (e.g. a statutory requirement, a court order, or any such similar obligation).

5.5. All departments will be required to adhere to the following:

- Share data with each other where it is lawful.
- Comply with the requirements of legal frameworks that govern data protection.
- Inform users when and how data is recorded about them and how their data may be used.
- Where possible, provide data in a format that is machine-readable, high quality and complies with agreed open standards, with as few restrictions on use as possible.
- Adopt as much as possible the 'once-only' principle. Once only principle is to ensure that entity will not ask citizens and businesses for the same information twice, and where upon login the entity will not ask for information that are available with the Government systems. Such

Information should be integrated and collected from respective Government systems and not asked from the citizens or Business to be provided again.

- Ensure that adequate technical and non-technical security measures are applied to the personal data being held and transferred.
- Promote staff awareness of the information sharing policies and procedures.
- Promote awareness of the need for information sharing through appropriate media.
- Departments are responsible for embedding these guidelines within their own departmental policies relating to information sharing, if any.
- All departments should appoint an authority for ensuring all information sharing responsibilities of the entity. This may comprise of person(s) who are from relevant sections such as Risk Management or Information Technology and who have sufficient understanding of the policies and procedures for information sharing.
- Information received by departments as part of an information sharing arrangement, shall not be further released to any third party or to another agency without the permission of the owner agency.
- Departments need to adhere to a number of safeguards in order to ensure a balance between maintaining confidentiality and sharing data appropriately. These include:
- Departments shall ensure that their staff are aware of and comply with:
    - Their responsibilities and obligations with regard to the confidentiality of personal data about people who are in contact with their agency.
    - Know whom to contact, and processes to follow, in the event of a breach of confidentiality.

- Departments shall ensure appropriate measures are in place to protect the confidentiality, integrity and availability of the data during all stages of processing.
- Data shared should be of a good quality and it is recommended that the data shared follows appropriate guidance used by the entity sharing the data. As a general guidance, the following six data quality principles may be applied: accuracy, validity, reliability, timeliness, relevance and completeness.

6. Monitoring and review

6.1. PITB, in conjunction with other relevant stakeholders, shall review these guidelines on a yearly basis unless new or revised legislation necessitates an earlier review.

6.2. Each department will be responsible for periodically monitoring and reviewing the implementation of these guidelines in their organisation.

7. Breaches

7.1. Departments shall have in place appropriate measures to investigate and deal with the inappropriate or unauthorised access to, or use of, personal data whether intentional or unintentional.

7.2. In the event that personal data shared in accordance with these guidelines is or may have been compromised, whether accidental or intentional, the entity making the discovery will, without delay:

- take appropriate steps, where possible, to mitigate any impacts
- inform the department, which provided the data, of the details
- take steps to investigate the cause
- take disciplinary action against the person(s) responsible, whenever appropriate.
- take appropriate steps to avoid repetition of similar conduct.

7.3. On being notified of a breach, the original data provider, along with the department responsible for the breach, and others (such as PITB), as appropriate, will assess the potential implications.

7.4. Where a breach is identified as serious, it shall be reported to the Punjab Information Technology Board. The original data provider, along with the breaching organisation and others, as appropriate, will assess the potential implications, identify and agree on appropriate actions.

8. Complaints

8.1. Departments must have procedures in place to address complaints relating to the disclosure of personal data. The departments shall agree to cooperate in any complaint investigation where they have data that is relevant to the investigation. Departments must also ensure that their complaints procedures are well-publicized.

8.2. If the complaint affects more than one agency, it should be brought to the attention of the respective authorities which should then liaise to investigate the complaint.

ANNEXURE 11: SPECIAL TECHNOLOGY ZONES

The Government of Pakistan has established a “Special Technology Zones Authority” through an ordinance. With the authority’s scope spanning over the entire country, frameworks and regulations developed for the STZs at the federal level will be adopted for Punjab.