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NAVTTC

Team Europe's TVET Sector Support Programme

Gender Skill Gap & Market Need Analysis

KP, GB & Balochistan

The TVET Sector Support Programme in Pakistan is co funded by the European Union and the Federal Republic of Germany. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH implements the Programme together with British Council in close cooperation with the National Vocational and Technical Training Commission and other public and private sector organizations in Balochistan, Gilgit Baltistan, Khyber Pakhtunkhwa and Punjab.

The programme's objective is to support the development of Pakistan's TVET sector, focusing on training for men and women in professions with a high demand, especially in digital and green skills.

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LIST OF ABRREVATIONS:

1. IT: Information Technology
2. TVET: Technical and Vocational Education and Training
3. HE: Higher Education
4. HEIs: Higher Education Institutes
5. HEC: Higher Education Commission
6. KP/KPK: Khyber Pakhtunkhwa
7. GB: Gilgit-Baltistan
8. COE: Centre of Excellence
9. CBT&A: Competency-Based Training and Assessment
10. ICT: Information and Communication Technology
11. BPO: Business Process Outsourcing
12. NAVTTC: National Vocational and Technical Training Commission
13. TEVTA: Technical Education and Vocational Training Authority
14. QAB: Qualification Awarding Body
15. PQF: Pakistan Qualification Framework
16. NVQF: National Vocational Qualification Framework
17. ITeS: IT-enabled services
18. P@SHA: Pakistan Software Houses Association for IT & ITeS
19. PSEB: Pakistan Software Export Board
20. NIC: National Incubation Centre
21. ORIC: Office of Research, Innovation, and Commercialization
22. CSR: Corporate Social Responsibility
23. OJT: On-the-Job Training
24. PWD: Persons with Disabilities
25. WFH: Work from Home
26. MOU: Memorandum of Understanding
27. KPI: Key Performance Indicator
28. FGD: Focus Group Discussion
29. IDI: In-depth Interview
30. KADO: Karakorum Area Development Organisation
31. ICTD: Information and Communication Technology for Development
32. BTEVTA: Balochistan Technical Education and Vocational Training Authority

Section 1: INTRODUCTION

The British Council, in partnership with GIZ, is implementing the European Union (EU) funded TVET Sector Support Programme (EU TVET-IV), which aims to develop human capital to meet private sector needs. The execution is being carried out in 4 key components each targeting a separate intervention area. The first three components are to be carried out by GIZ, while the implementation of the fourth component will be performed by British Council. These intervention areas are:

Components	Goals	Description
Component I	**Supply of Skilled labour in demand**	Increased supply of adequately skilled labour in demand including in green skills in the agribusiness, water and energy, and including women/ persons with disabilities, returnees and members of the refugee communities.
Component II	**Effective TVET governance**	A more effective national TVET governance system to exist
Component III	**Access for returning and prospective migrants**	Improved access to skills and employment opportunities for improved migration management
Component IV	**Skilled female labourforce in digital skills**	Increased availability of skilled female labour force in digital and high-tech skills.

The scope of this report is the component IV which aims to increase the skilled female workforce in the digital and high-tech sector in Gilgit Baltistan, Khyber Pakhtunkhwa, and Baluchistan. Under this initiative, digital and hi-tech courses/qualifications will be developed, and female-oriented centres of excellence (CoEs) will be established in target areas.

This programme, focusing on levels 4-7, aims to reinforce the participation of skilled women in the digital and hi-tech sectors within Gilgit Baltistan, Khyber Pakhtunkhwa, and Baluchistan. The British Council's primary contribution is the development of specialized digital and hi-tech courses and qualifications. Furthermore, the programme will oversee the establishment of female-oriented Centres of Excellence (CoEs) in strategically identified areas. These CoEs will serve as hubs for Training of Trainers (ToT) and provide essential technical training to women in high demand digital and high-tech skills.

To ensure the programme's effective implementation, Ipsos, has been commissioned by the British Council, to undertake a comprehensive mixed-methods research study. This research endeavour focuses on gathering, consolidating, analysing, and translating data into actionable insights.

Executed in two distinct phases, the study provides a robust framework for understanding the existing landscape and future needs.

Phase 1 delves into a detailed labour market analysis, encompassing a skill gap analysis within the target regions' IT and high sectors, identifying key market enablers and barriers, and offering strategic recommendations for their effective navigation. Building upon these findings, **Phase 2** will focus on conceptualizing the key attributes and operational frameworks for the CoEs and accordingly conduct a feasibility study for the centre of excellence.

This research employs a rigorous mixed methods approach to data collection and analysis, incorporating both secondary data analysis and primary data gathered through qualitative methods. This document specifically presents the findings from **Phase 1,** offering valuable insights into the market landscape, existing supply and demand gaps, and the critical barriers and challenges faced by the tech industry within the target regions.

Key Objectives

While the introduction provided a general overview of the programme's objectives, this section will elaborate on the specific aims of the TVET-IV programme and its corresponding research objectives.

According to the TVET-IV project brief, The British Council, under component 4, has the following two outputs 4.1 & 4.2 that contribute to the overall outcome of the component:

1. Developing and implementing Digital and High-Tech CBT&A courses for training of women, including from refugee communities and returnees

2. Establishing two internationally accredited Centres of Excellence for digital and High-tech skills for women and offering career-focused training programmes in Robotics, AI, IoTs, Data Science/Analytics etc.

To achieve these programme objectives, the research has been structured around three key objectives:

I. Course Identification Based on Gender Skill Gap Analysis:
   a. Conduct a comprehensive landscape review of existing TVET and Higher Education level courses.
   b. Analyse employer/market needs, and international market demands within the digital and high-tech sectors.
   c. Identify key access points and barriers faced by women pursuing careers in these sectors.

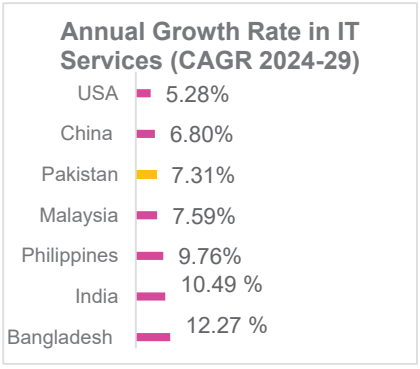
II. Feasibility Assessment and Identification of Two CoEs:
   a. Develop a shortlist of relevant institutions with the potential to host the CoEs.
   b. Conduct a thorough feasibility analysis for each shortlisted institution (to be undertaken in Phase 2).

III. Accreditation Pathway for Selected CoEs:
   a. Identify and assess suitable accrediting entities for the selected CoEs (to be undertaken in Phase 2).

This research framework, with its emphasis on data-driven insights, will be instrumental in guiding the successful implementation of the TVET-IV programme and its overarching goal of empowering women in the digital and high-tech sectors.

Background & Context

The IT industry is experiencing a global boom, and Pakistan is well-positioned to capitalize on this growth. The sector has demonstrated impressive growth, with IT exports reaching $3.2 billion[1]. While the Industry have grown considerably over the past few years, cross country comparisons suggest that Pakistan needs to put dedicated efforts to compete other countries that are increasingly exploiting the potential of IT services market.



According to IT Services: market data & analysis Report by Statista[2], Pakistan's IT services sector is expected to grow at 7.31% annually from 2024 to 2029, indicating steady progress. While China (6.80%) and the USA (5.28%) have lower growth rates, this is due to their more mature IT markets with higher base values. Malaysia, with a 7.59% growth rate, is similar to Pakistan but still slightly ahead. Meanwhile, India, despite already crossing **$220 billion USD**[3] in IT revenue, continues to grow at a remarkable 10.49%, underscoring its dominant position in the global IT landscape. Pakistan's growth is promising but faces strong competition from these established players.

Average Spend per Employee in IT Services	
Pakistan	US$29.73
Philippines	US$47.02
India	US$49.02
Malaysia	US$282.4
Bangladesh	US$23.61
USA	US$3.01k
China	US$99.14

The report also reveals that Pakistan has an average spend per employee in IT services of US$29.73, which is relatively low compared to other countries. This is slightly higher than Bangladesh (US$23.61) but significantly lower than India (US$49.02), Philippines (US$47.02), and especially China (US$99.14). The spend in Malaysia (US$282.4) and the USA (US$3.01k) is much higher, reflecting more mature and resource-intensive IT industries. For Pakistan, the low spend per employee may indicate cost-efficient operations, low investment in technology, training, and infrastructure. To compete globally and increase productivity, Pakistan needs to increase spending on employee development and technology.

1. https://www.arabnews.com/node/2570229/amp
2. https://www.statista.com/outlook/tmo/it-services/pakistan
3. https://www.ibef.org/industry/information-technology-india

Experts predict that the global software market will see a 13.5% to 14.0% increase in spending in the current and subsequent years[4], presenting a valuable opportunity for Pakistan's IT professionals. Furthermore, Pakistan benefits from a large pool of young talent, with 64% of its 235 million population aged between under 30. With over 10,000 software houses, BPOs and tech companies and more than 25,000 IT graduates entering the workforce annually, Pakistan has the human capital to drive significant growth in the IT sector[5]. Despite the potential of Pakistan's IT industry, there are challenges as well, as only 10% of these graduates are employable due to a gap between academic learning and industry requirements.[6] This scarcity of skilled professionals poses a significant challenge to the sector's growth.

In Pakistan, women make up half of the population but only 20% of the labour force. Research shows that women hold only 16% of jobs in the IT industry. Representation for other marginalized groups is even lower, with transgender people and religious minorities each holding 4% of IT jobs and people with disabilities holding 2%. This means a large portion of the labour force is either unemployed or underutilized. This untapped potential is a significant barrier to the growth of the Pakistani tech industry, preventing it from reaching its full potential[7] . This Human Resources shortage is only increasing with the industry's export market growth and rising business opportunities around the world. It is estimated that the IT Industry of Pakistan can grow to achieve almost USD 15 Billion worth of exports by the year 2028. It needs the resources to meet this target. The expected number of resources needed would be 650,000[8]. Even this $15 billion target is outdated, with the latest goal approaching $25 billion in IT exports over the next five years.

To achieve these targets, Pakistan is rapidly advancing its IT sector through a range of strategic initiatives aimed at boosting growth, innovation, and global competitiveness. Efforts to enhance ICT exports, develop infrastructure, and support freelancers and startups are key to this progress. Programmes like Digiskills.pk, the National Incubation Centres, and various capacity-building schemes have empowered millions, created jobs, and fostered entrepreneurship. Additionally, expanding telecom services in underserved areas and improving cybersecurity readiness highlights Pakistan's commitment to broadening digital access and strengthening its IT ecosystem. These ongoing efforts are propelling the country's IT industry to new heights on the global stage. Some of the initiatives that were undertaken this year, and are still being

4. Gartner Research reports on global IT spending• and S Global analysis by ICT analyst Waqas Ghani Kukaswadia
5. https://www.pasha.org.pk/publications/impact-assessment-report/
6. https://tribune.com.pk/story/2417643/only-10-it-graduates-employable
7. https://www.pasha.org.pk/publications/psha-diversity-inclusion-it-ites-landscape/
8. https://www.pasha.org.pk/publications/impact-assessment-report/

implemented to propel the IT sector to unprecedented heights as outlined by the Pakistan Economic Survey 2023-24[9] are as follows:

Goals	Steps	Description
Enhancing ICT Industry Exports	Marketing	• PSEB subsidised participation in 13 events, benefiting 200+ companies. • Organised 6 domestic events.
	Infrastructure Development	• 43 Software Technology Parks house 19,000+ ICT professionals. • Establishing an IT Park in Karachi. • Launched e-Rozgaar to create 250 centres • Developed ICT infrastructure in public universities; launched Women's Software Park in AJK.
	Human Resource Development	• ICT Internship Programme placed 800 interns in FY2024; 2,700 in the last 2 years.
	International Accreditation	• Helped with ISO certification to 35 IT companies and call centres. • Facilitated IP Allow listing for 304 call centres.
	Equity Capital Access	• Working to list IT companies on PSX GEM Board.
Technology Innovation and Entrepreneurship through National Technology Fund	National Incubation Centres (NICs)	• NICs support 245+ startups annually. • 1,480+ startups incubated, creating 128,000+ jobs. • Empowered 2,800+ women entrepreneurs.
	Digiskills.pk 2.0	• Trained 3.97 million individuals, including 42,266 overseas Pakistanis.
	Cybersecurity Hackathon 2024	• Pakistan's third cybersecurity hackathon trained 1,576 participants.
	National Grassroots ICT Research Initiative (NGIRI)	• Funded 8,429 final-year ICT projects since FY2012, with Rs 390.68 million disbursed.
Improving Access to Telecom Services through Universal Service Fund	Voice & Broadband Services	• Expanded voice and broadband services to unserved areas via optic fibre projects
	Backhaul Services	• **Baluchistan:** 26 projects launched, 20 completed, covering 3.95 million people. Rs 34.86 billion subsidy. • **Khyber Pakhtunkhwa:** 15 projects launched, 7 completed, covering 5.9 million people. Rs 14.13 billion subsidy. • **Punjab:** 23 projects launched, 15 completed, covering 9.8 million people. Rs 8.12 billion subsidy. • **Islamabad:** 2 projects launched and completed, covering 16,783 people. • **Sindh:** 15 projects launched, 11 completed, covering 10.18 million people. Rs 6.31 billion subsidy.

9. https://finance.gov.pk/survey_2024.html

Despite these efforts, there lies a sizable gap in the resource availability in the IT sector. It is important to highlight that the number of human resources is not the only factor contributing to hindered growth in the industry. Several factors contribute to this, such as the quality of education & training, which may not be producing graduates with the skills and knowledge required by the industry, a mismatch between skills supplied and market demand, meaning graduates may lack the specific skills that are in high demand; curriculum design gaps, where educational programmes may have outdated or irrelevant curricula that do not align with the evolving needs of the industry; insufficient career counselling, in which students may not receive adequate guidance and support in choosing career paths and developing relevant skills; the inability of tech graduates to accelerate in self-employment, as graduates may lack the entrepreneurial skills and support to start their own businesses; and specific barriers faced by women in education and the labour force, who often face unique challenges in accessing education and employment opportunities.

Considering this background, this research uses a mixed methods approach to understand the supply and demand of IT and high-tech skills in Pakistan. It involves analysing existing data and gathering new information from five groups:

Private Sector: IT and high-tech companies across Pakistan as well as industry associations and chambers of commerce. This group provides insights into the skills that are in high demand for employment in Pakistan (more specifically in KP, GB and Baluchistan).

Freelancers and Start-up Incubators: Freelancers Association as well as various start-up incubators were interviewed in this group. This group provided insights into the skills that are in high demand for freelance work, self-employment and start-ups, as well as the soft skills that students need to sustain in freelance industry.

Government Officials: This group included representatives from relevant government bodies in charge of IT and skills training. These include.

a. **The Higher Education Commission (HEC)** are among the pool of respondents, HEC Pakistan is an independent, government-established body responsible for overseeing and regulating higher education in the country. Established in 2002, it took over the responsibilities of the

9. https://finance.gov.pk/survey_2024.html

University Grants Commission (UGC) and plays a crucial role in funding, accrediting, and ensuring the quality of education in Pakistani universities and higher education institutions. The HEC formulates policies, sets standards, and promotes research and development to cultivate a knowledge-based economy in Pakistan.

b. Similarly, The **National Vocational and Technical Training Commission (NAVTTC)** is a Pakistani government organization that regulates and manages vocational and technical education and training in the country. It was established in 2005. NAVTTC works with other organizations in the public and private sectors to develop training programmes, create standardized curricula, and provide certifications to ensure a skilled workforce that meets the needs of the industry and the country.

c. **Government bodies that promote IT (e.g. KPITB, PSEB etc.)** promotes information technology, IT-enabled services, and IT education as well as industry growth in both the public and private sectors.

d. **TEVTAs (Technical Education and Vocational Training Authorities)** are provincial organizations in Pakistan that are responsible for regulating and promoting technical and vocational education. They were established in each province to develop a skilled workforce that can meet the needs of the industry. TEVTA offers a variety of programmes and certifications to equip students with practical skills. They play a vital role in supporting Pakistan's economic growth by providing relevant training and skills development opportunities for the youth.

e. **Trade testing boards** responsible for organizing, regulating, and supervising technical, commercial, and vocational education.

Academia: This group represents the supply side of skills landscape, including universities and training institutions that offer IT-related courses to students, preparing them for careers in the field. Under this category, the certification agencies/organisations have also been reviewed.

9. https://finance.gov.pk/survey_2024.html

Female Students and Graduates: The final group consists of the people who will benefit directly from this programme. This group is divided into two categories: current female students enrolled in IT-related disciplines and graduates from these disciplines, representing each region. This approach helps us understand the student perspective on the issues and barriers they face in their education and how these challenges impact their professional careers. It also allows us to explore potential solutions to these problems.

This report identifies the factors contributing to the IT industry's labour market gaps specially in KP, GB and Balochistan. It proposes solutions to address these issues via establishing centres of excellence in the three geographic regions and empower women in the digital and high-tech sectors.

Section 2:
Gender Skill Gap Analysis in Digital & High-Tech Sectors

2.1) Skill Market Demand and Opportunities (employment & entrepreneurship)

The first step towards conducting a skills gap analysis is to develop a clear understanding of the demand for digital and high-tech skills. To accomplish this, we set out to explore the key sectors where this demand mainly exists. These target markets include Pakistan's local ICT industry, the global ICT industry, and the freelance and self-employment sectors. In this section, we will delve into each of these markets to identify and understand the specific skills that are in demand within each sector.

Digital and Hi-tech Skills

The International Telecommunications Union (ITU) defines digital skills as "the ability to use digital technologies to access and share information, communicate with others, and solve problems." [10] Another take on what digital skills essentially entail is provided by the Broadband Commission. It refers to digital skills as “a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings” [11]

The range of jobs where digital technology plays a central role is steadily expanding, as an increasing number of jobs depend on Information and Communication Technologies (ICTs) to enhance outcomes and efficiency.[12] World Bank classifies the digital jobs that employ an array of digital skills into three broad categories .[13] This categorization helps in understanding the scope of digital skills across different job roles, while also reinforcing the relevance of these skills across varied domains of work.

10. https://www.itu.int/en/mediacentre/Pages/PR-2021-11-03-Digital-Skills.aspx
11. https://www.broadbandcommission.org/publication/the-state-of-broadband-2017/
12. https://digital-skills-jobs.europa.eu/en/latest/briefs/digital-jobs-deep-dive
13. worldbank.org/Digital-Jobs-Report

By high-tech skills, we refer to the specialized and technical ICT skillset. These specialized competencies are generally associated with intermediate and advanced levels of digital skills. International Telecommunications Union (ITU) defines advanced digital skills as "skills necessary to create, manage, test and analyse ICTS. They relate to technology development, network management, machine learning, big data analysis, IoT, cybersecurity and blockchain technology"[14]

Identifying Top In-Demand Skills in the ICT Sector

The basic rationale that underscores our exploration of the prevalent demand in the ICT sector is to eventually work our way towards finding the skills that are currently sought after by the employers hiring in the sector. This demand potentially springs for two reasons. Firstly, the current professionals making up the resource pool in the ICT industry are under equipped with the skillset and technical prowess that the jobs require which leads to employers facing a difficulty in finding competent resource. This translates into the unfulfilled demand in the market. Secondly, the growth of the industry and dynamic nature of the ICT landscape necessitate an expansion in the resource pool as well to fill the newly added jobs and roles. The inability to satiate the increased demand also adds to the unfulfilled demand. It is, therefore, essential to understand the target markets where this demand exists, and what skills are highly demanded by the industry. One of the primary objectives of this study is to identify the top in-demand digital and high-tech skills in the ICT sector.

The flow of this section complements our itinerary of building towards a shortlisted set of skills that covers the leading demand in the industry. Based on this exploration, the skills reflecting the highest demand and potential of growth are outlined in the recommendation section. The exploration involved two key steps.

1. Firstly, an elaborate desk-based study to garner an understanding about the market landscape and referring to the existing literature to see what is in demand.
2. Secondly, conducting in depth consultative rounds with stakeholders hailing from different spheres, but all related to IT and ITeS.

The insights from the IT Industry experts were particularly informative to capture the market demand. This mixed approach ensured a triangulation of our initial findings. It also helped in capturing the local context and nuanced perspective of the stakeholders, which was not entirely accounted for in the existing literature.

Local Market Demand

	List of Skills	P@sha	MOITT	PWC	World Economic Forum (Pakistan)
		IT Skills Survey Report 2024	Pakistan National ICT Industry Development	Unlocking Pakistan's IT potential	Future of Jobs 2024
1	2D/3D Art	✓			
2	5G		✓		
3	Adobe Photoshop	✓			
4	AI		✓	✓	
5	Angular	✓			
6	AR/VR Developer		✓	✓	✓
7	Automation	✓			
8	Big Data				✓
9	Block Chain Development		✓	✓	
10	Captivate	✓			
11	Cassanda	✓			
12	CDN		✓		
13	Cloud Computing			✓	
14	Code Repositories	✓			
15	CRM	✓			
16	Cybersecurity		✓	✓	
17	Data Analysis	✓			
18	Databases	✓			
19	DB2	✓	✓		
20	Digital Platforms and Apps				✓
21	Digital Trade				✓
22	Digital Twin		✓	✓	
23	Dotnet	✓			
24	E Agriculture			✓	
25	E Commerce				✓
26	E Health			✓	
27	E Tech			✓	✓
28	Edge Computing		✓		
29	Figma	✓			
30	Game Development	✓			
31	Git Hub	✓			
32	Internet Of Things				✓
33	Ios Objective	✓			
34	Ios Swift	✓			
35	Ipv6		✓		
36	ISTQB	✓			

Local Market Demand

	List of Skills	P@sha	MOITT	PWC	World Economic Forum (Pakistan)
		IT Skills Survey Report 2024	Pakistan National ICT Industry Development	Unlocking Pakistan's IT potential	Future of Jobs 2024
37	Java Script	✓			
38	Machine Learning			✓	
39	Microsoft Dynamic 365	✓			
40	Microsoft SQL	✓			
41	Mobile Development	✓			
42	Non-Relational Databases	✓			
43	OTN		✓		
44	PHP	✓			
45	PON/Ü0gpon		✓		
46	Power Storage and Generation				✓
47	Programming	✓			
48	Python	✓			
49	Qlik	✓			
50	React	✓			
51	Relational Databases	✓			
52	ROADM		✓		
53	Robotics		✓		
54	Salesforce	✓			
55	SAP	✓			
56	Selenium	✓			
57	Sensor Technology		✓		
58	Software Testing	✓			
59	Tableau	✓			
60	Test Complete	✓			
61	Text, Image, And Voice Processing				✓
62	UI/UX Design	✓			
63	Unmanned Aerial Vehicle		✓		
64	Web Development	✓			
65	Wi-Fi 6		✓		
66	Zoho CRM	✓			

To validate and enrich our findings, we engaged with industry experts and conducted consultative sessions with leading IT and ITes enterprises. Additionally, we ensured that the companies within our target sectors were considered to capture the spatial and industry-specific aspects of the demand. The skills that were identified by the participating stakeholders of the study are as follows:

	List of Skills	Federal	KPK	Baluchistan	G.B
1	3d Animation	✓		✓	
2	Adobe Escalation	✓			
3	Adobe Photoshop	✓			
4	Agile				
5	AI	✓	✓	✓	✓
6	Algorithm Analysis	✓			
7	App Development	✓	✓	✓	✓
8	Auto CAD			✓	
9	AWS	✓	✓	✓	
10	Block Chain	✓	✓	✓	✓
11	Blue Economy			✓	
12	C++	✓		✓	
13	Canva	✓	✓		
14	CCMA Certifications		✓		
15	CISCO Certifications		✓		
16	Cloud Computing	✓	✓	✓	✓
17	Computer Engineering	✓	✓		
18	Content Creation	✓	✓		
19	Content Writing	✓			
20	Cybersecurity	✓	✓	✓	✓
21	Data Analysis	✓	✓	✓	
22	Data Mining		✓		
23	Data Science	✓	✓	✓	✓
24	Database Management			✓	
25	Devops		✓		
26	Digital Agency		✓		
27	Digital Marketing	✓	✓	✓	✓
28	Digital Writing	✓			
29	Dotnet	✓			
30	Drone Technology			✓	

	List of Skills	Federal	KPK	Baluchistan	G.B
31	E Commerce	✓	✓	✓	✓
32	E Tech			✓	
33	ERP Enterprise			✓	
34	Ethical Hacking		✓		
35	Extraction Engineering	✓			
36	Fin Tech		✓		
37	Freelancing		✓		
38	Full Stack Development		✓	✓	
39	Gaming	✓			
40	Graph Computing				✓
41	Graphic Designing	✓	✓	✓	✓
42	HCIA/HCIE		✓		
43	HTML|			✓	
44	Information Security	✓	✓		
45	IT	✓	✓	✓	✓
46	Java	✓	✓	✓	
47	Java Script	✓		✓	
48	JNI	✓			
49	Mean/Mern	✓	✓		
50	Metaverse	✓			
51	ML	✓	✓		✓
52	MS Office			✓	
53	PHP		✓		
54	Power BI	✓		✓	
55	Programming		✓		
56	Project Management		✓		
57	Python	✓	✓	✓	✓
58	Quick Book			✓	
59	React Native	✓			
60	Salesforce	✓	✓		
61	Scrum Master	✓	✓		
62	Selenium		✓		
63	SEO			✓	
64	SEP		✓		
65	Social Media Marketing				✓
66	Software Development	✓	✓	✓	
67	Software Engineering		✓	✓	
68	SQL	✓		✓	
69	Web Designing		✓	✓	✓
70	Web Development	✓	✓	✓	✓

To validate and enrich our findings, we engaged with industry experts and conducted consultative sessions with leading IT and ITes enterprises. Additionally, we ensured that the companies within our target sectors were considered to capture the spatial and industry-specific aspects of the demand. The skills that were identified by the participating stakeholders of the study are as follows:

Demand in Digitalization of the Local Economy

Pakistan has a dynamic industrial landscape. While there is significant potential to grow our IT industry by addressing the skills gap, there is also a great opportunity to transform our local industries through digitalization. Each target region has its own local industries that can be empowered by digitizing routine practices and providing digital literacy to the people working in those sectors. Stakeholders emphasized that to fully harness the potential of digitalization, we must extend our focus to empowering other local industries through digital literacy and integration.

Focusing on digital technologies like mobile app development, graphic design, website development, and data administration can empower local industries across Pakistan, particularly in regions like Baluchistan, Gilgit Baltistan and Khyber Pakhtunkhwa. In Baluchistan, our stakeholders also highlighted the potential for integrating IT into existing industries is substantial. Digitizing sectors such as mineral extraction (e.g., Reko Diq and Saindak), and the blue economy (e.g., using fiber in boat construction, fisheries,) can enhance efficiency and productivity. Drone technology can further revolutionize these industries. Automating the local steel industry, modernizing Agri-processing (e.g., fruit packaging to meet international standards), and developing apps to support agriculture can help improve output. Digital tools can also support airport and seaport management in Gwadar. Empowering the artisan industry with digital marketing and e-commerce skills will boost local craftsmanship. Similarly, in regions like Gilgit-Baltistan, tourism can benefit from digital marketing, while in Khyber Pakhtunkhwa, photography, design, sewing, and cooking industries can flourish with the integration of digital tools and e-commerce opportunities.

Global Market Demand

The world has witnessed a colossal surge in the demand of the digital skills post the pandemic. Despite a temporary decline in job postings for various tech trends between 2021 and 2023 potentially due to cost reduction efforts, the overall job postings for tech-related roles saw an 8% increase.[16] This indicates sustained long-term growth in the demand for technical talent. The rapid rise in interest and investment in generative AI, evidenced by a 700% spike in searches and a sevenfold increase in investments from 2022 to 2023, underscores the growing demand for talent in fields such as AI, data science, and machine learning.[17] This surge is fuelling a global need for skilled professionals across industries like healthcare, financial services, and consumer goods. This also reinforces the fact that the digital revolution transcends far beyond the IT sector, and casts transformative influence on other industries as well. Besides AI, data science emerges as another highly sought after skill. For example, 22% of overall job postings in USA in 2023 asked for at least one skill related to data analysis.[18]

We rummaged through the existing literature to identify the skills that are driving the IT revolution and show significant capacity to scale in the years to come. The IT domains that are currently on the surge and exhibit growth potential in the near future include Artificial intelligence, machine learning, cybersecurity, and data science. The sources that were primarily explored to understand the trends in the international market include World Economic Forum's **Future of Jobs 2023 report**, **Global Skills Report** 2024 by Coursera, Technology Trends Outlook 2024 by McKinsey & co., the IT Skills and Salary Report 2023 by Skillsoft, and Burning Glass' Data Science is for Everyone report

The following chart shows the skills that were recurrently mentioned across the above listed source:.

16. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech
17. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech
18. https://www.burningglassinstitute.org/research/data-science-is-for-everyone

	List of Skills	Coursera	World Economic Forum (Global)	Skillsoft	McKinsey	Glassdoor
		Global Skills Report 2024	Future of Jobs 2024	IT Skills & Salary Report 2023-24	Technology Trends Outlook 2024	Data Science is for Everyone
1	A/B Testing	✓				
2	Ai		✓	✓	✓	✓
3	Algorithms				✓	
4	Android Development	✓				
5	Angular	✓				
6	AR/VR Developer			✓	✓	
7	Artificial Intelligence					
8	Automation				✓	
9	Automation				✓	
10	Azure					
11	Big Data		✓			✓
12	Block Chain Development			✓	✓	
13	C++	✓				
14	Cloud Apis	✓				
15	Cloud Computing	✓		✓	✓	
16	Computer Architecture	✓				
17	Computer Graphics	✓				
18	Computer Networking	✓				
19	Computer Security				✓	
20	Content Marketing					
21	Content Writing					✓
22	Continuous Integration	✓			✓	
23	Copywriting					
24	Crm			✓		
25	Crytography	✓				
26	Css	✓				
27	Cybersecurity	✓	✓	✓		
28	Data Analysis			✓	✓	✓
29	Data Architecture					✓
30	Data Centres				✓	
31	Data Governance					✓
32	Data Management	✓		✓		
33	Data Privacy					✓
34	Data Plotting	✓				
35	Data Science	✓		✓	✓	✓
36	Data Visualization	✓				
37	Data Strategy					✓
38	Databases	✓				
39	Deep Learning	✓			✓	
40	Design & Product	✓	✓			

41	Devops	✓			✓	
42	Digital Marketing					
43	Distributed Computing Architecture	✓				
44	Docker				✓	
45	Document Editing					
46	Electronics				✓	
47	Enterprise Resource Management			✓		
48	Front End Development					
49	Game Development					
50	GDPR And Data Privacy			✓		
51	Generative AI				✓	
52	Graphic Design	✓			✓	
53	Green Technology			✓		
54	Hadoop	✓				
55	Hardware Design Engineering					
56	Html	✓				
57	Human Computer Interaction	✓				
58	Identity Theft				✓	
59	Information Technology				✓	
60	Infrastructure And Systems			✓		
61	Interactive Design	✓				
62	Interactive Design	✓				
63	Internet Of Things	✓		✓	✓	
64	Ios Development	✓				
65	Java	✓				
66	JavaScript	✓				
67	Key Value Database	✓				
68	Kubernetes	✓			✓	
69	Machine Learning	✓		✓	✓	✓
70	Mechatronics				✓	
71	Mobile app development	✓				
72	Mobile Development	✓		✓		
73	Multitask learning	✓				
74	Network Architecture	✓				
75	Network Security					
76	Networks		✓	✓	✓	
77	Operating Systems	✓				
78	Predictive Modelling					✓
79	Product design				✓	
80	Product management	✓				
81	Programming	✓	✓			✓
82	Project Management					
83	Python	✓			✓	
84	Quantum Computing				✓	
85	R	✓				

86	Regulatory Compliance				✓	
87	Relational databases	✓				
88	Risk Analysis				✓	
89	SaaS	✓				
90	Scrum Master					
91	Search Engine Optimization					
92	Security Engineering	✓				
93	Service Management			✓		
94	Social Media Management					
95	Software Architecture	✓				
96	Software Development	✓		✓		
97	Software Engineering	✓			✓	
98	Solutions Engineering				✓	
99	Stakeholder Management				✓	
100	Storage Security	✓				
101	Tableau	✓				
102	Technology	✓				
103	Telecommunications				✓	
104	UI/UX Design					
105	User Experience	✓	✓			
106	User Experience (UX) Designing					
107	User Interface (UI) Designing					
108	User Research	✓				
109	Virtual Assistance					
110	Virtualization			✓		
111	Web Designing					
112	Web Development	✓		✓		

Demand in the Freelance Market

In this report, we are addressing the demand in the freelance market and the self-employment sector under one category as there exists a strong overlap in the skillset required in both the markets. Freelancers and self-employed individuals both rely on similar digital skills for client acquisition, project management, and business operations.

The top skills that are sought after in the freelance marketplace by employers are technology and digital skills.[19] In the U.S alone, freelancers generated $1.27 trillion in annual earnings in the year 2023.[20] The Pakistan Economic Survey 2024 revealed that the contribution of the freelancing community to the economy was $350.15 million of remittances in-flow. [21] The freelance market of Pakistan is expected to grow sizably with the projected share of $1.6 billion in 2030. This suggests that the demand in the freelancing sphere will be significantly growing over the coming years to actualize the projection. Pakistani startup investment grew from 75 million USD in FYI 2020 to 360 million USD demonstrating its colossal capacity for growth[22] .

19. https://flexiple.com/freelance/freelance-statistics-and-trends-2020
20. https://www.upwork.com/research/freelance-forward-2023-research-report
21. https://finance.gov.pk/survey/chapter_24/Economic_Survey_2023_24.pdf
22. https://ignite.org.pk/wp-content/uploads/2018/06/Ignite-Startup-Report.pdf

To gain a holistic understanding of the digital skills that are high in demand in the freelance and self-employment market, we explored the leading freelance platforms such as Upwork and Fiver. Moreover, the publications by the Freelancers Association of Pakistan, Ignite, and CyberVision proved instrumental in identifying the skills and technologies that need to be focused upon to enable the freelance community in Pakistan to leverage on the global demand. Following skills emerged as the top-rated set of skills from the mentioned sources:

	List of Skills	Cyber Vision	Upwork	Fiver	Ignite	PAFLA
		Freelance and Remote Jobs: Potential Need of IT & Digi skills Trainings in Pakistan	2024 In-Demand Skills: Unprecedented Growth in AI and Emergent Skills	Top Rated Fiver Skills Article	Assessment of Pakistan's Startup Ecosystem	Freelancing Landscape of Pakistan 2023
1	3d Animation		✓	✓		
2	AI			✓	✓	
3	App Design			✓		
4	AR/VR Development	✓			✓	
5	Artificial Intelligence	✓				
6	Automation		✓		✓	
7	Azure	✓				
8	Back End Development		✓			
9	Block Chain Development	✓				
10	Character Modelling			✓		
11	Cloud Computing			✓		
12	Computer Graphics	✓				
13	Content Marketing	✓				
14	Copywriting	✓				
15	CMS Development		✓			
16	Cybersecurity	✓			✓	
17	Data Analysis	✓	✓	✓		
18	Data Engineering		✓	✓		
19	Data Entry		✓			
20	Data Extraction		✓			
21	Data Mining		✓			
22	Data Processing		✓			
23	Data Science	✓		✓		

	List of Skills	Cyber Vision	Upwork	Fiver	Ignite	PAFLA
		Freelance and Remote Jobs: Potential Need of IT & Digi skills Trainings in Pakistan	2024 In-Demand Skills: Unprecedented Growth in AI and Emergent Skills	Top Rated Fiver Skills Article	Assessment of Pakistan's Startup Ecosystem	Freelancing Landscape of Pakistan 2023
24	Data Visualization	✓	✓	✓		
25	Databases	✓				
26	Deep Learning		✓			
27	Devops	✓		✓		
28	Digital Marketing	✓				✓
29	Digital Twin				✓	
30	Document Editing	✓				
31	E Commerce		✓	✓		✓
32	E Energy				✓	
33	Email Marketing			✓		
34	Email Marketing		✓			
35	Experimentation		✓			
36	Financial Assistance & Modelling		✓			
37	Front End Development	✓	✓			
38	Full Stack Development		✓			
39	Game Development	✓		✓		
40	Generative AI		✓		✓	
41	Graphic Design		✓			✓
42	Hardware Design Engineering	✓				
43	Illustration		✓	✓		
44	Image Editing		✓			
45	Image Modelling		✓			
46	Internet Of Things	✓			✓	
47	Logo Design		✓			
48	Machine Learning	✓	✓	✓		
49	Manual Testing		✓			
50	Marketing Automation		✓			
51	Mobile App Development		✓	✓		
52	Mobile Development	✓				
53	Network Security	✓				

	List of Skills	Cyber Vision	Upwork	Fiver	Ignite	PAFLA
		Freelance and Remote Jobs: Potential Need of IT & Digi skills Trainings in Pakistan	2024 In-Demand Skills: Unprecedented Growth in AI and Emergent Skills	Top Rated Fiver Skills Article	Assessment of Pakistan's Startup Ecosystem	Freelancing Landscape of Pakistan 2023
54	Presentation Design			✓		
55	Product Design		✓			
56	Product Management		✓			
57	Programming	✓				
58	Project Management	✓				
59	Quantum Computing	✓			✓	
60	Robotics				✓	
61	Scrum Master	✓				
62	Search Engine Marketing			✓		
63	Search Engine Optimization	✓	✓	✓		✓
64	Social Media Management	✓	✓			
65	Software Development			✓		
66	Solutions Engineering	✓				
67	Ui/Ux Design	✓	✓			
68	User Experience				✓	
69	User Experience (Ux) Designing	✓		✓		
70	User Interface (Ui) Designing	✓				
71	Video Editing		✓			
72	Video Production		✓			
73	Virtual Assistance	✓	✓			
74	Web Analytics			✓		
75	Web Designing	✓	✓	✓		
76	Web Development	✓	✓			✓
77	Website Maintenance			✓		
78	Word Press					✓

Additionally, our consultations with key stakeholders from National Incubation Centres, Ignite, and Pakistan Freelancers' Associations helped us in gaining informed perspective of the freelance market. Following skills emerged as the top in demand skills that are currently driving the trends in the global freelancing landscape, and will be steering the demand in the coming years as well:

	Skills	PAFLA	Ignite	NIC Islamabad	NIC Peshawar	NIC Quetta	NIC Gilgit
1	Adobe Escalation	✓					
2	Adobe Photoshop	✓					
3	Ai	✓	✓	✓			✓
4	App Development	✓	✓	✓			
5	AWS	✓					
6	Block Chain			✓			
7	Blue Economy					✓	
8	C++	✓					
9	Canva	✓					
10	Content Creation	✓			✓		
11	Content Writing	✓	✓				
12	Cybersecurity	✓		✓	✓		
13	Data Analysis			✓			
14	Data Science			✓			
15	Digital Agency				✓		
16	Digital Marketing						✓
17	Digital Writing		✓				
18	E commerce	✓			✓	✓	✓
19	Extraction Engineering			✓			
20	Fin Tech				✓		
21	Gaming	✓					
22	Graphic Designing	✓	✓		✓		✓
23	Java	✓		✓			
24	Java Script	✓					
25	JNI	✓					
26	Machine Learning			✓			
27	Mean/Mern	✓					
28	Mobile App Dev	✓					
29	MS Office					✓	
30	Python			✓	✓		
31	React Native			✓			
32	Scrum Master	✓					
33	Software Development					✓	
34	SQL	✓					
35	Web Development		✓			✓	✓

Demand in Cross Cutting Fields

As digitization increasingly permeates every aspect of life, digital roles are emerging across all industries and sectors.[23] The 2024 Tech Trends Report by Future Today highlights the significant impact emerging technologies are expected to have across various industries, as technology integration becomes increasingly inevitable. Sectors ranging from agriculture and education to financial services and the pharmaceutical industry, as well as real estate, supply chain and logistics, energy and renewables, retail, and restaurants, are all incorporating technology to enhance their operations.[24] This underscores the growing importance of technological skills, which are now essential across multiple fields.

Agriculture and energy are among the nine sectors prioritized for Pakistan's digital transformation under the Pakistan Vision 2025.[25] In this section, we will discuss the key cross-cutting technologies that are essential to fully realize the benefits of digital transformation across the fields of agriculture, water, and energy.

E-Agriculture

The World Economic Forum predicts that jobs in the agriculture sector will grow by around 30%, adding 3 million new positions, as agricultural technologies are increasingly adopted and investments in climate change adaptation continue to rise.[26] Pakistan is also actively seeking to leverage the productivity of its largest economic sector by digitizing the agricultural value chain. [27]

Energy and Water Sector

A recent estimate by the International Energy Agency (IEA) suggests that a green recovery could boost global GDP by 3.5% creating 9 million new jobs annually.[28] By 2030, the global green transition could generate 30 million jobs in clean energy, efficiency, and low-emission technologies. [29]

Although there is significant potential for integrating digital skills into the agriculture, water, and energy sectors in Pakistan, and the country envisions leveraging this

24. https://futuretodayinstitute.com/wp-content/uploads/2024/03/TR2024_Full-Report_FINAL_LINKED.pdf
25. https://moitt.gov.pk/SiteImage/Misc/files/Pakistan%20National%20ICT%20Industry%20Whitepaper.pdf
26. https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf
27. https://moitt.gov.pk/SiteImage/Misc/files/Pakistan%20National%20ICT%20Industry%20Whitepaper.pdf
28. https://origin.iea.org/reports/sustainable-recovery
29. https://origin.iea.org/commentaries/the-importance-of-focusing-on-jobs-and-fairness-in-clean-energy-transitions

potential, experts believe that these industries are not yet developed enough for such advanced integration. Current practices in these sectors remain relatively basic, and they lack the capacity to absorb transitions to high-tech solutions in their present state. Furthermore, only a small proportion of the water and energy sectors are operated by the private sector, which limits the demand for these digital advancements. This will be furthered discussed in the recommendation sections. With that said, the following skills have been identified as essential for driving growth in these industries:

Priority	Agriculture	Water	Energy
1	Remote Sensing and GIS For monitoring and advisory on Soil conditions, crop health via sensors/IoT	Remote sensing techniques for water application advisory with use of AI	Solar Energy Systems & Installation
2	Precision Agriculture techniques	Web based Water Accounting Tools to enable smart application ofwater	Housing and Commercial Building automation systems
3	Drone technology for seed plantation, pesticide and insecticide administration	IOT based smart automated irrigation system (drip, sprinkler and centrepivot irrigation system)	Storage systems & battery technology
4	Ecommerce for Farm Product Marketing	Chip Designing for Inverter / BMS	Domestic and Small-Scale Wind Turbine technology (specially in Sindh and Baluchistan)
5		Use of Remote Sensing and AI in Glacier Grafting and Ice Modelling	Use of Remote Sensing and AI in Glacier Grafting and Ice Modelling

Conclusion

Based on our analysis of different job markets for the digital and high tech, the following table corresponds to all the digital and technological skills that were identified as in -demand digital and hi-tech skills that across various sectors.

In the proceeding sections, we endeavour to quantify the demand of these skills in the target markets- local ICT industry, global market, and freelancing/ self-employment landscape and compare them to the aggregate supply figures to determine the size of the existing gap.

Freelance/ Startup Market	Local Market	Global Market	Others
Software Development & Programming	**Software Development & Programming**	**Software Development & Programming**	**Engineering & Emerging Technologies**
Back End Development	Angular	Android Development	Computer Architecture
Block Chain Development	Code Repositories	Angular	Computer Engineering
CSM Development	Dot Net	Cloud APIs	Drone Technology
DevOps	Full Stack Development	Distributed Computing Architecture	E agriculture
Front End Development	GitHub	Docker	E health
Full Stack Development	Java	Front End Development	Ed tech
Java	Java Native Interface	iOS Development	Electronics
Mobile App Development	JavaScript	Java	Extraction Engineering
Mobile Development	Mean/Mern	JavaScript	Game Development
Python	PHP	Key-value Database	Green Technology
Quantum Computing	Programming	Kubernetes	Hardware Design Engineering
React	Python	Python	Mechatronics
Solutions Engineering	React	Programming	Metaverse
Web Development		Software Architecture	Robotics
WordPress			Sensor Technology
Artificial Intelligence & Data Science	**Artificial Intelligence, Data Science & Big Data**	**Artificial Intelligence, Data Science & Big Data**	Telecommunications
Artificial Intelligence	AI	Algorithms	CISCO Certifications
Automation	Algorithms	Data Analysis	CCMA certifications
Data Analysis	Big Data	Data Architecture	HCIA/HCIE
Data Engineering	Data Analysis	Data Governance	SEP
Data Extraction	Data Management	Data Management	PNP
Data Mining	Data Science	Data Privacy	Unmanned Aerial Vehicle (UAV)
Data Processing	Databases	Data Plotting	**Telecommunications & Networking**

Freelance/ Startup Market	Local Market	Global Market	Others
Data Visualization	Cassandra	Data Strategy	5G
Databases	DB2	Data Visualization	
Deep Learning	Relational Databases	Databases	
Generative AI	Non-Relational Databases	Deep Learning	
Machine Learning	Machine Learning	Generative AI	
	Qlik	Hadoop	
	Tableau	Machine Learning	
		Multitask Learning	
		Predictive Modelling	
		Quantum Computing	
		R	
		Tableau	
Design & Creative Skills	**Cloud Computing & IT Infrastructure**	**Cloud Computing & IT Infrastructure**	
3D Animation	AWS	Azure	
App Design	CDN	Data Centres	
AR/VR Developer	Edge Computing	Distributed Computing Architecture	
Character Modelling	Information Technology	Infrastructure and Systems	
Computer Graphics	Information Security	Networks	
Graphic Design	Internet of Things (IoT)	Operating Systems	
Illustration	IPv6	Virtualization	
Image Editing	Microsoft SQL		
Image Modelling	PON/10GPON		
Logo Design	ROADM		
Product Design	Wi-Fi 6		
UI/UX Design			
User Experience (UX) Designing			
User Interface (UI) Designing			
Video Editing			
Video Production			
Web Designing			
Cybersecurity & IT Infrastructure	**Cybersecurity & Networking**	**Cybersecurity & Data Privacy**	
Azure	OTN	Computer Security	
Network Security	ROADM	Continuous Integration	
Internet of Things		Cryptography	
		GDPR and Data Privacy	
		Identity Theft	

Freelance/ Startup Market	Local Market	Global Market	Others
Support & Virtual Assistance	**Testing & Quality Assurance**	**Business, Enterprise Software & CRM**	
Document Editing	ISTQB	CRM	
Manual Testing	Selenium	Enterprise Resource Management	
Virtual Assistance	Test Complete	SaaS	
Website Maintenance		Service Management	
		Technology	
	Business & Financial Tools	**Support, Virtual Assistance & Research**	
	Quick Book	Document Editing	
	Power BI	Human-Computer Interaction	
	Power Storage and Generation	User Research	
	Project & Product Management	Virtual Assistance	
	Scrum Master		

In this section, we analysed the high-demand digital and high-tech skills required to meet the needs of local, global, and freelance markets. The subsequent sections of this report examine the supply of these skills in KP, GB, and Balochistan, followed by a detailed analysis of the gaps between supply and demand. Based on these findings, we provide a set of recommendations for courses that can effectively address these gaps.

2.2) Skills Supply and Relevance with Market

Demand alone lacks sufficient context and should always be considered alongside supply to accurately assess where gaps exist and their extent. Focusing only on demand can result in misleading conclusions and misguided interventions, potentially leading to market saturation. To balance this view, we conducted an in-depth exploration of the skills, knowledge, and competencies being taught to students who are about to enter the workforce.

This analysis focused on two primary educational streams in Pakistan:

1. **HEC-regulated Higher Education Institutes and;**
2. **NAVTTC-regulated TVET sector institutes.**

Additionally, we briefly examined a third stream—online learning platforms that offer micro-credentials primarily for self-learning. However, since this is not a formally recognized learning framework, it is only discussed briefly.

Since the focus of this analysis is on higher levels of education, the investigation primarily covers Level 4 and Level 5 qualifications within the TVET sector and Level 5 and Level 6 qualifications within HEC-regulated institutes. This approach ensures that we assess the supply of skills relevant to the current and emerging demands in the job market.

Following a systematic approach that both outlines the process we undertook and explains the steps and factors involved, this section begins by examining the qualifications framework currently followed in Pakistan. This is essential for understanding how the various levels of education are structured and how qualifications are awarded within the system. After establishing this foundation, we explore the education streams discussed earlier—namely the HEC-regulated Higher Education Institutes and NAVTTC-regulated TVET sector institutes. For each stream, we investigate its regulatory framework, the institutions involved, the qualifications offered, and the enrolment numbers specific to ICT disciplines. Finally, this section converges by computing the supply of in-demand digital and high-tech skills, aligning it with the previously identified skills gaps to provide a comprehensive view of the current educational landscape and its capacity to meet market needs.

Qualification Frameworks in Pakistan

There are primarily two qualifications ‘Frameworks that are followed for education provision in Pakistan. First, Pakistan Qualifications Framework (PQF) is followed to define the educational levels for formal education. Second, National Vocational Qualifications Framework (NVQF) is followed for technical and vocational education streams. Both the frameworks are implemented by educational regulating bodies; Higher Education Commission (HEC) and National Vocational and Technical Commission (NAVTCC), respectively. Both the frameworks have been adopted from the European Qualifications Framework and classify the education levels at eight distinct stages.

	Levels	PQF[30]	NVQF [31]	Time Required
Higher Education	8	Doctoral		18 Crt Hrs & Dissertation
	7	Masters	M. Tech	Min. 30 Crt HRs
	6	Bachelor (Hons)	B. Tech (Hons)	120-140 Crt Hrs
	5	Associate degree	B Tech (Pass)	50+ Crt Hrs
Higher Secondary	4	Higher Secondary School Certificate	Inter-Tech DAE	
Basic/Elementary	3	Secondary School Certificate	National Vocational Certification (Level 1) to 4)	
	2	Middle		
	1	Primary		

These frameworks provide clear guiding models according to which qualifications and curricula are designed. Each curriculum for these qualifications is designed according to a defined competency standard, ensuring alignment with industry or sector-specific requirements. These competency standards guide the development of curricula, which must provide a balanced combination of skills, knowledge, and responsibility. This structure ensures that learners acquire the practical abilities, theoretical understanding, and professional accountability needed for their respective qualifications.

30. https://www.hec.gov.pk/english/services/universities/pqf/Documents/National%20Qualification%20Framework%20of%20Pakistan.pdf
31. https://nvqf.pk/

The terms qualification, competency, and skills are often used interchangeably, yet they hold distinct meanings. While closely related, each plays a unique role in education and workforce development. Both the Pakistan Qualifications Framework (PQF) and the National Vocational Qualifications Framework (NVQF) provide clear standards for each term, which are subsequently adopted by educational and training institutes. According to the European Qualifications Framework (EQF), these concepts are defined as follows:

Concept	Definitions[32]
Qualification	Qualifications are the formal outcome of an assessment and validation process by a competent authority and typically take the form ofdocuments such as certificates or diplomas. They determine that an individual has achieved learning outcomes to given standards. Those learning outcomes may be achieved through a variety of paths in formal, non formal or informal settings, whether in national or international contexts. Information on learning outcomes should be easily accessible and transparent
Competency	'competence' means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development;
Skill	'skills' means the ability to apply knowledge and use knowhow to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments
Knowledge	'knowledge' means the outcome of the assimilation of information through learning. Knowledge is the body offacts, principles, theories and practices that is related to a field of work or study. In the context of the EQF, knowledge is described as theoretical and/or factual
Responsibility	responsibility and autonomy' mean the ability of the learner to apply knowledge and skills autonomously and with responsibility;

32. https://www.hec.gov.pk/english/aboutus/pages/aboutus.aspx

Stream I: Higher Education Institutes (HEIs)

Higher Education Institutes in Pakistan are regulated by the Higher Education Commission. The Higher Education Commission is an independent, autonomous, and constitutionally established institution responsible for primary funding, overseeing, regulating, and accrediting the higher education efforts in Pakistan[33]. There are 220 universities operating under higher education commission all over Pakistan, out of these 44 are in KP, 8 are in Balochistan and 2 are operating in GB. The table below illustrates the current state of ICT enrolment and graduates all over Pakistan as well as in KP, GB and Baluchistan.

	Number of Universities			Number of Enrolments in ICT			Estimated ICT Graduates Per Year			Estimated Female ICT Graduates Per Year		
	BS	MS	Total	BS	MS	Total	BS	MS	Total	BS	MS	Total
Pakistan			220	174478	12747	188560	43620	6373	47140	10704	1099	11912
KPK	39	30	44	16635	1274	18114	4159	637	4529	335	50	392
Baluchistan	8	8	8	3423	181	3627	856	91	907	156	10	167
G.B	2	0	2	578	0	578	145	0	145	31	0	31

As shown in the table above, compiled through HEDR, there are approximately 200,000 students enrolled in ICT-related qualifications across the country, of which around 23,000 are enrolled in KP, GB, and Balochistan. Based on this, we estimate that approximately 4,500 students graduate with ICT-related qualifications annually in KP, 900 in Balochistan, and 145 in GB. However, the ratio of female graduates remains extremely low, with only 8% in KP, 18% in Balochistan, and 21% in GB.

33. https://www.hec.gov.pk/english/aboutus/pages/aboutus.aspx

HE Qualifications

HEC recognized universities and higher education institutions offer a variety of disciplines related to ICT. The courses and specializations within these programmes are extensive and vary from institute to institute. HEC provides a broad outline for designing each programme, but the content is usually curated by the institution. That's why, the advancement of content taught in each programme at different institute may vary. Following list outlines the variety of ICT programmes offered at universities:

Levels	Award Type	Programmes
Level 6	BS	1. Computer Science 2. Software engineering 3. Artificial intelligence 4. Data science 5. Information technology 6. Computer engineering 7. Cyber security 8. Animation Design 9. B tech 10. Information engineering technology 11. CS software 12. Computer art 13. Computer engineering technology 14. Computer system engineering 15. Game Design 16. Information Design 17. Robotics 18. Telecommunication and networking 19. Telecommunication system
Level 7	MS	1. Computer Science 2. Software engineering 3. Artificialintelligence 4. Data science 5. Information technology 6. Computer engineering 7. Telecommunication system 8. Science Computer 9. Cloud Computing 10. Data Communications & Networks 11. Embedded Systems and IoTs 12. Information security
Level 8	PhD	1. Computer Science 2. Artificial intelligence 3. Information technology 4. Computer engineering

In Khyber Pakhtunkhwa (KPK), the number of universities offering Computer Science (CS), and Information Technology (IT)-related degrees reflects a diverse landscape of academic disciplines with varying levels of specialization. The highest number of programmes is in Computer Science, with 39 universities offering BS degrees, 30 offering MS, and 17 offering PhDs. Software Engineering is the second most popular, with 17 universities offering BS degrees and 7 offering MS degrees. Emerging fields such as Artificial Intelligence (AI) and Data Science are also gaining traction, though they are less widely offered, with 10 universities providing BS programmes in each. Fields like Cyber Security, Animation Design, and Game Design remain in the early stages of development, with only a handful of universities providing related degrees.

Number of Universities In KPK offering CS & IT Related Degrees			
Discipline	**BS**	**MS**	**PhD**
Computer Science	39	30	17
Software engineering	17	7	
Artificial intelligence	10	1	1
Data science	10	3	
Information technology	8	3	4
Computer engineering	3	1	1
Cyber security	3		
Animation Design	1		
B tech	1	1	
Bsc Information engineering technology	1		
BSCS software	1		
Computer art	1		
Computer engineering technology	1		
Computer system engineering	1		
Game Design	1		
Information Design	1		
Robotics	1		
Telecommunication and networking	1		
Telecommunication system	1	1	
Science Computer		1	
Cloud Computing		1	
Data Communications & Networks		1	
Embedded Systems and IoTs		1	
Information security		1	

16. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech
17. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-top-trends-in-tech
18. https://www.burningglassinstitute.org/research/data-science-is-for-everyone

In Gilgit Baltistan, there are two universities. Both offer bachelor's degrees in computer science, software engineering, and IT. The gender participation ratio in Gilgit Baltistan is a total of 79% male and 21% female enrolment in IT related programmes.

Number ofUniversities In G.B offering CS & IT Related Degrees			
Discipline	BS	MS	PHD
Software engineering	1		
Information technology	1		
Computer science	2	2	
Artificial intelligence	1		
Data science	1		
GIS and Remote sensing	1		

Baluchistan has 8 universities offering technology-related courses. 6 universities offer a BS in Computer Science, making it the most widely available undergraduate programme in this field. Information Technology follows with 3 institutions, while Computer Engineering and Software Engineering are each available at 2 universities. At the graduate level, Computer Science is offered by 3 universities, while Information Technology is available at 2. None of the universities in Baluchistan currently offer PHD level programmes related to ICT. This underpins the lack of highly specialized educational opportunities in Baluchistan.

Examining gender participation in Baluchistan's education system reveals a significant gap, with 82% male enrolment compared to 18% female enrolment.

Number of Universities In Baluchistan offering CS & IT Related Degrees			
Discipline	BS	MS	PHD
Computer engineering	**2**	**1**	
Computer science	**6**	**3**	
Information technology	**3**	**2**	
Software engineering	**2**		
Telecommunication engineering	**1**		

1) Fee Structures

Cost associated with degree programmes is a major indicator to consider while exploring the landscape of higher education. It influences the decisions of the students when choosing an institute to enrol in. The fee structure for higher education institutes varies significantly, with a major difference in the overall costs associated with degree programmes at private versus public sector universities. The table below illustrates this disparity across different regions and HEIs. In KPK, the lowest fee is approximately Rs. 36,000 (University of Peshawar), while the highest fee soars to Rs. 800,000 (GIKI), indicating a substantial range in tuition costs. Similarly, in Baluchistan, the fees range from Rs. 10,800 (University of Baluchistan) to Rs. 171,000 (NUST Quetta). In Gilgit-Baltistan (G.B), the fee range is from Rs. 36,000 (University of Baltistan) to Rs. 53,000 (Karakoram International University), which is relatively modest in comparison to the other regions.

Fee Structure of Universities (BS in Computing Qualifications - Per Semester)		
Region	**Lowest Fee**	**Highest Fee**
KPK	Rs. 36,000	Rs. 800,000
Baluchistan	Rs. 10,800	Rs. 171,000
G. B	Rs. 36,000	Rs. 53,000

Stream II: Technical and Vocational Education and Training institutions

According to UNESCO, “Technical and vocational education and training’ (TVET) is understood as comprising education, training and skills development relating to a wide range of occupational fields, production, services and livelihoods. TVET includes a wide range of skills development opportunities attuned to national and local contexts. Learning to learn, the development of literacy and numeracy skills, transversal skills and citizenship skills are integral components of TVET.”

In Pakistan, NAVTCC is the apex regulating body that leads the way in vocational training in the country, developing policies, curricula, and certifications that align with industry needs. Its focus on bridging the gap between academia and industry and ensures that training programmes are practical and effective. NAVTTC's assessments and partnerships contribute to the development of a skilled workforce, which is vital for Pakistan's progress.

Overview of the Institutes

In Pakistan there are more than 5000 technical and vocational institutes. There are a total of 13 Qualification Awarding Bodies (QABs) in Pakistan, including NAVTACC to develop trainings, and certify individual who successfully clarify a qualification. Furthermore, the provincial Technical Education and Vocational Training Authorities (TEVTAs) also play an integral role in implementation of qualifications and regulating institutes at the provincial level. Some institutions fall under the direct jurisdiction of the provincial TEVTAs, while rest are affiliated with the QABs for assessment and certification purposes. Both government and private institutes are linked with these bodies. 67149

According to the datasets shared by NAVTTC, the total number of TVET institutes in **KPK** (including both public & private) is 1284[35]. In **Baluchistan,** there are a total of 343 institutes whereas In **Gilgit Baltistan,** there are 141 institutes.

TVET Institutes in Pakistan	
Region	**Total Number of Institutes**
AJK	250
Baluchistan	343
Gilgit Baltistan	141
Islamabad	179
KP	1284
Punjab	1996
Sindh	1142
Total	**5335**

Since its evolution in 2013, NVQF has been implemented in 1690 institutes across Pakistan.[36] These institutes provide Competency Based Trainings (CBT). A C**ompetency based training,** as per ILO's, 'Competency-Based Training (CBT): An Introductory Manual for Practitioners', is "a structured training and assessment system that allows individuals to acquire skills and knowledge in order to perform work activities to a specified standard."[37] The distribution of CBT Institute across the target areas is demonstrated in the table below:

	KPK	Baluchistan	GB
Male	98	37	20
Female	28	17	16
Both/Co - Education	5	14	6
Transgender	0	1	6
Total	**131**	**69**	**49**

35 Data shared by NAVTTC
36 https://nvqf.pk/
37 https://unevoc.unesco.org/home/TVETipedia+Glossary/show=term/term=Competency-based+training

ICT Qualifications offered in TVET institutes

TVET institutes offer various courses and trainings in ICT as per the qualifications designed by NAVTCC. It is important to mention that qualifications under Level 5 have not been fully implemented yet. Following is a list of the qualifications across different levels that are offered:

Levels	Qualifications
Level 1	1. AI Data Technician
Level 2	1. Computer Operator 2. Computer Business Management/ IT Office Assistant) 3. AutoCAD 4. AI Data Technician 5. Android Application Developer (Junior Assistant)
Level 3	1. AutoCAD 2. AutoCAD 1 Year 3. Computer Graphics Print 4. Call Centre Agent 5. REVIT & SKETCHUP 6. AI Data Technician 7. Digital Marketing 8. (Computer Graphics-Motion) V2 9. Web Designing and Development
Level 4	1. Computer GraphicsMotion 2. 3D Studio MAX 3. AI Data Technician 4. (Computer Graphics-Motion) V2 5. Digital Marketing 6. Android Application Developer (Assistant) 7. Android Application Developer 8. E Commerce
Level 5	1. Robotics 2. Networking cloud computing 3. Game Development 4. Mobile App Developer 5. Internet of Things 6. Graphic Designing 7. Digital Marketing 8. Design E Commerce & Digital Marketing (DED) 9. Data Analyst 10. Cybersecurity and Networks 11. Content Writing 12. Cloud Computing 13. Artificial Intelligence 14. 3 D Modelling and Game Development
DAE	15. Diploma in Information Technology 16. Diploma in Hardware Engineering 17. Diploma in Information Communication Technology 18. Diploma in Telecommunication 19. Diploma in Computer Technology

In addition to these qualifications, NAVTACC also works on many commissioned training programmes and dedicated initiatives. The IT related programmes that ran in 2024 include the Prime Minister Youth Skill Development Programme, End to End 2024 TVET Uplift Programme, Special Skill Training Programme for AJK, Special Skill Training Programme for Gilgit Baltistan, Summer of Code, Skill Training Voucher Programme (BISP).[38] The courses included in these programmes are enclosed in the annexure.

Supply/ Enrolments of TVET Institutes

The data on enrolments for Information and Communication Technology (ICT) specifically for Competency-Based Training (CBT) qualifications is not readily available. Despite exploring multiple sources, we were only able to gather fragmented data. For instance, while Skillings provides the provincial distribution of aggregate annual supply across all trades, it does not offer specific numbers for ICT enrolments. Similarly, the dataset acquired from the National Vocational Qualification Framework (NVQF) clearly indicates a lack of availability of enrolment data. Additionally, our findings from the KP TEVTA's annual report[39] only present the numbers shown in the table below.

Level	Qualification	Enrolments 2023-24
DAE	Computer Hardware	323
	Telecom	258
CBT Level II (Boys only)	Computer Operator	847
	AutoCAD	142
CBT Level III (Boys)	Graphic Designing	27
	ProgrammableLogic Controller	17
CBT Level II (Girls)	ComputerOperator	557
	IT Assistant	402
CBT & A Trades for Women (Level III)	Computer Operator	38

The only reliable and comprehensive data we were able to acquire was for the different IT related programmes and initiatives like PMYSDM, Summer of Code, and End to End programme. These data sets are enclosed in the **annexure.**

38 NAVTTC
39 https://kptevta.gov.pk/wp-content/uploads/2023/11/Annual-Progress

Cost and Fee Structure for Courses

The fee structure in TVET institutes vary widely depending on the course, its duration, and the level of specialization. Despite these variations, the cost of education in TVET institutes is generally minimal compared to the expenses associated with universities or other institutions offering formal education. The fee structure also varies depending on the type of institute. For example, Pearl Institute Quetta charges approximately Rs. 7000 for most of the three months' duration courses that they offer. CORVIT Systems which is an accredited private technical training institute charge anywhere between Rs. 25,000 to Rs. 200,000 for the similar type of courses. Government TEVTA institutes, for example have lesser fee. The following table presents the fee structure of TEVT institutes for various programmes[40]. The amount covers admission and tuition fee, pupil funds, and refundable institute security.

Technical Stream Courses	**DAE Courses**	**B. Tech Courses**	**Matric Tech Courses**	
	Rs. 14,455	Rs. 12,640	Rs. 5,565	
Vocational Stream Courses	**1 & 2 Years**	**6 Months**		
	Rs. 5,565	Rs. 1,825		
CBT & A Courses	**GTTLs**		**(GTTC & GVTI W)**	
	Level II -IV (6 Months)	Level III - IV (12 Months)	Level II - IV (6 Months)	Level III - IV (12 Months)
	Rs. 2,485	Rs. 4,390	Rs. 1,945	Rs. 3,385

Stream III: Online Learning Platforms

The third stream on the supply side is the online learning platforms. Online learning platforms are digital environments that provide access to educational content and resources. These platforms can host a variety of learning materials, including videos, quizzes, and interactive modules, allowing learners to study at their own pace or in a structured format. Online learning platforms typically operate through a combination of pre-recorded lessons, live sessions, and interactive elements. Learners can access these materials via the internet, allowing for flexibility in terms of time and location.[41]

41 Online Learning Platforms: The Different Types And Their Benefits – Forbes Advisor

The popularity of online learning platforms has surged, especially during and after the COVID-19 pandemic. The e-learning market is projected to grow by 20.5% from 2022 to 2030.[42] Worldwide, 49% of students have completed some form of online learning.[43]

In Pakistan, the adoption of online learning platforms has been growing, particularly in response to the pandemic. However, challenges such as connectivity issues and lack of institutional support have hindered widespread adoption. This was highlighted during our primary research as well, by the students and the consulted stakeholders alike. Despite these challenges, students seemed eager to pursue self-learning specially in the IT sector as online platforms and diversity of courses available addresses the concern of obsolete curricula and outdated assessment and instruction practices in traditional institutes.

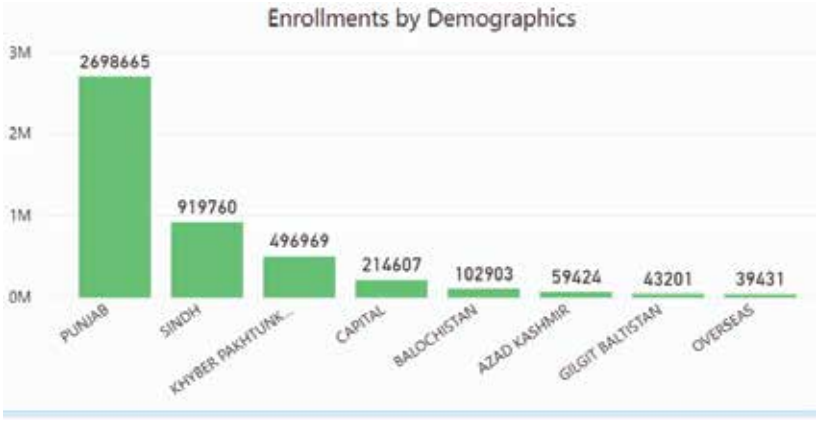
Most popular online learning platforms in Pakistan[44] :

Coursera	Udemy	Skillshare
Khan Academy	edX	Sabaq
NPTEL	Unacademy	Codecademy

Digiskills.pk

Launched in 2018 by the government of Pakistan through the Ministry of Information Technology and Telecommunication, Ignite (National Technology Fund), Digiskills.pk is a **free online training programme** in Pakistan aimed at equipping individuals with the skills needed to participate in the digital economy. More than 4 million people have been trained through this initiative in IT related skills.[45]

42 2024 Online Learning Statistics – Forbes Advisor
43 Online Learning Statistics: The Ultimate List in 2024 | Devlin Peck
44 Top 10 Educational Websites in Pakistan - United Sol
45 https://digiskills.pk/



A total of 15 online courses including virtual assistant skills, freelancing, e-commerce management, digital marketing, digital literacy, QuickBooks, AutoCAD, WordPress, graphic design, creative writing, and SEO (Search Engine Optimization) are being offered through this programme. The table illustrates the overall enrolments in the courses across geographic areas of Pakistan. In KPK, over four hundred thousand people enrolled. Similarly, in Baluchistan more than a hundred thousand people enrolled in the courses. For G.B, this number crossed forty-three thousand people.

The chart[47] shows that women make up almost one third of the total enrolments. The enrolment numbers underscore that online learning is a viable option for our target regions. There is a clear need to explore avenues that can integrate online learning into formal qualification frameworks, ensuring that this mode of learning is recognized in employment and career advancement opportunities. Such integration would not only enhance accessibility but also broaden the pathways to formal recognition and professional growth. Moreover, women's participation in DigiSkills is higher than enrolment figures in higher education and TVET institutions. This indicates that online learning, effectively leveraged, can unlock the potential of women by offering them the opportunity to learn at their own pace, with the flexibility to study from home.

Current use of Digital / Online Tools in Training and Assessment

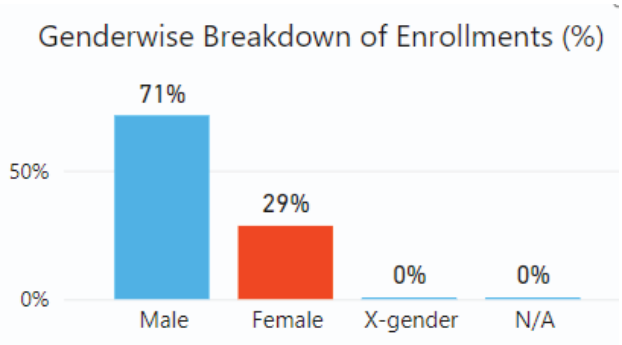
On the other hand, the results we obtained from our targeted areas, Khyber Pakhtunkhwa, Gilgit-Baltistan, and Balochistan demonstrate that online learning is not very well established in universities & institutes due to unstable internet connection and lack of equipment and resources. Students also showed dissatisfaction with it. In GB and Baluchistan, stakeholders report a lack of proper internet infrastructure which further complicates this mode of learning.

Universities in Pakistan rely on in-person learning. Although some universities have independently taken the initiative to arrange online lectures. This approach, however, has not been widely adopted. Even when online lectures are available, many students in these regions find them challenging and do not feel comfortable with it.

46 https://app.powerbi.com/view?r=eyJrIjoiYmRlMTMwMDctNmVjNS00M2U5LWFjMGYtZjY0ZTc5NDgyMzZlIiwidCI6Ijc1ZGYwOTZjLThiNzItNDhlNC05YjkxLWNiZjc5ZDg3ZWUzYSIsImMiOjI9

47 https://app.powerbi.com/view?r=eyJrIjoiYmRlMTMwMDctNmVjNS00M2U5LWFjMGYtZjY0ZTc5NDgyMzZlIiwidCI6Ijc1ZGYwOTZjLThiNzItNDhlNC05YjkxLWNiZjc5ZDg3ZWUzYSIsImMiOjI9

HEC is trying to shift this and has provided access to Coursera for students in universities. However, traditional Technical and Vocational Education and Training (TVET) institutes have not yet integrated online tools into their teaching modes.



Female access to available institutes / courses

The enrolment ratio in the IT and high-tech courses and disciplines is extremely skewed, with only a handful of women enrolled in these programmes across the institutes as shown in the above sections. The trend has various underlying reasons including access issues, and cultural barriers. These reasons are discussed at length in the gender related gaps section. Many stakeholders from Academia emphasized on the direness of addressing this gender gap in the sector. In our focus group discussions, Students themselves, shared their perspective on how cultural barriers bar them from going to universities that are far off, and the institutes that are locally established do not have good standards. This highlights the geographical limitations women face, as distance and inadequate transportation infrastructure can hinder their access to educational institutions. These factors are comprehensively discussed in the section on gaps, challenges, and barriers to female access to education.

Conclusion

In summary, the supply of skills across KP, GB, and Balochistan demonstrates promising efforts, with offerings that cover a range of digital and high-tech fields, including emerging technologies. However, these initiatives are often fragmented and lack integration, reducing their overall impact and reach. Moreover, the absence of comprehensive and reliable data on skills supply, especially in-case of TVET supply poses a significant challenge to effective planning and policy formulation.

A key concern remains the low female participation in formal education and training programmes. Encouragingly, trends show that the highest ratio of female learners is found in online learning platforms, though the use of online tools overall remains limited. Expanding the use of online learning could significantly enhance women's participation by offering flexible, accessible pathways to skill development.

Despite these initiatives, a supply-demand gap persists, and in the next section, we will explore the underlying factors contributing to this imbalance and propose potential solutions to bridge the gap.

Section 3:
Barriers, Gaps and Challenges

This section identifies and examines the key barriers, gaps, and challenges facing the digital and high-tech sectors in Khyber Pakhtunkhwa (KP), Gilgit-Baltistan (GB), and Balochistan. These include mismatches between academia and market demands, obstacles to women's participation, qualification gaps, weak industry-academia linkages, shortages of skilled trainers, insufficient startup support, inadequate career counselling, and poor infrastructure. Addressing these issues is essential for cultivating a skilled and inclusive workforce in these regions.

3.1) Skills Supply-Demand Gaps

a. In terms of numbers

In this section, we converge and compare our findings from the previous sections on demand and supply to identify the prevailing skills gap in the market. To achieve this, we followed a systematic approach:

1. **Skills Curation:** We curated a comprehensive list of over 150 skills in demand across local and international job markets, as well as the freelance market. This was based on both primary data (qualitative consultations with key stakeholders) and secondary data (desk-based research).
2. **Skills Merging:** Once an exhaustive list of skills was identified, we then merged them into various domains to follow our next steps.
3. **Job Posting Analysis:** We explored job posting platforms such as LinkedIn and Indeed to determine the actual number of job postings for each skill. For Pakistan, we focused on entry-level positions, while global job postings reflected overall demand.
4. **Freelancing Platforms:** We also analysed freelancing platforms, such as Fiverr and Upwork, to identify the total number of gigs available for each skill.
5. **Demand Quantification:** This enabled us to quantify the demand for each skill. We ensured that only skills with clear demand made it onto the final list, avoiding reliance solely on opinions or their mentions in reports or online sources.

Once we had a clear understanding of demand, we turned our focus to assessing the supply of these skills. This involved the following steps:

1. **Education Programmes Review:** We identified the qualifications and programmes being offered at levels 5 to 7 in universities within the target areas, and levels 4 and 5 in the TVET sector. We also included programmes run by NAVTTC.
2. **Course and Competency Compilation:** We compiled the courses, competencies, modules, and key learning outcomes specified by HEC for higher education institutions (HEIs) and by NAVTTC for TVET initiatives.
3. **Skill Alignment Assessment:** We then conducted a detailed analysis of the courses, competencies, modules, and key learning outcomes (CLOs) to determine whether the skills in demand were being offered in the current educational and training programmes.
4. **Supply Quantification:** This allowed us to quantify the supply of each skill by level and programme, providing a clearer picture of how well the educational and training sectors are addressing the market demand for these in-demand skills.

A detailed numeric analysis based on this approach has been **annexed**. The tables list various skills, and for each skill, we have quantified the supply (considering both higher education qualifications' course learning outcomes and TVET competencies). Against these supply figures, we have also quantified the demand in local, global, and freelance markets, using the sources described earlier.

It is important to note that complete supply data for all programmes and degrees were not available, which may limit the full accuracy of these numbers. Consequently, certain gaps in our findings could be due to missing information rather than an actual lack of supply. To address this, we consulted IT industry and academic experts to categorize each skill into three supply and demand categories: low, medium, and high. The following skill-gap analysis is the result of this process.

Skill Gap Analysis:

In analysing the gap, it became evident that it manifests in two distinct forms:

1. **Shortage of the skilled workforce** (demand exceeding supply)
2. **Surplus of the skilled workforce** (supply exceeding demand) and

This dual perspective is crucial, as it provides insight into both the oversupply of certain skills and the areas where there is a shortage. Understanding these dynamics allows for targeted interventions—highlighting where skill training and development are excessive and where additional training is needed to address gaps. Consequently, it informs strategic decisions on how to align educational and vocational training efforts with actual market needs, ensuring a more balanced and effective approach to skill development. We discuss the gap for local market and freelance market below. The global market is not included because it is intuitively understandable that the global demand numbers will surely surpass the local supply numbers, and the gap identified in terms of numbers would not yield any particularly insightful trends.

Shortage of the Skilled Workforce:

In analysing the shortage of IT skills, we identified those with high demand but observed that the market supply remains inadequate in the three regions we studied. This shortage highlights a gap that may arise from two factors: either the workforce being trained in these skills is insufficient, or the market demand is expanding more rapidly than the supply generated by higher education institutions (HEIs) or the TVET sector. This indicates a need for greater emphasis and investment in the development of these skills to align with the market's increasing demands. Following are the skills exhibiting shortage in the workforce as per our study:

Skills	Demand	Supply
Source Code Management & Automation (Git, GitHub)	High	Low
Azure/AWS	High	Low
Automation	High	Low
Figma	High	Medium
Generative AI	High	Low
Automated Testing with Selenium	High	Low
UI/UX Design	High	Medium
Software Testing	High	Medium
React	High	Medium

Surplus numbers but Inadequate quality of the Skilled Workforce

To calculate the surplus of IT skills, we first identified those skills with high supply in the market but relatively low or medium demand. This surplus suggests market saturation, which can indicate one of two things: either the workforce for these skills is already sufficient, or the supply is too theoretical and lacks the practical skills demanded by the industry. This calls for a more detailed analysis of the course content for these skills, which we have conducted, leading to the recommendations provided in the relevant section.

Skills	Supply	Demand
Graphic Design	High	Med ium
Cybersecurity (theoretical)	High	Medium
Virtual Assistance	High	Medium
E commerce	High	Medium
Search Engine Optimization	High	Low
Digital Marketing	High	Medium

Furthermore, we also identified and categorized a few skills that, while adequately offered in terms of numbers, are too theoretically focused to produce a skilled workforce that meets market needs.

Skills	Supply (theoretical)	Demand
Artificial Intelligence	High	High
Python	High	High
Machine Learning	High	High

In addition to the above categories, we also identified a few skills where both supply and demand are low. However, readers should not view these skills as unimportant, as they remain highly sought after in the global IT landscape. While they may not currently be in high demand in the local market, their relevance on the global stage underscores their long-term value.

Skills	Demand (local market)	Supply
AR/VR Developer	Low	Low
Qlik	Low	Low
Scrum Master	Low	Low

In terms of quality

In core skills offered by the higher education as well as TVET institutes, there is a significant relevance problem: stakeholders are identifying a demand for skillfulness in emerging technologies but highlight the lack of available human resources skilled in those emerging technologies. This demonstrates a relevance problem as the supply is not meeting the demand for these emerging skills. It is noted that most graduates know theory, but they lack hands-on experience; additionally, stakeholders observed quality issues. We tried to dig deeper into these quality issues and have identified that the basic reason behind this is that Curricula of universities frequently lag behind emerging and industry prevalent technologies. There are potentially several reasons for this, as highlighted below:

1.**Tedious Process of Curriculum Revision:** Most of the universities in these provinces follow curriculum provided by HEC or its affiliated accreditation body for computing and technical programmes. The overall process of curriculum release from HEC to its adoption in a university is a tedious process and is not aligned with the continuously evolving technology needs. For instance, the National Computing Education Accreditation Council (NCEAC) is responsible for accreditation of computing education in Pakistan. NCEAC creates national bodies of experts and revises its curriculum on average every three years. The last revision being made in 2023. The curriculum is intended to be a guidance, but due to limited experts' availability in most of the universities in these three provinces, the universities opt to follow the curriculum as-it-is. Once the curriculum is released, the universities start the adaption process, which may take anywhere from 1 year to 5 years in getting it approved from various statutory bodies, Board of Studies, Board of Faculty, Academic Council, Syndicates. The industry is working on rapidly evolving technologies that drastically change in a two-year window. This mismatch results in students not obtaining the skills in line with the industry needs.

2.**Orientation towards theoretical foundations:** Universities in Pakistan are inherently focused on strengthening core concepts and theoretical foundations, which results in a noticeable gap in the integration of practical technological skills within their curricula. This emphasis on foundational knowledge, though essential, often overlooks the rapidly evolving technological landscape that industries demand. This results in fresh graduates who frequently encounter significant skill limitations that hinder their employability in today's dynamic job market. Industry experts estimate that around 80% of technical graduates from typical Pakistani universities are not immediately employable, highlighting a critical disconnect between academic education and industry requirements.

3. Lack of Industry Awareness: A significant barrier to bridging the skills gap is the insufficient awareness among academic institutions regarding the latest industry trends and requirements. Universities often lack direct channels of communication with industry leaders, resulting in curricula that do not reflect the current demands of the job market. This disconnect means that university faculty may not be fully informed about the specific skills and technologies that employers are seeking, leading to outdated or irrelevant course content. Additionally, there is a scarcity of industry-driven projects, internships, and collaborative programmes within universities, which further diminishes students' exposure to real-world applications and professional environments. The establishment of industry advisory boards is a positive step in this direction, but many universities have yet to operationalize these boards. In instances where they are active, meetings occur only once a year, resulting in delayed feedback and insufficient alignment with the fast-paced changes in the industry. Consequently, curriculum updates are slow to incorporate new skills and technologies, increasing the skills gap and reducing graduates' competitiveness in the job market.

4. Lack of Available Resources and Teachers Skills: Another limitation is the inadequate availability of resources and the technical proficiency of faculty members. This limitation is more critical in the three target provinces, as the technology industry in these provinces is limited. The technical skills of faculty members often do not keep pace with the latest developments in the field. Many educators may lack practical experience with emerging technologies or have limited opportunities for professional development to stay updated with industry trends. This results in a teaching workforce that is not fully equipped to mentor students in modern technologies, thereby increasing the skill gap and diminishing the overall quality of education delivered. The university reward system is inclined on research, which is mostly theoretical in the universities.

5. Soft Skills: With problems of quality & quantity both discussed above, we now turn towards the third major issue; lack of soft skills among HE and TVET graduates. Both primary and secondary sources show a lot of emphasis on the lack of soft skills among graduates.

The TechLift programme, which addressed the lack of skilled tech workers in the country, was initiated through a partnership between the Pakistan Software Export Board (PSEB), Pakistan's IT Industry Association (P@SHA), maintained a curriculum of 90% technical skills and 10% soft skills[48] .

48 https://www.pasha.org.pk/publications/impact-assessment-report/

Our stakeholders emphasized a lot on soft skills, an analysis of the soft skills mentioned by 50+ stakeholders are illustrated in the infographic below.

As illustrated in the infographic above, the soft skills emphasized by stakeholders can be categorized into 7 categories, as discussed below

1.Basic Skills: These foundational skills, such as personal hygiene, overcoming shyness, and understanding how to dress appropriately, are essential for creating a professional image. Stakeholders emphasized that while these may seem simple, they play a critical role in shaping how individuals are perceived in professional settings. Focusing on these skills can help students build confidence and create a strong first impression, which is often key to career success.

2.Presentation Skills: The ability to effectively present ideas is crucial in the workplace. This includes not just the technical know-how of using presentation tools, but also the ability to communicate confidently and maintain focus during a presentation. Stakeholders highlighted the need for training in structuring content, engaging an audience, and conveying key messages with clarity, which can significantly improve a student's ability to influence and persuade in professional environments.

3.Communication & Interpersonal Skills: Emotional intelligence, teamwork, and English language proficiency are fundamental skills that employers seek in the global market. The gap analysis identified a strong demand for individuals who can collaborate effectively, communicate across different cultures, and navigate complex interpersonal relationships. Stakeholders stressed that these skills are necessary for students to thrive in diverse, multicultural, and remote work settings.

4.Entrepreneurship Skills: Branding, marketing, and product development are essential for students aspiring to start their own ventures or contribute to entrepreneurial initiatives within organizations. Stakeholders noted the need for students to understand the basics of entrepreneurship, from creating a marketable product to managing a business. Equipping students with entrepreneurial thinking will enable them to innovate and take on leadership roles in fast-evolving industries.

5.Problem-Solving Skills: Problem-solving involves the ability to think critically, analyse situations, and develop effective solutions. This skill is vital in almost every career and industry. The demand-supply gap analysis found that students need training in structured problem-solving approaches, which includes breaking down complex challenges and applying logical methods to resolve them. Stakeholders recommended practical case studies and scenarios as tools for developing this competence.

6.Financial Skills: Financial literacy, understanding pricing, and providing commercial services are key aspects of financial skills that stakeholders identified as crucial for students' success. Many students lack the ability to manage budgets, interpret financial statements, or understand market pricing strategies. By learning these skills, students can make informed financial decisions, whether managing their own finances or contributing to the financial health of a business.

7.Career Development Skills: Knowing how to apply for jobs, freelance, and navigate job interviews are crucial career development skills. Stakeholders highlighted that students often lack practical knowledge on how to market themselves in the job market. Training in these areas ensures that students are prepared not only to secure employment but also to manage their career growth over time. Offering guidance on resume building, networking, and interview techniques can greatly enhance a student's employability.

32. https://www.hec.gov.pk/english/aboutus/pages/aboutus.aspx

3.2) Gaps in Qualifications

It appears there's a significant gap between the skills demanded by the tech industry and what educational institutions are currently providing. Much of this is already discussed in the section on quality issues already, here we discuss certain high-demand skills that were not found in the Levels 4-7 qualifications being offered by universities or TVET institutes, these include.

Most of these courses are considered as important by any experts our primary research, are highlighted in the demand we identified, and are also listed in existing other reports under high demand skills.

- Frontend Development with React
- Backend Development with Node.js & MongoDB
- Web Development with WordPress & PhP
- Cross Platform Mobile App Development with Flutter
- AWS and Azure cloud platforms
- Business Automation with Python & RPA Tools
- Automated Testing and Quality Assurance for Software (Manual + Automated)
- SalesForce Administration

Course design processes (HE and TVET)

The primary entities responsible for shaping course design within Pakistan's higher education system include the Higher Education Commission (HEC), whereas in the Technical and Vocational Education and Training (TVET) institutes NAVTTC is responsible. Each of these stakeholders plays a distinct role in ensuring the quality and relevance of academic programmes, particularly in the rapidly evolving field of technology.

The curriculum revision process of **HEC** is divided into two phases. The first phase focuses on the assessment and analysis of the existing curriculum. It involves forming a National Curriculum Revision Committee (NCRC) composed of experts from various universities and organizations. This committee reviews the existing curriculum, considering aspects like learning outcomes, course content, teaching strategies, and evaluation methods. The committee then drafts a revised curriculum based on their analysis and discussions. The second phase involves circulating the draft curriculum for feedback and finalization. The draft is shared with local and international experts, universities, and relevant organizations to gather diverse perspectives and suggestions.

The NCRC then reconvenes to discuss the received feedback and finalize the curriculum. After obtaining approval from the competent authority, the revised curriculum is then shared with universities and institutions for implementation. This meticulous process ensures that the curriculum remains current, relevant, and meets the evolving needs of the education sector.[49]

For **TVET,** the course designing process in Pakistan involves a systematic approach to ensure courses are relevant to industry needs. The process begins with the formation of a Qualification Development Committee (QDC), comprising representatives from TEVTA, industry experts, and academics. The QDC works in stages, with the first stage focused on developing Occupation Profiling Charts (OP Charts) and Competency Standards. In the second stage, the committee creates Assessment Packs and the curriculum itself. The third stage sees the development of Teaching and Learning Materials (TLM). Finally, the National Qualification Accreditation Committee (NQAC), with representation from all TEVTAs and boards, validates the qualification, ensuring its quality and industry relevance. This multi-step process ensures that TVET courses are aligned with market demands and equip students with the skills needed for employment.[50]

But these organizations only provide the high-level guideline, the responsibility for ensuring the relevance and responsiveness of academic programmes to the evolving needs of the tech industry is distributed across various stakeholders. The Higher Education Commission (HEC) sets the foundation by providing curriculum outlines that align with global standards. These outlines, developed by the National Computing Education Accreditation Council (NCEAC), serve as a blueprint for computing courses offered by universities across the country. The HEC conducts a comprehensive review of these outlines every three years to ensure their continued relevance.

While the HEC provides the framework, universities bear the responsibility for implementation and regular curriculum updates. Some institutions, like IMSciences, have taken a proactive approach by **establishing annual review meetings and boards that include industry experts and alumni.** This collaborative approach ensures that curriculum revisions are informed by real-world industry needs and trends. However, not all universities demonstrate curriculum modernization. Some institutions have outdated curricula, with updates lagging six years or more behind industry standards, highlighting inconsistencies in how universities adapt to the dynamic tech landscape.

49.https://www.hec.gov.pk/english/services/universities/cr/Pages/default.aspx#:~:text=The%20first%20draft%20prepared%20is,institutions%20and%20organization%20soliciting%20their
50.Primary data sources with NAVTTC personnel

At the faculty level, individual professors play a crucial role in keeping course content up-to-date and relevant. However, while there are mechanisms such as students feedback, peer reviews, HEC visits, in regions we are interest in, current system lacks a robust check-and-balance mechanism to ensure that course content remains aligned with industry needs. This **lack of oversight** leads to outdated teaching materials and a disconnect between academic learning and practical application. Additionally, the emphasis on research and academic publications within the higher education system can sometimes overshadow the importance of practical, industry-relevant training, further widening the skills gap.

Technical and Vocational Education and Training (TVET) institutes play a vital role in bridging the skills gap by providing industry-specific training programmes. While organizations like GIZ and NAVTCC have implemented changes to modernize TVET programmes, such as the revised DIT curriculum that requires trainers to deliver the course in a condensed six-month timeframe, a comprehensive assessment of these programmes' effectiveness in meeting industry demands is crucial. Understanding the processes, identifying existing gaps, and ensuring that TVET graduates possess the skills required by the industry are essential steps in maximizing the impact of these programmes.

Accreditation (domestic and international)

Current Situation

The current situation of universities in Pakistan is characterized by a reliance on accreditation solely from the Higher Education Commission (HEC) of Pakistan and National Vocational & Technical Training Commission (NAVTTC).

HEC's process of recognizing an institute involves a thorough evaluation by a government body or an authorized agency. This evaluation aims to ensure that the institute meets predetermined standards and requirements. The assessment typically encompasses various aspects, including the institute's infrastructure, faculty qualifications, curriculum, financial stability, and adherence to legal and regulatory norms. Upon successfully meeting these criteria, the institute is granted recognition, signifying its legitimacy and authorizing it to operate legally and offer recognized qualifications.[51]

51 https://www.hec.gov.pk/english/services/universities/Documents/887_HEC2_Criteria_of_university_institutions.pdf

The accreditation process of NAVTTC is a comprehensive evaluation system used to assess the quality of TVET institutes in Pakistan. This process focuses on various aspects like governance, finances, faculty qualifications, infrastructure, teaching methods, and industry connections. Institutes are thoroughly checked against a defined set of criteria to ensure they meet the required standards. Based on their performance, they are awarded an institutional accreditation valid for five years or a programme accreditation valid for three years[52] .

There is currently no system in place for special international accreditation.

_certification needs within the Pakistani higher education system to ensure alignment with international standards.

Certifications Needs & Recommendations

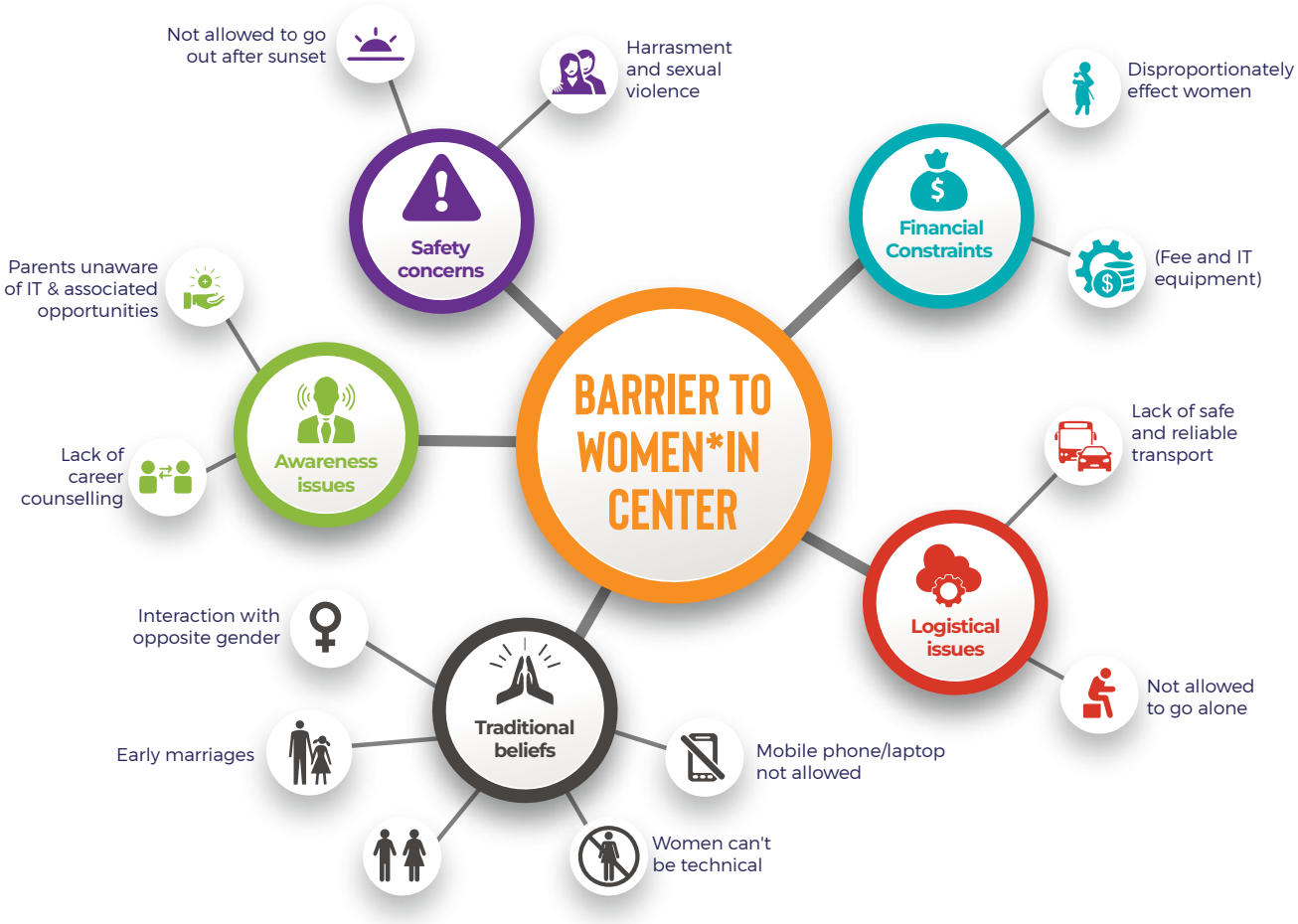
The research indicates that while local industries in Pakistan prioritize skills over certifications, certifications are particularly important for international positions and freelance work. Certifications play a critical role in the global ICT industry. In a rapidly evolving sector where new technologies and tools are introduced frequently, certifications provide a way for professionals to demonstrate their up-to-date knowledge and specialized skills. Considering this, our **recommendations section** includes few courses, that must be taught in accordance with the certification needs, these include;

Recommended certifications
META Front -end Developer
W3Schools Certified React Developer:
OpenJS Node.js Application Developer (JSNAD)
MongoDB Associate Developer
AWS Certified Cloud Practitioner Certification
Microsoft Certified: Azure Fundamentals
Microsoft Certified: Power BI Data Analyst Associate
ISTQB Certified Tester Foundation Level
Salesforce Certified Administrator
CISSP - Certified Information Systems Security Professional

52 NAVTTC accreditation manual

3.3) Barriers to Women in Tech

This section delves into the obstacles women encounter in accessing education and joining the workforce in our target regions of KP, GB and Balochistan. Numerous barriers hinder women, returnees, and individuals with disabilities from acquiring tech skills, pursuing entrepreneurship, and securing employment. Primary data analysis for each target region—KPK, Balochistan, and GB—reveals overarching barriers: **cultural, geographical, and affordability constraints.** Additional hurdles include limited awareness, inadequate education quality, and safety concerns. This section will elaborate on the major overarching barriers, while the infographic below outlines the specific barriers identified during our primary qualitative research.



To explain these gaps further, we have divided these into three categories, the first being cultural barriers, this includes traditional beliefs, awareness issues and safety concerns. The second category is logistical issues, and the third category is financial constraints, discussed separately for each region below.

a. Cultural Gaps

The primary data shows many cultural gaps among masses that translates into women not being able to get education or contribute to workforce.

Firstly, the issue of **awareness** among women and their family members regarding the tech field, including its market and scope, has been repeatedly raised. This lack of awareness is particularly prevalent in the KPK and Balochistan regions, compared to GB, which appears to have a more progressive outlook on education and the importance of the tech field.

The second type of issue identified in this area is the concept of **associating fields with gender.** The stakeholders express how linguistics and medicine are associated with women, while engineering and tech are generally associated with men.

Another reason that seems obvious from the data is that many females in the target region face additional pressures: they are not allowed to study in **co-education,** they are not allowed to work with the **opposite gender,** and they are **pressured to marry** early and focus on their family life.

The table below presents insights directly from women residing in these regions—KPK, Balochistan, and GB. These verbatim accounts, drawn from interviews with students and recent graduates, shed light on the multifaceted issues they face.

Balochistan		
Cultural barriers	**Limited Awareness**	**Safety Concerns**
"In our community, girls are discouraged from going to school after a certain age. Parents don't believe in educating girls beyond basic schooling."	"Parents here don't understand the value of IT education for women. They push girls into traditional roles instead of supporting them in pursuing IT careers."	"Safety is a big issue for girls traveling to educational institutions. Parents don't allow them to attend if it's too far or unsafe."
"Many families in rural Balochistan don't allow their daughters to pursue careers like IT. It's seen as inappropriate for women."	"There's a general lack of awareness about IT jobs and their potential, especially for women. Parents and families don't see it as a viable career."	"There are safety concerns about girls commuting long distances, and this discourages many families from allowing their daughters to pursue IT education."
"Culturally, girls in Balochistan are expected to take up household responsibilities rather than studying or pursuing IT careers."	"Many people here believe that IT is not for women, so they don't encourage their daughters to pursue it."	"Parents fear for the safety of their daughters, especially when they have to travel far for education. This prevents them from attending IT institutes."
KPK		
Cultural Barriers	**Limited Awareness**	**Safety Concerns**
"In our community, we don't give importance to education but skills...We have the cultural barrier where people don't see IT as beneficial for women."	"Most families here don't realize how much potential IT has. They don't see it as a valid career for women."	Parents are concerned about the safety of their daughters when they have to travel for education. They fear harassment and don't allow them to go far."
"Many parents don't allow their daughters to attend universities due to cultural restrictions."	"There is a lack of career counseling for women in IT. Many girls don't even know what kind of job opportunities exist in this field."	"Safety is a huge issue, especially for girls traveling alone to educational institutions. This is why many families don't send their daughters to study."
"We have less female participation in IT because of cultural barriers."	"We need more awareness programmes to educate families about IT careers for women.	"There should be proper security arrangements in educational institutions to assure parents
"There are cultural norms that expect women to take up traditional roles rather than entering the IT sector."		
G.B		
Cultural Barriers	**Limited Awareness**	**Safety Concerns**
In Skardu, there is strong cultural pressure on girls to marry early. Parents don't see IT as a career for women."	"We don't have enough awareness programmes to educate people about IT careers, especially for girls. Parents don't see it as a valid option."	"Safety during travel is a major concern. Families don't let their daughters attend universities if it means traveling long distances."

b. Geographical Gaps

Geographic factors pose significant mobility challenges within the region. Balochistan's expansive size leads to considerable travel distances, while Gilgit-Baltistan faces limitations due to underdeveloped road infrastructure amid mountainous terrain. These geographic constraints disproportionately impact women and persons with disabilities, for whom long-distance travel for education or employment is often impractical. This is compounded by safety concerns, inadequate transportation options, and prevailing societal restrictions

“Women face mobility issues. This lack of mobility and infrastructure further discourages women from pursuing training and career advancement in the IT sector." - stakeholder – GB

A stark disparity exists between urban centres and remote areas. Major cities offer more educational resources, job opportunities, and infrastructure, while remote regions lag significantly. This disproportionately impacts women who

“In Baluchistan, there are few industries or software houses, and this creates a barrier, especially for females, in finding work in their chosen fields also there is only one women’s university that offers computer science and IT programmes." – University professor – Balochistan

“In GB, there wasn't much local industry for IT. Those who studied IT often had to move to another cities, which was not feasible for many females." – Stakeholder from GB

This report identifies multiple gender-based mobility issues. Women, in general, have limited means of transport. This is especially problematic in the target regions, where mobility options are even more limited. The following tables contains the focus group discussion responses related to this gap from the students and graduates from each region:

Region	Logistical Issues
Balochistan	"The only software house in the area is far from where most girls live, and there's no transportation available to get there."
	"Girls in Balochistan don't have access to transport, and they can't travel far to attend IT courses. This limits their opportunities."
	"Public transport is almost non-existent in many parts of Balochistan, which makes it impossible for girls to attend universities or IT institutes."
KPK	"Transportation is a big problem here. Many women can't travel long distances to reach universities because of poor public transport."
	"There are very few transport options for girls who want to study IT. They rely on male family members for transport, which limits their freedom."
	"Public transport is unsafe and unreliable, and many families don't allow their daughters to use it, which prevents them from attending IT courses." Source: Peshawar FGD
G.B	"The mountainous terrain makes it difficult for girls to reach universities. We don't have reliable transport, so many girls drop out."
	"Transportation is a huge problem in Gilgit-Baltistan. Girls have to travel far to attend IT classes, and many can't make the journey."
	"There are very few transport options for women here, which means many girls can't attend IT courses even if they want to."

c. Affordability Gaps

The cost of quality tech education, professional certifications, and specialized training programmes often proves prohibitive for women, especially those from disadvantaged backgrounds. Affording essential equipment like computers, software, and reliable internet access poses a significant challenge, particularly for women who may have less financial autonomy.

Additionally, there is a financial aspect: the fee structure at universities is quite high. For example, when considering education for both boys and girls, families often prefer to invest more in the education of male children and provide only basic education to females. For them, this is considered a luxury rather than a right. If resources are limited, there is a preference for investing in male education." – University professor from Balochistan

" The financial limitation of technology available can be a barrier. This is an issue for everyone, but specifically for women, because sometimes female expenses are not well understood by families" – University Professor in Islamabad

This section highlighted the significant barriers women face when trying to enter the tech industry. These barriers are deep rooted in societal norms and perceptions. Addressing these issues requires a multifaceted approach that includes education and awareness campaigns targeting both men and women.

One promising strategy to attract more women to the IT sector is emphasizing the flexibility it offers, particularly regarding remote work and home-based learning. This approach can directly address concerns about mobility, safety, and family obligations, which are particularly relevant for women in the regions studied. The awareness can be promoted using relevant slogans, such as, **Safety, Security, Success.**

The stakeholder consultative sessions also spark a debate about the effectiveness of women-only institutions. While some believe these institutions provide a supportive environment where women can thrive without facing gender bias, others argue that they might unintentionally reinforce segregation. A balanced approach might involve fostering inclusive learning environments within existing institutions while simultaneously offering specialized programmes tailored to address the specific needs and challenges women face.

“Women should work alongside men, so both can learn each other’s qualities”-Incubation centre representative – KPK

The report points out that cultural perceptions of women in tech vary geographically. While some areas have a more progressive outlook, others remain deeply traditional. This difference highlights the need for tailored interventions that consider the specific cultural context of each region. For example, awareness campaigns might need to be framed differently in regions where the acceptance of women in tech is lower.

The following table presents insights directly from students in KPK, Balochistan, and GB, highlighting the affordability related challenges they encounter in their educational and professional journeys. These verbatim accounts provide a raw and unfiltered perspective on the financial obstacles hindering their progress.

Balochistan	
Limited Access to quality education	**Financial Constraints**
"There are very few IT institutions in Balochistan, and most of them are located in Quetta, far from rural areas where most girls live."	"Girls from lower-income families can't afford IT education. The fees for courses and the cost of equipment are too high for most people."
"Many girls can't access IT education because there are no specialized courses available in their areas. They don't have the resources to move to cities like Quetta."	"Many girls want to study IT but can't because they don't have the financial resources to pay for the courses or the necessary equipment."
"The quality of IT education here is very poor. Even those who attend classes don't learn much because there aren't enough qualified teachers."	"There are very few scholarships available, and many girls drop out because they can't afford to continue their education."
KPK	
Limited Access to quality education/Infrastructure	**Financial Constraints**
"Girls here can't access IT education because there are very few institutions offering these courses, especially for women."	Many students here can't afford the fees for IT courses. Even those who want to study further can't continue due to financial difficulties."
"The limited number of educational institutions in KP makes it very hard for women to get IT education, especially in rural areas."	"Laptops, internet access, and other resources needed for IT courses are too expensive for most families in this region."
"We lack qualified teachers in our area to teach advanced IT courses. Many girls drop out	"Scholarships are limited, and many deserving girls can't pursue IT education because they
G.B	
Limited Access to quality education/Infrastructure	**Financial Constraints**
We don't have proper IT institutions here in Skardu. Girls have to travel far to get IT education, and many can't afford to."	"Many girls can't afford the resources needed for IT education. Laptops and internet access are too expensive for most families."
"There are no advanced IT courses in our region. Girls who want to pursue higher studies in IT have to move to other cities."	"Even if girls want to pursue IT, they can't continue because their families can't afford the equipment or the fees."
"The lack of quality educational facilities is a big issue in Gilgit-Baltistan	"Scholarships are very limited, and many deserving students can't get access to the financial help they need to pursue IT courses."

3.4) Industry-Academia Linkage Gaps

a. Overview

A general consensus emerges that a significant gap exists between industry and academia. One primary concern is that academic courses are often misaligned with current industry needs, leading to graduates being ill-prepared for the modern workplace. This issue is further exacerbated by limited interaction between educators and industry professionals, hindering the timely updating of course curricula. While academia expresses disappointment over the lack of industry support for collaborative initiatives, industry engagement with academia often remains restricted to superficial activities like job fairs and open houses. This transactional approach fails to address the crucial need for collaborative curriculum development and a deeper understanding of evolving technological landscapes.

Although some efforts are being made to bridge this divide, such as increased collaboration with industries and the emergence of MOUs created jointly by industry and academia, stakeholders' express dissatisfaction with the progress. These efforts can be divided into three types of collaborations, Direct linkage with academia, Indirect linkage with academia and Indirect linkage with Academia staff, the table below briefly outlines what the type of these linkages are, and which of the target regions that are currently following it:

	Linkage Type	Linkage Detail	Region		
			KPK	GB	Balochistan
1	Direct Industry-Academia Linkages	Formal agreements (MOUs) between companies and universities for internships and hiring graduates.	ü		ü
2	Indirect Linkages	Informal collaborations like seminars, joint placement drives, and internships without formal MOUs.	ü	ü	
3	/Direct Linkages with Faculty/Staff	Unofficial relationships with professors for hiring interns, reviewing projects, and sharing selection criteria.	ü		

i. Direct Industry academia linkages

Primary data suggests some companies currently have direct linkages with academia, such as, Arbisoft and NayaTel, have established MOUs with universities. Arbisoft has agreements with around 20 universities, including NUST and NUML, for internship programmes. NayaTel has signed MOUs with several universities in Peshawar, including UET Peshawar, UET Mardan, IM Sciences, and City University Peshawar, for hiring graduates in engineering, finance, HR, and marketing.

ii. Indirect Linkage

Primary data suggests that some industries and universities maintain indirect linkages, collaborating on activities without formal Memorandums of Understanding (MOUs). For instance, the University of Baltistan has hosted numerous IT-focused seminars and speeches featuring professionals from private companies. Additionally, a few private companies have established connections with universities to conduct joint placement drives or recruit interns, indicating a less formal but still active collaboration between these sectors.

iii. Direct Linkages with Faculty/staff

Some industries have unofficial relationships with university professors and placement officers to exchange information and collaborate on certain tasks, such as hiring interns or reviewing final-year projects. These collaborations often involve discussing top students and their suitability for specific roles within the company. The company might request recommendations from professors and subsequently share their own reports with universities, highlighting their selection criteria for new graduates. This collaborative approach helps institutes connect with potential candidates and streamline the hiring process.

B. Government Support to Industry (Sponsorship, Tax Relief)

This section outlines the government's role in fostering a robust tech industry, starting with the Apprenticeship Act. This updated act expands apprenticeship opportunities across various sectors. The Act widens the definition of "employer" to include diverse employment structures, accommodating modern workplaces. Additionally, "designated trade" now encompasses any trade, occupation, or field within sectors like engineering, technology, and management, promoting a wider range of apprenticeship opportunities. The previous requirement for employers to have a minimum of 50 workers to participate is removed, enabling smaller companies to engage in apprenticeship programmes. The Act also recognizes and incorporates informal apprenticeships, acknowledging diverse learning pathways. Finally, the Act clarifies the exclusion of apprentices from the "Worker Definition," providing legal clarity.

Secondly, the primary data reveals that PSEB runs a co-opting programme. The PSEB has initiated a co-opting programme in collaboration with PASHA to connect Pakistani students with the local tech industry. from this programme, 500+ companies registered with Pasha are provided access to a portal for a pool of potential interns. The programme's objective is to bridge the gap between academia and industry by offering graduates opportunities to gain practical experience and enhance their employability. While the portal's full implementation will require some time, it demonstrates a commitment to supporting graduates as they transition into the workforce.

Moreover, MOITT and PSEB, in collaboration with Pasha, are planning to scale up the TechLift programme. This programme aims to identify skill gaps in the Pakistani IT sector and design training modules tailored to meet industry demands. By creating industry-led training models and implementing them throughout Pakistan, the programme seeks to ensure that graduates are well-equipped for the job market. To achieve international recognition and standardization, the programme will also allocate international curriculum and certifications. With a budget of 4 billion PKR, the programme aims to train 20,000 students, bolstering Pakistan's IT sector and fostering its growth on a global scale.[53]

On international level, The Digital Cooperation Organization (DCO) is an international organization comprised of seven member states: Pakistan, Saudi Arabia, Bahrain, Kuwait, Nigeria, Oman, and Jordan. The DCO aims to facilitate the growth of the digital economy among its member states. One of its key initiatives is the creation of a digital passport, which will streamline the process for businesses in one member state to expand their operations to another. This initiative will be particularly beneficial for Pakistani IT companies looking to tap into the Saudi Arabian market. The DCO is also collaborating with Pakistan on an initiative to create a new industry co-op programme that will be a part of the final semester of computer science degrees at universities. This programme will allow students to earn 6-9 credit units by working in the IT industry, giving them practical experience before they graduate. Additionally, the DCO is working to establish a Digital Foreign Direct Investment (FDI) event to attract investment in digital ventures within its member states.[54]

Similarly, **PSEB organizes industry meetups.** For instance, the Industry Academy meet-up in GB proved instrumental in integrating industry professionals into academic programmes. This event fostered dialogue between industry leaders, PSEB representatives, students, and local stakeholders.

53 https://www.pasha.org.pk/wp-content/uploads/2024-Budget-Recommendations-by-P@SHA.pdf
54 https://moitt.gov.pk/NewsDetail/MWJiNGI1NjItZTE0OS00MmUyLWIyMWQtMGJiN2NjZTlkODI5

The table below outlines the area of intervention, the impact, and the expected outcomes of the relevant interventions:

Sr no.	Initiative	Impact	Outcome
1	Apprenticeship Act Reforms	Broadened definition of "employer" and "designated trade" - Removal of minimum worker requirement for employers - Recognition of informal apprenticeships	Increased apprenticeship opportunities across various sectors, including smaller companies. - More inclusive apprenticeship programmes, accommodating diverse learning pathways and modern workplaces. **However, this act is not widely implemented currently in the target regions**
2	PSEB Co-opting Programme	Connects Pakistani students with the local tech industry. - Provides 500+ companies access to a portal of potential interns.	Bridges the gap between academia and industry. - Offers graduates practical experience and enhances their employability.
3	TechLift Programme Expansion	- Identifies and addresses skill gaps in the Pakistani IT sector. - Creates industry-led training models. - Allocates international curriculum and certifications.	- Ensures graduates are equipped with industry-relevant skills. - Strengthens Pakistan's IT sector and promotes its global growth.
4	DCO Initiatives	- Facilitates the growth of the digital economy among member states. - Creates a digital passport for streamlined business expansion. - Plans a Digital FDI event.	- Easier expansion for Pakistani IT companies into new markets like Saudi Arabia. - Increased investment in digital ventures within DCO member states.
5	PSEB Industry Meetups (e.g., GB Meetup)	Integrates industry professionals into academic programmes. - Fosters dialogue between industry and academia.	Have been really fruitful whenever it happened, however, the frequency is inconsistent.

C. Summary

To summarize the challenges and proposed solutions for bridging the industry-academia linkage gap, it's essential to provide a cohesive and well-structured narrative.

Effective mechanisms for bridging the industry-academia linkage gap involve a multi-pronged approach.

1. **Engaging alumni in a structured manner** can provide invaluable support. This can include initiatives like inviting alumni for guest lectures, establishing mentorship programmes for students with alumni, involving alumni in curriculum review boards, and encouraging alumni to offer internship opportunities within their companies. Universities should actively foster these interactions by creating dedicated alumni networks and platforms.
2. Furthermore, **establishing technology parks and co-working spaces within universities/institutes** can cultivate a vibrant ecosystem where students, faculty, and industry professionals can collaborate on real-world projects. These spaces can serve as hubs for startup incubators, hackathons, and workshops, providing students with hands-on experience and exposure to current industry trends.
3. While **job fairs** offer a valuable platform for connecting potential employers with graduates, their effectiveness can be significantly enhanced by implementing strict **hiring KPIs.** Universities should work closely with participating companies to establish clear hiring targets and meticulously track the number of jobs offers extended and accepted. This data-driven approach will ensure that job fairs translate into tangible employment outcomes for graduates.
4. Finally, the recently reformed **Apprenticeship Act** provides a robust legal framework for expanding apprenticeship opportunities across various sectors. Universities should actively promote and facilitate apprenticeships by connecting students with registered companies and integrating apprenticeship modules into their curricula. This practical experience will significantly enhance graduates' employability and bridge the gap between theoretical knowledge and real-world industry application. By implementing these strategies, educational institutions and industry partners can work together to nurture a new generation of skilled and work-ready graduates.

3.5) Master Trainers', Trainers and Assessors availability & quality gaps

a. Current situation

The current hiring mechanism for educators, while prioritizing academic qualifications, reveals a crucial gap between academic expertise and evolving industry needs.

Universities

In Universities, the existing system, heavily reliant on the Higher Education Commission (HEC) guidelines, emphasizes research output and academic degrees as primary criteria for hiring and promotion. For instance, securing a lecturer position mandates an MPhil degree, while assistant professors are required to possess a PhD. The climb up the academic ladder further necessitates a growing list of publications, with associate professors needing 10 and professors requiring 15, alongside significant experience. This research-centric approach, while crucial for advancing academic knowledge, often overshadows the importance of practical, industry-relevant expertise.

TVET

For TVET, a structured hiring mechanism ensures the recruitment of qualified professionals for various roles. For positions like General Manager, Deputy General Manager, and Manager, candidates must have a master's degree or equivalent professional qualifications and relevant experience ranging from 4 to 8 years. These roles also require computer literacy. For technical and commerce streams, positions such as Principal, Professor, and Associate Professor require specific qualifications like B.Sc. Engineering or M.Com/MBA, along with 8 to 10 years of experience and computer proficiency. Additionally, roles like Project Manager and District Manager demand similar educational qualifications and 4 years of relevant experience. The hiring process involves job advertisement, application screening, initial and panel interviews, assessment tests, final evaluations, job offers, and comprehensive onboarding programmes. This ensures the selection of competent individuals capable of contributing to the institution's goals. It's important to note that all these designations require "relevant experience" but does not specifically require "Industry experience", hence professionals with relevant degrees and variable kinds of experience may apply.

The hiring process itself involves a multi-step procedure, starting with degree verification to ensure candidates' credentials are from recognized institutions. This is followed by a general knowledge assessment to gauge overall knowledge, a written test for lecturer positions, a presentation to evaluate both presentation skills and subject expertise, and finally, an interview to assess the candidate's suitability for the role. However, this process often lacks a robust mechanism for evaluating candidates' practical skills and industry knowledge, particularly in rapidly evolving fields like technology.

This disconnect between academic qualifications and industry needs is further highlighted by the fact that teachers often express a lack of access to the latest technical know-how. The current system, with its emphasis on research and publications, often leaves educators with limited opportunities and incentives to stay abreast of the latest technological advancements and industry trends. This gap is further widened by the lack of involvement of industry professionals in the academic process. The absence of "professors of practice, i.e." seasoned industry experts who can bring real-world experience into the classroom, limits students' exposure to practical applications of theoretical concepts.

b. Need analysis for Trainers and Assessor

The need analysis reveals a critical need for reevaluating the training and assessment landscape for tech educators. While the current system prioritizes academic qualifications, it often overlooks the crucial aspect of competitive compensation. Trainers and assessors often face inadequate pay scales, which can lead to a lack of motivation and impact the quality of instruction. This is further compounded by a tendency to prioritize quantity over quality, with a /focus on meeting targets and numbers rather than ensuring the delivery of high-quality training. Furthermore, there's a pressing need to address the skills gap within the teaching staff itself. Teachers need access to consistent re-skilling and upskilling opportunities to stay current with the latest technological advancements and evolving industry demands. The current reliance on theory-based teaching, while important for building a foundational understanding, often fails to equip students with the practical skills and hands-on experience highly sought after by the industry.

c. Proposed Strategy (with performance-based retention / progression, and skill upgradation)

To effectively equip educators with the necessary skills and knowledge to thrive in a rapidly evolving technological landscape, a robust and forward-looking strategy is essential. This proposed strategy centres on.

1.Performance-based retention and skill upgradation, ensuring that educators remain motivated and equipped to deliver high-quality instruction.

2.A key aspect of this strategy involves **harnessing the power of online learning platforms.** This can include curating high-quality online sessions conducted by industry experts, providing educators with flexible and accessible avenues for upskilling. To ensure effective engagement and knowledge absorption, these online sessions can be further enhanced by incorporating moderators who can facilitate discussions, answer questions, and guide participants through the learning material. Furthermore, to bridge the gap between academia and industry,

3. **Establishing a system for "Professors of Practice" is crucial.** This involves inviting seasoned industry professionals to share their practical experiences and insights with students, providing them with real-world context and preparing them for the demands of the job market. Another option could be to ensure that current teachers are adequately prepared for their teaching roles, a dedicated programme can be implemented where they undergo a 3-month immersion within the industry before commencing their teaching engagements.

3.6) Acceleration/Incubation gaps

a. Current situation and opportunities

In recent years, the growth of incubation centres in Pakistan has gained momentum, particularly through government and private sector initiatives aimed at fostering entrepreneurship and innovation. In KP, GB, and Balochistan, incubation centres are gradually establishing a foothold, though they remain less developed compared to other parts of the country.

National Incubation Centres (NICs)

- **NIC Peshawar** (KP) has been instrumental in supporting startups in areas such as agritech, fintech, and e-commerce. The centre has successfully incubated several startups, creating job opportunities and contributing to the local economy. However, challenges such as a lack of consistent funding and limited industry connections hinder the growth of startups.
- **NIC Quetta (Balochistan)** is a relatively new initiative but plays a vital role in promoting entrepreneurship in the province. The centre focuses on regional issues, such as agriculture and livestock, which are critical to Balochistan's economy. While it has sparked interest among aspiring entrepreneurs, there is still a need for more widespread awareness and support to scale its impact.

Unfortunately, **GB** is yet to have its own National Incubation Centre, but there is growing interest and demand for such a facility to nurture local talent, especially in sectors such as tourism and renewable energy.

Private Incubation Centres

The presence of private incubation centres in these regions is more limited, though a few centres have emerged in KP and Balochistan, offering additional support to startups:

In **KP,** several private incubation centres, such as Durshal (a KP IT Board initiative), provide coworking spaces, training, and networking opportunities. Durshal operates across multiple districts in KP and serves as a hub for young entrepreneurs. Other private initiatives are emerging, though on a smaller scale. Moreover, a new incubation centre in Peshawar which has just started is Arifa Kareem Incubation Centre.

In **Balochistan**, private incubation efforts are still in their infancy, with only a few small-scale centres attempting to provide services. Collaboration between private investors and educational institutions is needed to accelerate the development of private incubation spaces.

GB has a small but growing entrepreneurial community. While there are no prominent private incubation centres in the region except for Hunza-hub, local universities and small community-driven efforts are stepping in to fill this gap, focusing on tech and tourism-related startups.

b. Issues and Challenges

Pakistan's startup ecosystem has experienced significant growth in recent years, driven by a young, tech-savvy population and increasing internet penetration. The country has witnessed a surge in venture capital funding, particularly in sectors like e-commerce, fintech, and logistics. However, the ecosystem faces challenges such as regulatory hurdles, macroeconomic instability, and a slowdown in funding due to global economic factors. Despite these challenges, government initiatives, a focus on sustainable business models, and the potential for regional expansion offer promising prospects for the future of Pakistan's startup landscape[55]

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These incubation centres offer a valuable platform for aspiring entrepreneurs to access resources, mentorship, and networking opportunities. However, many stakeholders believe that fresh graduates don't necessarily need immediate incubation and acceleration, this argument was further emphasized in a stakeholder meeting in attendance of major industry experts and academia experts. They argue that new graduates often lack the essential skills to run a business, even with strong technical abilities. Instead of sending graduates directly to incubation centres, these stakeholders suggest allowing them to gain some practical experience in their field first. This experience, they believe, will better equip graduates for the challenges of entrepreneurship and increase their chances of success.

However, if one was to implement incubation and acceleration programmes for students, the current approach is not effective. Right from the beginning, within the Centre of Excellence (CoE), students should be given proper guidelines on entrepreneurship. They need to be equipped with a strong ethical framework and a thorough understanding of market conditions. All of this information needs to be provided to the student from the very start of the course, alongside the curriculum, to increase their chances of success.

c. Proposed Strategy

To foster a thriving startup ecosystem, secondary sources recommend Streamlining regulations and easing bureaucratic hurdles to facilitate easier startup registration, operation, and access to funding. Strengthening financial infrastructure and expanding access to capital is crucial, including promoting venture capital funds, encouraging angel investors, and creating alternative financing avenues tailored to startup needs. Government initiatives should focus on fostering innovation and digital literacy through targeted investments in education, skills development programmes, and technology incubators. Bridging the gender gap in the startup ecosystem is vital by encouraging female entrepreneurship through mentorship programmes, access to funding, and policy support. Finally, promoting collaboration between startups and established businesses can drive innovation and create a more robust ecosystem through mentorship programmes, joint ventures, and knowledge-sharing platforms[56] .

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For the purpose of this programme, we propose the following strategic measures:

1. **Integrating Business Ethics and Entrepreneurial Principles in courses offered in centres of excellence:** To enhance the effectiveness of incubation and acceleration programmes, students should receive comprehensive instruction in business ethics and entrepreneurial principles from the outset of their courses. Integrating these crucial aspects early in the curriculum, rather than at a later stage, can better equip students for entrepreneurial success. While some experts may advise against student incubation, providing structured guidance, ethical grounding, and a thorough understanding of market dynamics can significantly increase a student's likelihood of thriving in a business environment compared to the current approach.
2. **Fostering a Culture of Entrepreneurship:** In addition to teaching entrepreneurial skills and business ethics, students should be given opportunities to develop products and showcase them at exhibitions and similar events. This would help cultivate a culture of entrepreneurship among students, encouraging innovation and practical application of their skills.

3.7) Career counselling gaps

a. Current Situation

Currently, a significant gap exists in the career counseling landscape, in the TVET as well as higher education landscape. Students often lack direction, enrolling in programmes without a clear understanding of their career paths or future prospects. This is largely due to the absence of structured career counseling frameworks and dedicated departments. While some universities like IM Sciences in Peshawar have implemented initiatives like backward integration programmes, others rely heavily on teachers to provide ad-hoc career advice. Even when career counseling departments exist, their effectiveness is often limited by operational challenges and low student engagement. This lack of a structured system is particularly concerning in less developed universities where such services are largely unavailable.

The consequences of inadequate career guidance are significant. Students remain unaware of industry trends, job market demands, and essential skills, leading to a mismatch between academic pursuits and real-world opportunities. Furthermore, a prevalent mindset prioritizing government jobs over private-sector options further limits career aspirations and discourages practical learning experiences.

There is lack of carrer consueling for girls in Baluchistan, leading them to choose traditional career paths instead of exploring opportunities int he IT sector
Incubation Centre Representative

b. Proposed Strategy

The proposed strategy to mitigate this gap and empower students involves implementing career counselling models during their education.

1.Students should be assigned projects on career related themes like "Mapping the Job Market" of their relevant fields. This will enable them to research the scope and current state of their chosen fields.

2. Similarly, career counseling for parents is equally crucial. Many parents in the target regions lack vision and still favour traditional fields like engineering and medicine, often associating specific genders with these fields. To empower women in the tech industry, parents need to be educated on the scope of IT in both local and global markets.

We must focus on raising awareness among parents, not just students. Parents need to be involved as support when children can't make their own course decisions." – Incubation Center Representative

3. Utilization of Globally recognized tools/frameworks; For example, Career construction theory, proposed by Mark Savickas in 2005, is a modern approach to career counseling that focuses on constructing and evolving careers through personal experiences and social interactions. It emphasizes vocational personality (career-related traits), career adaptability (psychological resources for managing transitions), and life theme (personal motivations). Through structured interviews and collaborative processes, individuals can deconstruct and reconstruct their career narratives to develop actionable career plans.

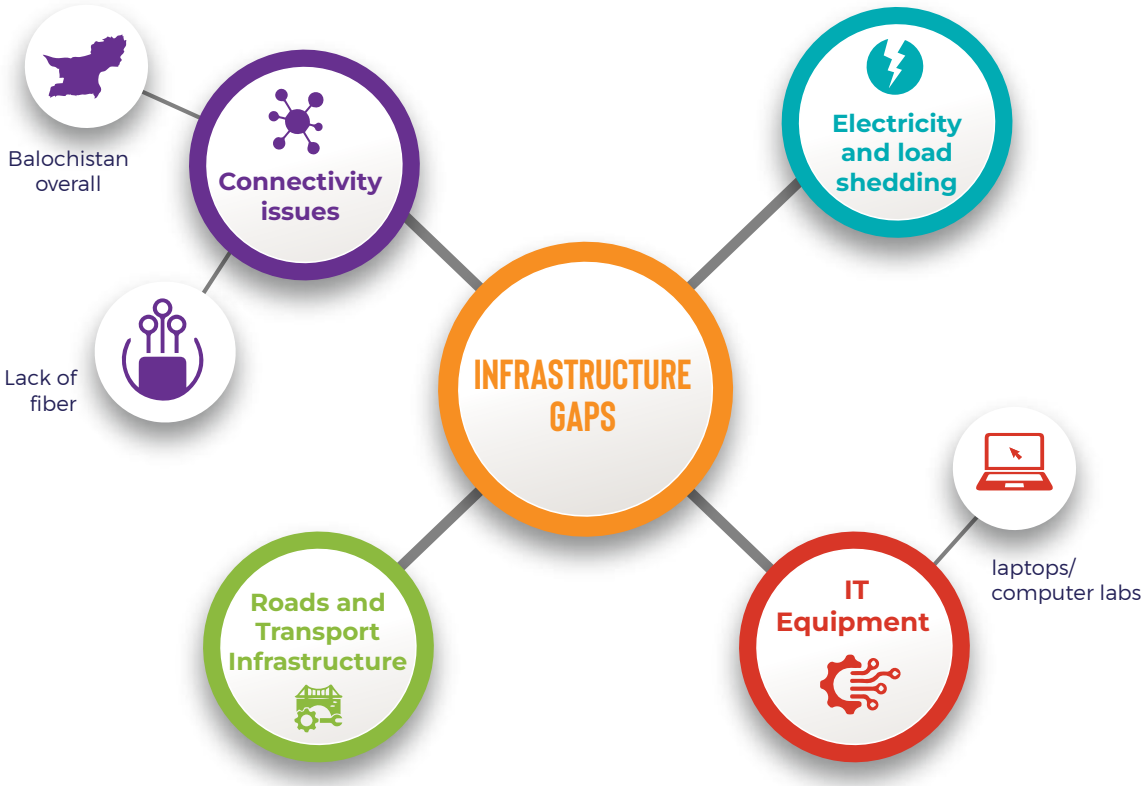
4. Utilization of Online tools: A cornerstone of effective career counselling is the use of various assessment tools, particularly psychometric assessments, such as, personality tests, Interest Inventories, aptitude tests, and Values and Skills Assessments. Mentioned below are the different types of assessments available that are commonly used.

Sr no.	Type of assessment	Tool	Description
1	Personality Tests	Myers-Briggs Type Indicator (MBTI)	Based on Carl Jung's theory, categorizes individuals into one of 16 personality types.
2		Big Five Personality Test	Measures five broad domains of personality to understand traits and their influence on career satisfaction.
3	Interest Inventories	Strong Interest Inventory (SII)	Measures interests in occupations, academic subjects, and leisure activities, suggesting aligned career options.
4		Holland Code (RIASEC)	Assesses based on six personality types to help find careers fitting the dominant personality types.
5	Aptitude Tests	General Aptitude Test Battery (GATB)	Evaluates natural abilities in specific areas, offering career guidance based on skill set.
6		Cognitive Ability Tests	Assesses reasoning abilities to provide insights into suitable career paths.
7	Values and Skills Assessments	Values In Action (VIA) Survey	Assesses individual values and virtues to align career choices with core beliefs.
8		Clifton Strengths (formerly StrengthsFinder)	Identifies top strengths across 34 themes to leverage in professional settings.

3.8) Infrastructure gaps

a. Current Situation

This section explores the existing infrastructure gaps that hinder the growth and accessibility of the tech sector in the target regions. While one might argue that this section should have been listed first among the gaps, it has been placed last because these challenges are a given, and we must navigate them regardless. The infographic below summarizes these infrastructural gaps present in all three regions.



Currently, the lack of reliable infrastructure poses a significant challenge to the growth and accessibility of the tech sector. Limited internet connectivity, especially in remote areas of GB and Balochistan, hinders access to online learning platforms and remote work opportunities. For instance, many households in GB still lack fiber optic connections, severely limiting their participation in the digital economy. Furthermore, frequent electricity failures, as reported in both regions, disrupt online learning and impact productivity. The lack of reliable and safe transportation options for women in all regions, further exacerbates these challenges, limiting their access to education and employment opportunities. Lastly, universities and institutes in all three regions, especially those that are not present in the provincial capitals complain of lack of IT equipment available for their students.

b. Proposed Strategy

To address these infrastructure barriers and create a more inclusive tech ecosystem, a '**Hub and Spoke**' model is proposed for the centre of excellence. This model involves establishing central 'Hubs' equipped with high-speed internet, reliable electricity, and state-of-the-art technology. These hubs can serve as centres for training, collaboration, and resource sharing. 'Spokes' can then be established in more remote areas, connected to the central hubs through a combination of online and offline strategies. This approach leverages the power of online learning platforms to deliver high-quality training content to remote locations. Additionally, recording training sessions and making them available for self-paced learning can further enhance accessibility for individuals facing time and mobility constraints.

Section 4: Recommendations

To effectively address the gender skill gap in the IT and high-tech sectors within KPK, GB, and Balochistan, the stakeholders consulted gave the following recommendations, we have categorized these into eight key areas. These recommendations aim to guide the development of Centres of Excellence (COEs) that will be sustainable, relevant, and impactful.

1.Addressing Supply-Demand Gaps

In analysing the demand-supply gap, two distinct scenarios emerged: supply exceeding demand and demand exceeding supply. Understanding these dynamics allows for targeted interventions. Stakeholders recommended introducing skills that are high in demand and low in supply. Meanwhile critical monitoring is essential to avoid market saturation in any particular skill. Based on this analysis, the relevant section explains the recommended set of courses for immediate and later deployment.

- Focus on Quality instead of just meeting KPIs: Stakeholders strongly suggest that a development programme like this one should focus on quality of training needs rather than merely meeting numerical targets (e.g. training 2000 girls/year). This will ensure that graduates possess the skills needed in the industry.
- Emphasis on Soft Skills: Beyond technical proficiency, Stakeholders repeatedly highlighted that there is a critical need for soft skills, these are discussed in the detail in the relevant section above.

2. Addressing Gender-Related Barriers

- **Manage Cultural Sensitivities:** Stakeholders repeatedly emphasised that cultural sensitives do exist in our areas of interest, therefore the safety and security must be ensured for all female students. Therefore, they recommend that the IT and high-tech skills training programme should be branded as safe, secure, and success-oriented initiative for women, to overcome cultural barriers.
- **Address women's mobility issues:** Stakeholder emphasized that women in our society have severe mobility challenges. This issue must never be ignored.
- **Promote IT as a flexible field:** Stakeholders repeatedly highlighted that the potential for remote working, home-based learning, and earning opportunities in IT, should be marketed in a way that parents and students find it an attractive field for women.
- **Market IT as a Work-from-Home (WFH) Opportunity:** Position IT careers as viable options for women who prefer or need to work from home.
- **Leverage Local Trust Circles:** Collaborate with community leaders and influencers to build trust and promote the Centres of Excellence as safe and culturally supportive spaces for women.

3. Addressing Qualification Gaps

- Short-Term, Skill-Oriented Courses: Stakeholders emphasised that universities in Pakistan are inherently focused on strengthening core concepts and theoretical foundations, which results in a noticeable gap in the integration of practical technological skills within their curricula. This emphasis on foundational knowledge, though essential, often overlooks the rapidly evolving technological landscape that industries demand. This results in fresh graduates who frequently encounter significant skill limitations that hinder their employability in today's dynamic job market. in this scenario, the focus should be on offering short-term, practical courses that are directly aligned with industry needs. The duration of courses should however be not less than 6 months. Stakeholders also recommended competency-based models so that it should be set in the beginning what knowledge and skills would the student have once the course gets completed.
- Regular Curriculum Updates: Most of the universities in these provinces follow curriculum provided by HEC or its affiliated accreditation body for computing and technical programmes. The overall process of curriculum release from HEC to its adoption in a university is a tedious process and is not aligned with the continuously evolving technology needs. Stakeholders highlighted the need to ensure that the curriculum is updated, in this regard – stakeholders recommended formation of a board that consists of both Industrial and academic experts to regularly review and revise the curriculum at the institute level.
- Adopt a Pathways Approach: Some Stakeholders mentioned that we should establish multiple access pathways within the Centres of Excellence to accommodate learners at different educational and skill levels, ensuring that everyone has the opportunity to advance in IT and high-tech fields, regardless of their starting point.
- Qualification and Curriculum Alignment with Industry: Regularly update and align the curriculum with industry standards to ensure that students acquire industry-relevant skills and knowledge. This should include systematic monitoring and the involvement of alumni and industry experts in curriculum development.
- Upskilling and Re-skilling Courses: Implement upskilling and re-skilling programmes specifically for students in ICT. These courses should be designed to keep pace with technological advancements and industry requirements, ensuring that graduates remain competitive in the job market.
- Ensuring Employability Skills: Despite the presence of four-year BS and two-year MS programmes, as well as associate degrees, a significant gap remains due to the lack of employability and entrepreneurial skills among graduates. The Centres of Excellence (CoEs) must ensure that students acquire the necessary skills to be employable. The industry spectrum indicates a preference for skills over degrees. Therefore, we recommend offering short-term courses with pre and post-assessments to quickly develop skilled individuals. Experts suggest that these courses should not be shorter than six months and should cover both soft and technical skills.

4. Addressing Industry-Academia Linkage Gaps

- Define Partnerships on Shared Goals and Flexible Terms: Establish partnerships between academia and industry based on clearly defined shared goals, with flexible roles to achieve these objectives, rather than rigid terms that limit collaboration.
- Implement Apprenticeship Laws: Stakeholders emphasised on the availability of a relevant law that allows the mechanism of apprenticeships; however, its implementation is minimal or non-existent. Therefore, implementation of the updated apprenticeship law (2018) should be done to provide students with practical industry experience.
- Enhance Industry Advisory Boards: Stakeholders mentioned how the role of industry advisory boards in academic institutions can bring about the required change, in this regard, involving alumni has been identified as the most suitable idea.
- Job Fair KPIs: Stakeholders emphasized the Measurement of the success of job fairs by the number of actual hirings, ensuring that these events lead to tangible employment opportunities.

5. Addressing Master Trainer Availability & Quality Gaps

- Engage Professors of Practice: Multiple stakeholders emphasized that the most viable option to bridge the industry academia gap is to Involve industry professionals as professors of practice to bring real-world experience into the classroom.
- Reskill and Upskill Educators: However, in case professors of practice is practically unfeasible, provide opportunities for current university teachers to reskill or upskill, ensuring they are up to date with the latest industry trends and technologies.
- Adopt the Tech-Lift or similar Models: Stakeholders from the private sector appreciated an earlier model adopted by the Pakistan Software export board and Pakistan Software houses association, which is Tech-lift model – under this model industry professionals contribute to the education sector through short-term teaching assignments and in return they get to hire their trainees once the training gets completed. The research team also studied similar models such as the Mckinsey Generation programme, Skills future programmes Singapore, and the techbridge programme.
- Implement Hybrid AI-Based Training Modules: Some stakeholders, especially from the freelance background suggested that AI-driven hybrid training modules should be developed within academic programmes to enhance the learning experience, which is being practiced now in many parts of the world. This means that international courses can be adapted through a moderator and AI based assessments etc.
- Engage Industrial Trainers and Provide Industrial Exposures: To further enhance the quality of master trainers, it is recommended to engage industrial trainers and provide students with industrial exposures. This will ensure that both educators and students have a practical understanding of industry requirements and trends, which will improve the overall learning and teaching quality.

6. Addressing Career Counselling Gaps

- Establish Dedicated Career Counselling Units: Set up specific career counselling units within each institution, equipped with clear KPIs and strong industry linkages to effectively guide students towards relevant career opportunities.
- Parents Career Counselling: Provide multiple levels of career counselling for students as well as parents, guiding them through career options in IT and high-tech fields.
- Career options' mapping Courses: Introduce courses/assignments that map the job market, and other career paths, helping students understand where opportunities lie and how to prepare for them. Stakeholders mentioned that this could be given as a project to students as well and discussions can be generated in classrooms on the job market/career options.

7. Ensuring Sustainability

- Financial Modelling for COEs: Stakeholders strongly emphasized on developing a workable financial model for COEs to ensure long-term sustainability and self-reliance even after 4-year completion of funding tenure.
- Empower Local Economies: Stakeholders emphasized that while imparting IT and high-tech skills, local ecosystem must be strengthened, this could be done in multiple ways such as student-investor equity models on industry projects or aligning final year projects with local industry demands. In this regard, Fisheries, livestock, agriculture, and tourism can be the key target sectors in our regions of interest.
- Learning and Earning Opportunities: Establish co-working spaces and software technology parks within institutes to foster a culture of continuous skill enhancement and entrepreneurship.
- Maintain Graduate Databases: Track and support students' post-graduation to ensure they successfully transition into the workforce.
- Sustainable Model for COE: Propose a sustainable model for COEs that includes the formation of a Board of Governors comprising 50% participants from the industry and alumni. This board can play a crucial role in aligning educational programmes with industry needs. Additionally, incorporating IT product development services and offering Initial Public Offerings (IPO) shares to students can generate revenue and ensure the COE's financial sustainability.

Key Gaps Identified That Need to Be Addressed by a COE

Based on the key gaps identified in the stakeholder consultative sessions and the recommendations they provided (which are discussed in detail in the previous section), the following section contains essentials that must be in our centre of excellence in order to make it truly a centre of excellence.

1. Infrastructure

- Basic Infrastructure: The COE must ensure reliable internet connectivity, provide laptops, and have an electricity backup as a minimum requirement.

2. Supply-Demand Gaps

- Responsive Mechanism: The COE should proactively respond to changing market demands through partnerships that provide insights into future needs. The COE should continuously monitor and offer high-demand skills, rather than locking in predictions for the next five years. This report recommends some courses that can be offered at a later stage; however, we recommend yearly monitoring to check latest relevance of the supply-demand gaps
- Soft Skills Training: Programmes should include dedicated hours for soft-skills training, with at-least 20% of the time spent in teaching/training on soft skills, as emphasized by stakeholders.
- Freelance and job search training: In addition to technical and soft skills, the COE should train students on securing freelance, remote jobs, and entrepreneurship opportunities, ensuring they are truly market ready.

3. Promoting Inclusivity and Overcoming Barriers for Women, PWDs, and Minorities

We suggest two models that can be implemented for a COE—one exclusively for women and another co-educational. Both have their pros and cons, The female-only COE can address cultural restrictions, while the co-ed COE prepares women for a mixed-gender job market. However, the Female-Only COE should have classes in morning sessions only, avoiding post-sunset timings. Furthermore, in addition to suggesting these two models, we propose the following aspects in a bid to increase inclusivity in a COE.

- Accessible Location: The COE should be situated in an easily accessible location.
- Transport Facilities: Provision of transport facilities for women is essential.
- Security and Harassment Policies: Implement of strict security and surveillance programmes, alongside well-publicized policies against harassment, and promote diversity and inclusion.
- Daycare Centre: A daycare centre should be available to support women with children.

- Inclusive Infrastructure: Ensure wheelchair access and other facilities that make the COE accessible for persons with disabilities (PWDs).
- Self-Paced Learning (for special cases): Offer a self-paced learning model via digital libraries, allowing women who miss classes due to domestic responsibilities to catch up.
- Need-Based Scholarships: Provide scholarships for female students based on need.
- Inspirational Leadership: Appoint a female CEO or Head of the COE to serve as a role model.
- Engage Women-Led Businesses: Interact with women-led businesses that require digitization, offering relevant services and support.

4. Addressing Qualification Gaps

- Programme Length: Our review of current qualifications has revealed that the majority of in-demand skills are already being theoretically covered in universities. However, these programmes tend to focus heavily on theory, lacking the practical, skill-based training that is essential for meeting industry demands. To address this gap, we recommend the introduction of specialized courses ranging from 6 to 8 months in duration. A six-month period is typically sufficient to equip learners with the necessary hands-on skills for many disciplines, while some courses, depending on complexity and industry requirements, may benefit from a longer duration. These extended courses would provide deeper, more comprehensive training to ensure that students are fully prepared to enter the workforce with both theoretical knowledge and practical expertise. This approach will bridge the gap between academic learning and the demands of the job market, making graduates more competitive and better equipped for real-world challenges.
- Competency-Based Certification: Courses should follow a competency-based model, ensuring that graduates have documented evidence of their knowledge and skills. In this regard, International Competency based models tailored to the local context and delivered in local languages may be adopted. Course content should be approved by a multi-stakeholder board before delivery and re-evaluated post-implementation against student assessments.

5. Addressing Industry-Academia Linkage Gaps

- Multi-Stakeholder Board: Instead of a board that has academicians only, we recommend establishing a multi-stakeholder board to approve curricula, content, and assess progress.
- Mandatory Industry Engagement: Industry engagement should be a starting point, this Include but not limited to mandatory internships, industry projects, monthly guest speakers, and job fair participation with hiring MoUs.
- Learning & Earning at the same venue: The COE should ideally have its own Software Technology Park or a software house, or at-least co-working space to support IT skills. For specific skills where these facilities are not beneficial, placement opportunities must be introduced for students nearby.

- Structured Role of Industry/Employer in Annual Curriculum Review/Feedback Mechanism: Incorporate a structured role for industry and employers in the annual curriculum review process to ensure that the programme remains aligned with industry needs and trends.

6.Addressing Master Trainer Availability & Quality Gaps

- Professors of Practice: Engage private sector professionals to teach, providing them with incentives to hire graduates from these programmes. Establish upfront MoUs with organizations, companies and industry associations to ensure a pipeline for employment.
- Pre-selection Assessment of master trainers: Implement preselection assessments for trainers, evaluating both subject knowledge and pedagogy skills.

7. Addressing Career Counselling Gaps

- Awareness Sessions especially for parents: Conduct awareness sessions for both students and parents, emphasizing the opportunities in IT, as many parents are unaware of its potential.
- Pre-Admission Counselling: Ensure pre-admission career counselling to determine if students are genuinely interested in IT; those who are not should be guided to more suitable fields.
- Orientation Programmes: Provide thorough orientation for both students and parents, assuring them of the safety, security, and success of their enrolment.
- Job Market Mapping Project: Introduce a job market mapping exercise as a mandatory project or credit hour requirement, encouraging students to identify and assess market opportunities independently.
- Zero Semester/Pre-COE Bootcamp: Offer a zero semester or pre-COE bootcamp to address foundational skill gaps.

8. Ensuring Sustainability

- Integration with Local Economy: Integrate COE projects with the local economy, this may include a potential placement requirement in the same region for at least one year to counter the trend of graduates relocating to major cities such as Karachi, Lahore & Islamabad.
- Post-Graduation Support: Maintain contact with graduates and provide coaching and mentoring to support their career progression. Their data should not be missed.
- Sustainable Model for COE: There should be a sustainable model for COEs that includes the formation of a Board of Governors comprising 50% participants from the industry and alumni. This board can play a crucial role in aligning educational programmes with industry needs. Additionally, incorporating IT product development services and offering Initial Public Offerings (IPO) shares to students can generate revenue and ensure the COE's financial sustainability. Lastly, Industry must invest in the course deployment by providing trainers, and in return – they should get the opportunity to hire the graduates.

Recommended Courses to address the supply demand gaps

Based on the detailed supply and demand gap analysis we conducted, we identified several skills that are entirely absent from the current supply, as well as skills that, while present in university or TVET curricula, suffer from gaps in relevance or quality. To address these shortcomings, we adopted a systematic approach (as detailed below) to evaluate both the market needs and the educational gaps. This process allowed us to develop a comprehensive list of courses that must be offered at our Centre of Excellence. These courses are designed to bridge the gap between theoretical knowledge and practical, industry-relevant skills, ensuring that students are fully equipped to meet the demands of the evolving job market.

Methodology for Course Recommendation

1.Comprehensive Analysis and Data Collection: To ensure the alignment of our course offerings with industry demands, we undertook a thorough analysis incorporating diverse inputs. Central to this process was an extensive stakeholder's primary research that gathered valuable insights on the skills required in industry. We also utilized existing reports, which contained input from the industry regarding the digital and high-tech skills required by the software and ITeS industry. These skills were categorized into three primary segments:

- Freelancing Demand
- Local Market Demand
- Global Market Demand

2. Identification and Categorization of Relevant Skills: Building on the primary research data, we systematically identified and compiled a list of skills essential for each category. This structured approach enabled us to discern the specific competencies that are in high demand across different market segments

3. Course Selection Aligned with Identified Skills: Based on the curated skills list, we proceeded to identify a suite of courses designed to effectively teach and enhance these competencies. Each course was mapped to its corresponding skill set, ensuring that the curriculum directly addresses the needs highlighted by the primary research.

4. Domain-Specific Course Mapping: To further enhance the relevance and applicability of our courses, we categorized the identified courses into specific domains. This classification facilitated a focused approach in course development, allowing us to address distinct areas of expertise required by the industry.

5. Expert Consultation and Validation: For expert validation, we organized a meeting with industry & academia specialists. During this, each proposed course was reviewed in detail to assess its alignment with the identified skills and domains. The experts provided critical feedback, ensuring that the courses not only meet current industry standards but are also best suitable for the career growth of potential students belonging to the three regions (KP, GB and Balochistan).

6. Prioritization of Course Offerings: The collaborative efforts with experts culminated in a prioritized list of course recommendations, segmented into three distinct categories:

- Immediate Deployment: Courses deemed essential to meet current market demands and provide immediate value to learners.
- Future Deployment: Courses identified for introduction in the near future, addressing emerging skills and anticipated industry needs.
- Stakeholder Recommendations: Additional courses suggested by stakeholders that, while valuable, do not currently align with immediate or near future market requirements but hold potential for long term consideration.

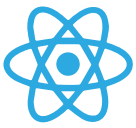
Based on the above structured and consultative approach, we are recommending a list of courses that must be offered in a centre of excellence in order to ensure that our course offerings are strategically aligned with industry needs, providing learners with relevant and market-driven skills.

S#	Course Name	Course Domain	Recommendation
1	Frontend Development with React	Web Application Development	Immediate Deployment
2	Backend Development with Node.js & MongoDB	Web Application Development	Immediate Deployment
3	Web Development with PhP & WordPress	Web Application Development	Immediate Deployment
4	Cross Platform Mobile App Development with Flutter	Mobile Application Development	Immediate Deployment
5	Cloud Computing Essentials (AWS)	Cloud Computing	Immediate Deployment
6	Cloud Computing Essentials (Azure)	Cloud Computing	Immediate Deployment
7	AI & Data Science with Python	Artificial Intelligence	Immediate Deployment
8	Data Analytics with Power BI and Tableau	Artificial Intelligence	Immediate Deployment
9	Business Automation with Python & RPA Tools	Artificial Intelligence	Immediate Deployment

10	Testing and Quality Assurance for Software (Manual + Automated)	Software Testing	Immediate Deployment
11	Salesforce Admin (SalesForce Admin Certification)	ERP Management	Immediate Deployment
12	Cybersecurity Fundamentals	Cyber Security	Immediate Deployment
13	Game Development with Unity/Unreal Engine	Game Development	Immediate Deployment
14	UI/UX Design Fundamentals (Figma, Adobe XD)	Software Development & Supporting	Immediate Deployment
15	2D/3D Design & Animation	Miscellaneous	Immediate Deployment
16	Professional Video Editing & Motion Graphics	Miscellaneous	Immediate Deployment
17	Small Business Accounting	Miscellaneous	Immediate Deployment
18	E-Commerce Store Management	Miscellaneous	Immediate Deployment
19	Development with Java Spring Boot	Web Application Development	Future Deployment
20	Development with C# / ASP (.NET)	Web Application Development	Future Deployment
21	Backend Development with Python	Web Application Development	Future Deployment
22	Kotlin for Android Development	Mobile Application Development	Future Deployment
23	iOS Development (Objective-C & Swift)	Mobile Application Development	Future Deployment
24	DevOps Tools & Automation	Cloud Computing	Future Deployment
25	Cloud Security Best Practices	Cloud Computing	Future Deployment
26	Artificial Intelligence for Business Solutions	Cloud Computing	Future Deployment
27	Advanced Cloud Technology (Docker, Kubernetes, Redis, ElasticSearch)	Cloud Computing	Future Deployment
28	Blockchain Development for Beginners	Blockchain Development	Future Deployment
29	Internet of Things (IoT) with Raspberry Pi	Robotics & IoT	Future Deployment
30	Robotics Engineering with ROS	Robotics & IoT	Future Deployment
31	Financial Data Analytics	Financial Data Analytics	Additional Recommended by Stakeholders

32	Modern Data Engineering with Cloud and Big Data Tools	Modern Data Engineering	Additional Recommended by Stakeholders
33	Enterprise Resource Planning with Microsoft Dynamics 365	Enterprise Resource Planning	Additional Recommended by Stakeholders
34	Introduction to SAP ERP, Odoo	Enterprise Resource Planning	Additional Recommended by Stakeholders
35	AR/VR Development	AR/VR Development	Additional Recommended by Stakeholders
36	Digital Marketing & SEO Services	Digital Marketing	Additional Recommended by Stakeholders
37	Digital Content Creation & Copywriting	Digital Content Creation	Additional Recommended by Stakeholders
38	Quantum Computing Essentials	Quantum Computing	Additional Recommended by Stakeholders

Below, we detail each of the above-mentioned courses along with their associated certifications where applicable.

Recommended for Immediate Deployment				
Domain: Web Application Development				
1		**Frontend Development with React** Explore front-end development using modern frameworks like React, Vue, and Angular to create dynamic user interfaces and manage state effectively.	Relevant certifications: META Front-end Developer, https://www.coursera.org/professional-certificates/meta-front-end-developer#courses W3Schools Certified React Developer: https://www.w3schools.com/react/react_exam.asp	Meta
2		**Backend Development with** Build and manage back-end services using Node.js and MongoDB, learning server-side programming, RESTful API development, and database integration.	Relevant certifications: OpenJS Node.js Application Developer (JSNAD) https://training.linuxfoundation.org/certification/jsnad/ MongoDB Associate Developer https://learn.mongodb.com/pages/mongodb-associate-developer-exam	 MongoDB.
3	 	**Web Development with** Develop custom WordPress themes and plugins while integrating e-commerce functionalities with WooCommerce, manage content management systems, enabling students to manage content-heavy websites. Development with PHP, Laravel framework, building web apps with MVC architecture, MySQL databases		

Domain: Mobile Application Development				
1	Flutter	**Cross Platform Mobile App Development with Flutter** Master hybrid mobile app development with Flutter framework, enabling students to create efficient, cross-platform mobile apps.		
Domain: Cloud Computing				
1	aws	**Cloud Computing Essentials (AWS)** Understand cloud infrastructure with AWS, Azure, and GCP, focusing on cloud service deployment, scaling, and security management. Cyber security for AWS	Relevant certifications: AWS Certified Cloud Practitioner Certification https://aws.amazon.com/certification/certified-cloud-practitioner/	aws certified Cloud Practitioner FOUNDATIONAL
2	Azure	**Cloud Computing Essentials ()** Understand cloud infrastructure with Azure focusing on cloud service deployment, scaling, and security management. Cyber security for Azure.	Relevant certifications: Microsoft Certified: Azure Fundamentals https://learn.microsoft.com/en-us/credentials/certifications/azure-fundamentals/?practice-assessment-type=certification	Microsoft CERTIFIED FUNDAMENTALS
Domain: Artificial Intelligence:				
1	tableau Power BI	**Data Analytics with Power BI and Tableau** Learn to visualize data and create business insights using Power BI and Tableau, mastering reporting and data-driven decision-making.	Relevant certifications: Microsoft Certified: Power BI Data Analyst Associate https://learn.microsoft.com/en-us/credentials/certifications/data-analyst-associate/	Microsoft CERTIFIED ASSOCIATE
2		**AI & Data science with Python** Explore generative AI with Python to build models for generating text, images, and media, focusing on deep learning and generative networks. Analyse and manipulate data using Python libraries like pandas and NumPy, focusing on statistical analysis and data visualization techniques. Include financial data analysis. Master financial modelling and analysis using Python, learning techniques for time series forecasting and financial decision-making.		

3		**Business Automation with Python & RPA Tools** Automate tasks using Python scripts for web scraping, task automation, and data manipulation, focusing on increasing efficiency in IT operations. Develop AI solutions for business automation, focusing on NLP, data-driven models, and AI-powered process optimization. Automating repetitive tasks with RPA tools like UiPath, Zapier, and Make, process optimization, and workflow automation.		
Domain: Software Testing				
6		**Testing and Quality Assurance for Software (Manual + Automated)** Learn software testing techniques, including Test-Driven Development (TDD) and automation tools like Selenium, for ensuring software quality.	Relevant certifications: ISTQB Certified Tester Foundation Level https://pstb.pk/certifications/Certified%20Tester%20Foundation%20Level%20v4	
Domain: ERP Management				
7		**Salesforce Admin (Salesforce Admin Certification)** Master Salesforce CRM development and automation, preparing students to manage customer relationships and enhance sales processes.	Relevant certifications: Salesforce Certified Administrator https://trailheadacademy.salesforce.com/classes/crt101-prepare-for-your-administrator-certification-exam	
Domain: Cyber Security				
8		**Cybersecurity Fundamentals** Learn the basics of network security, ethical hacking, and GDPR compliance to secure client systems and mitigate data breaches. Develop skills in penetration testing and vulnerability scanning, focusing on network defence and ethical hacking practices to protect systems.	Relevant certifications: CISSP - Certified Information Systems Security Professional https://www.isc2.org/certifications/cissp	
Domain: Game Development				

9	UNREAL ENGINE unity	**Game Development with Unity/Unreal Engine** Learn the art of 3D game development using industry-standard tools like Unity or Unreal Engine. This course covers game mechanics, scripting, and essential game design principles. Additionally, students will learn about hyper-casual game development and the process of publishing games, equipping them with the skills to launch their own games or work in the gaming industry.	Relevant certifications: Unity certified Developer https://unity.com/products/unity-certifications/associate-game-developer	CERTIFIED Associate
Domain: User Experience Design				
1	Xd	**UI/UX Design Fundamentals (Figma, Adobe XD)** Learn the fundamentals of user experience design, wireframing, and prototyping using tools like Figma and Adobe XD to create intuitive interfaces		
Domain: Miscellaneous				
1		**2D/3D Design & Animation** Learn 3D modeling, texturing, lighting, and animation using Blender, focusing on creating high-quality 3D designs and animations.		
2	Ae CapCut	**Professional Video Editing & Motion Graphics** Master advanced video editing, colour grading, and motion graphics using Adobe Premiere Pro, with options to explore tools like After Effects, DaVinci Resolve, and Final Cut Pro. Perfect for creating high-quality, professional video content across various platforms.		

3		**Small Business Accounting** Learn to manage small business finances using QuickBooks, Xero, and Zoho Books, offering bookkeeping, invoicing, and payroll services to clients.
4	E-COMMERCE	**E-Commerce Store Development & Management** Learn how to build, customize, and manage online stores using platforms like Shopify, WooCommerce, and Magento. This course covers everything from setting up a storefront, managing products and inventory, integrating payment gateways, to handling customer service and marketing strategies, equipping students with the skills to create and run successful e-commerce businesses.
Recommended for Future Deployment		
Domain: Web Application Development		
1	spring boot	**Development with Java** Build and manage back-end services using Node.js and MongoDB, learning server-side programmeming, RESTful API development, and database integration.
2	ASP.NET	**Development with & ASP (.NET)** Building enterprise web applications, MVC design patterns, API development, database integration

3		**Backend Development with Python** Learn to create robust web applications and APIs using Python frameworks such as Django and Flask, with a focus on backend development and system integration.
Domain: Mobile Application Development		
1		**Kotlin for Android Development** Learn Android app development using Kotlin, covering UI design, API integration, and publishing mobile applications on Google Play.
2		**OS Development (Objective-C & Swift)** Focus on iOS app development using native technologies like Swift and Objective-C, mastering Apple-specific development environments and best practices.
Domain: Cloud Computing		
1		**DevOps Tools & Automation** Learn to automate deployment processes using DevOps tools like Jenkins, Ansible, Terraform, and Azure DevOps, with a focus on CI/CD pipelines and infrastructure as code. Master cloud security, covering best practices for securing cloud environments, identity access management, and encryption techniques.

2		**Artificial Intelligence for Business Solutions** Learn to create AI solutions for optimizing business processes, focusing on machine learning, data automation, and AI integration in real-world applications.
3		**Advanced Cloud Technology (Docker, Kubernetes, Redis, ElasticSearch)** Gain hands-on experience in advanced cloud technologies such as Docker, Kubernetes, Redis, and ElasticSearch, focusing on containerization and cloud scalability
Domain: Block Chain Development		
1		**Blockchain Development for Beginners** Explore blockchain technology, learning to develop smart contracts, decentralized apps (dApps), and use Ethereum and Solidity for blockchain solutions. Learn Solidity programming to create smart contracts and decentralized applications on Ethereum, focusing on blockchain solutions.
Domain: Robotics & IoT		
1		**Internet of Things (IoT) with Raspberry Pi** Develop IoT solutions using Raspberry Pi, focusing on sensor networks, cloud integration, and hardware programming.
2		**Robotics Engineering with ROS** Learn to develop and simulate robotic systems using the Robot Operating System (ROS), focusing on robot kinematics and real-world simulation.

Recommended by Stakeholders		
1		**Financial Data Analytics** Master financial modeling and analysis using Python and Excel, learning techniques for time series forecasting and financial decision-making.
2		**Modern Data Engineering with Cloud and Big Data Tools** Learn to build scalable data pipelines and ETL processes using cloud-native tools like AWS Glue, Google Cloud Dataflow, and Apache Spark.
3	Microsoft Dynamics 365	**Enterprise Resource Planning with Microsoft Dynamics 365** Learn to manage enterprise resources, finance, and supply chain processes using Microsoft Dynamics 365, focusing on ERP solutions.
4	odoo SAP ERP	**Introduction to SAP ERP, Odoo** Master SAP ERP systems, focusing on business process optimization in modules like FI/CO, MM, and SD for enterprise-level management.
5	AR/VR	**AR/VR Development** Learn Augmented Reality (AR) and Virtual Reality (VR) development using Unity and ARKit/ARCore, focusing on 3D visualization and interaction design.

6		**Digital Marketing & SEO Services** Learn SEO, content marketing, and so cial media advertising strategies, focusing on optimizing online presence and driving business growth.
7		**Digital Content Creation & Copywriting** Learn to create compelling content for blogs, websites, and social media, focusing on content marketing and effective copywriting techniques.
8		**Quantum Computing Essentials** Introduction to quantum computing fundamentals, focusing on quantum algorithms and data-driven solutions.

Essential skills across Courses

Following is a list of essential skills that are to be taught in all courses. These skills were identified during the industry experts meeting and are considered to be of paramount importance considering the local demographics, state-of-the-practice and the nature of work that the students will be employed on after the completion of the courses.

- Ethics in Working: Ethical principles are crucial at every stage of project execution and delivery, from respecting client confidentiality to ensuring data privacy and fair business practices. Students should be taught skills to navigate ethical challenges while working on projects, managing sensitive data, and interacting with clients, ensuring they uphold integrity in all professional dealings.

- Product/Project Management, Issue/Task Tracking: Mastering tools like Jira for issue and task tracking is essential for projects. Tracking progress and ensuring collaboration across teams through tools is critical for smooth project execution. The courses should impart skills on working on these tools for task tracking and project management.
- Use of Code Repositories (GitHub, GitLab): Proficiency in using code repositories like GitHub and GitLab is essential for version control and collaboration on development projects. Technical courses should teach students how to manage codebases, track changes, and collaborate with teams on shared projects, ensuring smooth project execution.
- Sense of Entrepreneurship: Fostering an entrepreneurial mindset encourages students to innovate, take initiative, and explore new opportunities beyond conventional employment. Whether they want to go for a job, work as a freelancer, they should be taught cultivate self-reliance and a proactive attitude in identifying and seizing business opportunities. They should also be taught the pros and cons of freelancing for them to make informed career choices. They should understand the flexibility and freedom freelancing offers while weighing the challenges such as professional grooming, income variability, career progression options, and client acquisition challenges.
- Data Privacy: With increasing reliance on digital platforms, understanding data privacy laws (e.g., GDPR) and best practices for securing sensitive information is indispensable. It builds trust with clients and ensures compliance with global standards.
- Continuous Learning: The courses should highlight the tips and best practices for students to stay at pace with changing technological landscape. Each course should have a component of self-learning where the student is made to learn a new technology/tool/concept and apply it for solving a problem.
- Cross-Cultural Communication: As remote work and global teams become more common, the ability to communicate effectively across cultures is vital. Professionals need to navigate language barriers, cultural differences, and time zones while maintaining clear and respectful communication. Ensuring clear and respectful communication, handling client expectations, scheduling, conducting meetings, navigating language and cultural difference are key skills to be imparted in all courses.
- Problem Solving and Critical Thinking: Strong problem-solving and critical thinking skills are essential for tackling challenges in any field. The courses should teach the students to analyse issues, identify potential solutions, and execute them effectively—skills that are crucial for success in software development, business strategy, and client relations.
- Emotional Intelligence: Emotional intelligence, or the ability to manage one's own emotions and understand others', is critical for fostering productive relationships and resolving conflicts. This course should help students build emotional intelligence to enhance team dynamics and client interaction

Concept – Centre of Excellence

Below, the illustration details the concept of the centre of excellence based on key gaps identified in the current skills landscape in KP, GB, and Balochistan, as well as recommendations from key stakeholders. For illustrative purposes, the illustration showcases the management structure, followed by a proposed 12-month student journey, and concludes with essential features and facilities. To develop this model, Ipsos conducted over 50 consultative meetings with public, private, and academic stakeholders. Additionally, three workshops with dedicated sessions on master trainers, skills supply-demand gaps, and acceleration and incubation were held. National and international models, such as P@SHA's tech-lift programme, McKinsey's Generation Programme, Singapore's SkillsFuture programme, and the US-based TechBridge programme, were also studied.

For the concept of the Centre of Excellence (COE), we propose a three-part structure that encompasses pre-admission preparation, coursework phase, and comprehensive post-graduation support and the main structure recommendation.

Main structure of the COE

To effectively guide the Centre of Excellence (COE), the main structure of the CoE should have a diverse management team. Based on stakeholder recommendation, this team should be composed of professionals from various backgrounds, including academia, industry, and the public sector. Their combined expertise will provide a well-rounded approach to overseeing the COE's strategic direction. Furthermore, to inspire female students in the target regions and foster gender diversity, appointing a woman with a strong IT background to the position of CEO is highly recommended.

Phase 1: Pre-Admission

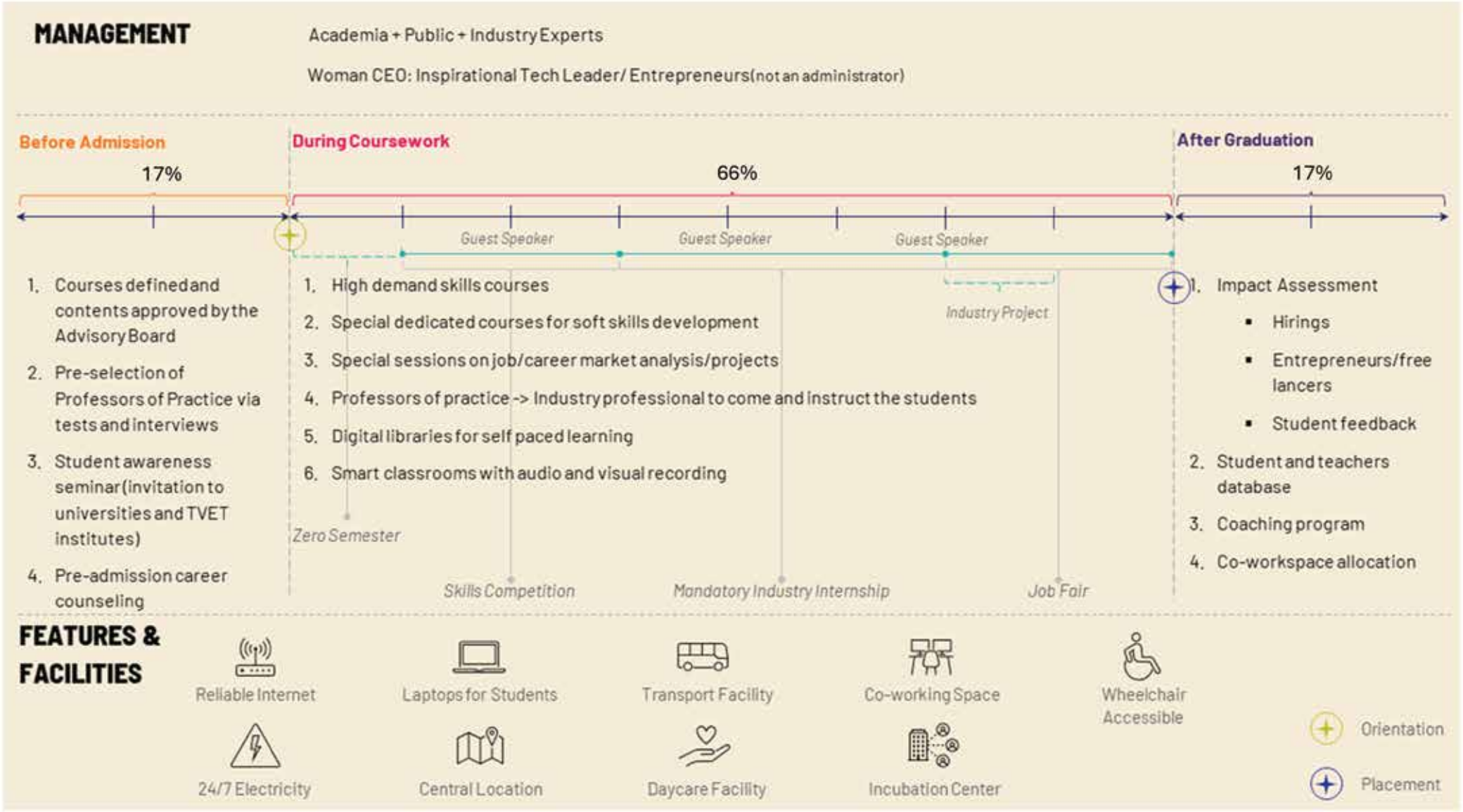
In the pre-admission phase, before admissions, all courses and their content should be approved by the advisory board. Additionally, trainers should be pre-selected, focusing on those with practical experience through a rigorous process that includes tests and interviews, these trainers should be professors of practice i.e. either they must be industry professionals, or teachers who must have some industry experience. To increase awareness, the COE should host a student awareness event and extend invitations to universities and TVET institutes within the province. Lastly, pre-admission career counselling should be done with all the selected students to help them choose the best course for them.

Phase 2: Coursework

The second part, the coursework phase, should ideally span six to eight months. We recommend a "zero semester" prior to the start of actual field work to help students gain practical experience. In addition to the deployment of above recommended courses, there should be a special focus on job and career development. To enhance their learning in this area, students should be assigned market analysis projects. Another suggestion for this phase is to invite industry professionals to the centre to conduct seminars, providing students with valuable insights. Thirdly, the centre should be equipped with facilities such as digital libraries and smart classrooms to create a modern learning environment. In addition to this, Occasional skills competitions could be organized to encourage a competitive learning environment. Industry projects should be made compulsory, and students should be required to complete a mandatory internship for a specific duration to earn credit hours towards graduation. Finally, job fairs should be organized to connect students with potential employers, facilitating their hiring out of the COE.

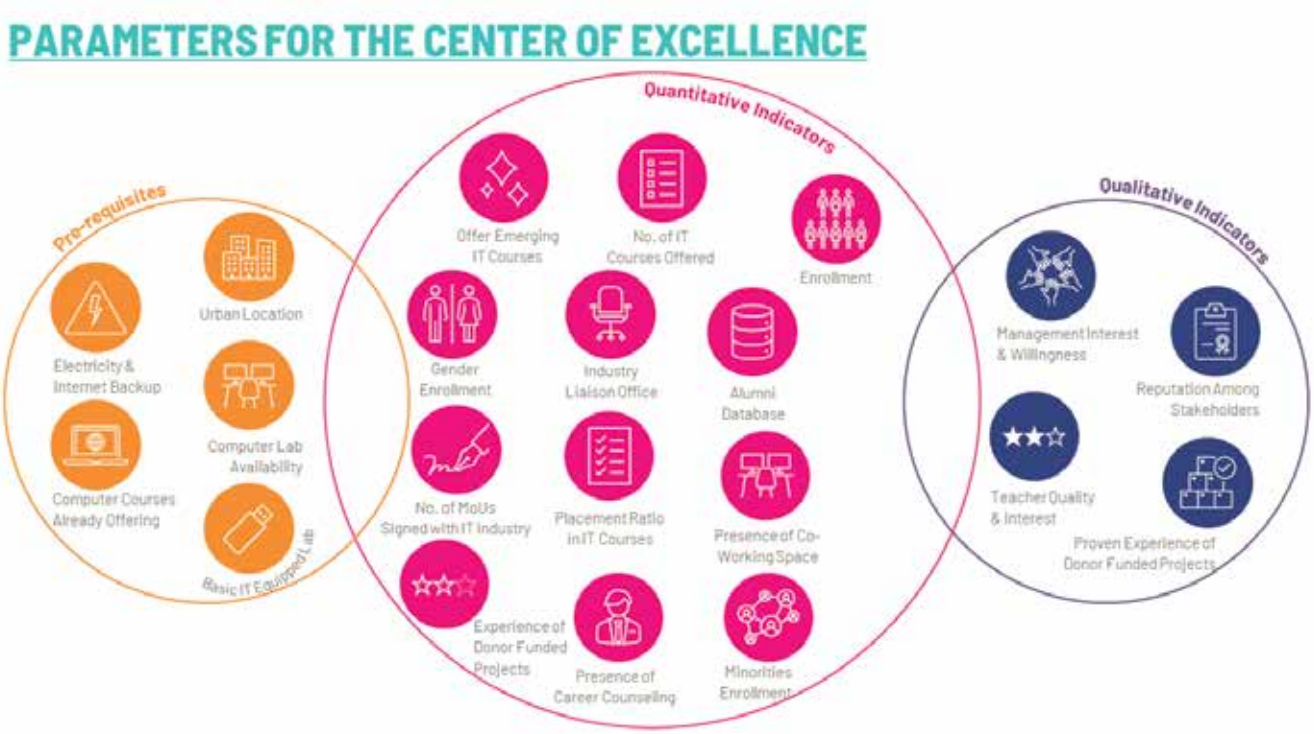
Phase 3: Post course completion

The third and final part of this concept focuses on the period after coursework completion, i.e., The third and final part of this concept focuses on the period after coursework completion. We recommend dedicating the two months after coursework to assessing the COE's performance. This assessment should consider factors such as the number of students hired directly from the COE, the performance of freelancers and self-employed individuals who are COE graduates, the number of COE graduates overall, and the feedback from students and teachers. This data should be collected and analysed. To ensure long-term sustainability and continuous improvement of the COE programme, a database of students and teachers should be maintained.


MANAGEMENT
Academia + Public + Industry Experts
Woman CEO: Inspirational Tech Leader/ Entrepreneurs(not an administrator)
Before Admission
17%
During Coursework
66%
After Graduation
17%
Guest Speaker
Guest Speaker
Guest Speaker
1. Courses defined and contents approved by the Advisory Board
2. Pre-selection of Professors of Practice via tests and interviews
3. Student awareness seminar (invitation to universities and TVET institutes)
4. Pre-admission career counseling
1. High demand skills courses
2. Special dedicated courses for soft skills development
3. Special sessions on job/career market analysis/projects
4. Professors of practice -> Industry professional to come and instruct the students
5. Digital libraries for self paced learning
6. Smart classrooms with audio and visual recording
Industry Project
1. Impact Assessment
Hirings
Entrepreneurs/free lancers
Student feedback
2. Student and teachers database
3. Coaching program
4. Co-workspace allocation
Zero Semester
Skills Competition
Mandatory Industry Internship
Job Fair
FEATURES & FACILITIES
Reliable Internet
Laptops for Students
Transport Facility
Co-working Space
Wheelchair Accessible
24/7 Electricity
Central Location
Daycare Facility
Incubation Center
Orientation
Placement

Proposed Selection Parameters

Initially, for selection of the centre of excellence, the proposed parameters for selection were proposed to include some pre-requisites i.e. essential conditions include an urban location with proximity to public transport, complete internet availability, electricity backup, existing computer courses, available computer labs, and basic IT equipment in classrooms. Some Quantitative Indicators such as the number of IT courses offered, the presence of emerging courses, overall and gender-specific enrolment figures, enrolment of persons with disabilities (PWDs) and minorities, the presence of an industry liaison office, an alumni database, the number of MOUs with the IT industry, placement ratio for IT courses, availability of career counselling facilities, presence of a co-working space, and past experience with donor-funded projects. As well as some qualitative indicators that focus on the institution's internal qualities and external reputation. These initial set of indicators are shown in the infographic below.



Based on these initial set of proposed indicators, a more detailed feasibility tool was developed having the following sections.

1.Pre-Requisites: This section outlines the initial requirements or criteria that must be met before considering the establishment of a Centre of Excellence. These included include infrastructure, partnerships, regulatory approvals, and other foundational elements essential for feasibility.

3. Feasibility Questions: This section included key questions that need to be addressed in determining the feasibility of setting up the centre. These questions covered aspects such as CBT&A already being offered or not, availability of a management committee, apprenticeship opportunities offered or not, RPL (recognition of prior learning) frameworks available or not, Incubation facilities available or not etc.
4. Other Indicators: This section contains additional metrics or factors that affect the decision-making process. These include having an industry liaison office, career counselling office, job portal, industry partnerships, availability of co-working spaces, and experience with donor funded projects.
5. TNA (Training Needs Analysis): This section focuses on identifying the specific training needs for faculty to offer the recommended courses.

Key actors in GB, KP and Balochistan

For establishing centre of excellence in GB, KP and Balochistan, following stakeholders need to be consulted and taken on board in their respective roles.

Actors/Stakeholders	Roles
National Level	
1. HEC	The Higher Education Commission (HEC) will play a pivotal role in ensuring that the academic standards and quality of education at the Centre of Excellence are aligned with national higher education policies. HEC will be responsible for overseeing the development and implementation of curricula that are relevant to the digital and high-tech industries. It will ensure that these programmes meet both national and international standards, facilitating the accreditation process for qualifications offered by the CoE.
2. Navttc	NAVTTC will be crucial in designing, validating, and approving vocational and technical training programmes that cater to the needs of the labour market, particularly in the digital and high-tech sectors. NAVTTC will develop competency-based curricula and occupational standards that ensure graduates are equipped with the skills required by employers. The commission will also ensure that these programmes are in line with the national vocational training frameworks, providing continuous quality assurance and supporting the CoE in maintaining high standards of training delivery. Additionally, NAVTTC will collaborate with industry stakeholders to keep the training programmes responsive to emerging trends and technologies.

3. Ministry of IT	The Ministry of IT will provide strategic direction and support in integrating advanced IT infrastructure within the CoE. It will assist in formulating strategies for digital transformation, innovation, and the incorporation of emerging technologies like artificial intelligence, cloud computing, and cybersecurity into the training programmes. The Ministry will also facilitate partnerships with technology providers, enabling the CoE to access state-of-the-art tools, software, and platforms necessary for delivering high-quality education. Furthermore, MoIT will help secure funding for technological advancements and infrastructure development, ensuring the CoE remains at the forefront of technological education.
4. PSEB	PSEB will focus on establishing robust industry linkages between the CoE and the software and IT sectors. It will play a key role in promoting the CoE's programmes to potential employers, both domestically and internationally, ensuring that the skills being developed are aligned with the needs of the industry. PSEB will facilitate internships, job placements, and apprenticeships, providing students with practical experience and direct pathways to employment. Additionally, PSEB will support the development of entrepreneurship programmes within the CoE, encouraging students to launch their own technology ventures, thus contributing to the growth of Pakistan's IT export industry.
5. P@SHA	P@SHA will serve as an industry advisory body to the CoE, providing valuable insights into market trends, skill requirements, and technological advancements. It will help ensure that the CoE's curriculum remains relevant and adaptive to the fast-evolving IT landscape. P@SHA will also facilitate collaboration between industry and academia by organizing seminars, workshops, and guest lectures, where industry professionals can share their knowledge with students. Moreover, P@SHA will assist in establishing mentorship programmes, where experienced industry leaders guide students in navigating their careers in the digital economy.
6. Pakistan Freelancers Association	PFA will play a crucial role in integrating freelancing and remote work modules into the CoE's training programmes. Recognizing the growth of the global gig economy, PFA will help design courses that equip students with the necessary skills to succeed as freelancers, including technical skills, business management, and client acquisition. The association will also provide access to platforms and networks that connect students with global freelancing opportunities, enabling them to start earning while they are still completing their education. Additionally, PFA will advocate for policies and initiatives that support freelancers, ensuring that graduates of the CoE have the resources and opportunities to thrive in the freelancing sector.

KP	
7. NAVTTC KP	NAVTTC KP will collaborate closely with the national NAVTTC to adapt vocational training programmes to the specific economic and industrial needs of Khyber Pakhtunkhwa. NAVTTC KP will also engage with local employers to ensure that the training programmes are aligned with the job market's needs, providing students with the skills necessary to secure employment within the province. Additionally, NAVTTC KP will monitor and evaluate the effectiveness of these programmes, making necessary adjustments to improve training outcomes and ensure the programmes' relevance.
8. KP TEVTA	KP TEVTA will be responsible for the operational management of vocational and technical education programmes at the CoE. This includes recruiting and training instructors, providing teaching materials, and maintaining training facilities. KP TEVTA will ensure that all programmes are delivered to a high standard, emphasizing practical, hands-on training that prepares students for the workforce. The authority will also work to expand the reach of these programmes, making them accessible to a broader population, including women and marginalized groups in KP. Additionally, KP TEVTA will collaborate with local industries to create employment pathways for graduates.
9. KP ITB	KP ITB will provide the enabling environment and technological infrastructure support necessary to support the CoE's IT-related programmes. KP ITB will also foster partnerships with local and international tech companies, creating opportunities for students to engage in real-world projects and gain exposure to the latest technological developments. Additionally, KP ITB will support the
	CoE in organizing tech events, hackathons, and competitions that promote innovation and entrepreneurship among students.
10. KP BTE	KP BTE will oversee the certification and accreditation of all technical and vocational programmes offered at the CoE. It will ensure that the qualifications provided meet both provincial and national standards, enhancing the employability of graduates. KP BTE will also participate in the continuous review and improvement of curricula to ensure that they remain relevant to industry needs. Furthermore, the board will work to establish the recognition of these qualifications in other regions and countries, thus enhancing the mobility and career prospects of CoE graduates.

GB	
11. IT dept GB	The programme should strive for blessings of the IT department in GB to have the necessary approvals to operate in GB.
12. NAVTTC GB	NAVTTC GB will focus on tailoring vocational and technical training programmes to the unique needs and opportunities within Gilgit-Baltistan. This includes developing training modules that are relevant to the local economy, such as tourism, IT services, and agriculture. NAVTTC GB will ensure that the CoE's programmes are accessible to the diverse population of the region, including women and youth from remote areas. Additionally, NAVTTC GB will engage with local employers to identify emerging job opportunities and adapt training programmes, accordingly, ensuring that students are equipped with the skills needed to succeed in the local job market.
13. KADO	KADO is Karakorum area development organisation which has been working for the past 25 years in Gilgit-Baltistan and Chitral. Although they have many thematic areas, but their primary focus is ICTD, which stands for Information and Communication Technology for Development. As KADO, they were the first to introduce the internet in Hunza District back in 2007, which was one of our many development projects
Balochistan	
14. BTEVTA	In Balochistan, we believe BTEVTA will be the most important actor, responsible for overseeing the implementation and management of vocational and technical training programmes at the CoE in Balochistan. It will ensure that these programmes are aligned with the province's economic development strategies, with a focus on key sectors such as mining, agriculture, and IT.
15. Ministry/Department of Education Balochistan	In addition to BTEVTA, we recommend taking the department of education (Balochistan) on board due to their high engagement with the current programme enabling the necessary support required to navigate the complex Balochistan landscape.

Annexure 1

1.Approach and Methodology

The research utilizes a mixed-methods approach, thorough desk research and qualitative primary data collection. This study is further divided into two phases, phase 1 and phase 2. This document contains the details to the approach conducted to execute phase 1.

This initial phase focused on gathering foundational knowledge about the IT, digital, and high-tech landscape and identifying key stakeholders. It involved two main activities: a thorough desk review of existing data and a stakeholder mapping exercise to guide subsequent data collection. The objective of this was to map the landscape of the IT industry in Pakistan, specifically in the target regions i.e., GB, KPK and Balochistan including demand, supply and identifying relevant stakeholders.

1.1 Desk Research

The project commenced with a comprehensive desk review to understand the demand side of the IT, digital, and high-tech sector. This involved analysing existing data from various sources including, HEC data bases (HEDR, NAHE, University wise enrolment, Pakistan Qualification Register), KP-TEVTA, B-TEVTA, NAVTTC, KPITB, KPTTB, GIZ, SkillingPakistan, NVQF, KPBTE, and online learning portals like Coursera, EDX, Udemy, LinkedIn certifications for the supply side of the picture. To cater to the demand; sources like, Pasha[575859606162], Report on Pakistan IT by PSEB/PWC, LinkedIn jobs report 2024[63], Skillsoft[64] were reviewed.

1.2 Stakeholder Mapping: To guide primary data collection, a stakeholder mapping activity was conducted. This identified key stakeholders across four categories:

- **Private Sector:** This stakeholder group had the private tech companies and IT associations.
- **Public Sector:** This stakeholders group involved representatives from some of the relevant authoritative government bodies representing both the supply and demand sides.

57 Skill Gap/Supply Deficiency
58 The Bar Chart with the demand in percentage
59 https://www.pasha.org.pk/publications/psha-diversity-inclusion-it-ites-landscape/
60 https://www.pasha.org.pk/publications/impact-assessment-report/
61 https://www.pasha.org.pk/publications/it-skills-survey-2023/
62 Skill Gap/Supply Deficiency
63 https://www.linkedin.com/pulse/linkedin-jobs-rise-2024-25-fastest-growing-roles-us-linkedin-news-dxmie/
64 Compensation for the Certifications

- **Incubation Centres/Freelancing Associations:** this group had representatives from two types of entities, private or public incubation centres and the freelancers' associations of Pakistan.
- **Academia:** This group had representatives from HEC and TVET institutes.
- **Students & Graduates:** this group included students and graduates of the higher education as well as the TVET institutes.
- Each stakeholder group was carefully composed to ensure representation from each group in each region.

1.3 Primary Data Collection

Building upon the foundational knowledge gained in the previous step, this phase focused on gathering firsthand insights from key stakeholders directly involved in or impacted by the IT, digital, and high-tech sector. This was achieved through in-depth interviews and focus group discussions.

1.3.1 Key Informant Interviews/In-depth Interviews (IDIs): IDIs were conducted with representatives from each stakeholder category identified during the mapping activity. Conducting IDIs was crucial to this study because it allowed for an in-depth understanding of individual perspectives and experiences related to the industry. IDIs facilitated the gathering of detailed and nuanced insights into why industries prioritize skills and how certifications play a role specifically at entry-level positions and in freelance work. The IDIs helped in understanding the gaps to skilling in IT & high-tech sector. One-on-one interviews allow stakeholders to express their opinions fully, which is generally not possible in a group setting due to interruptions and differing opinions.

1.3.2 Focus Group Discussions (FGDs): FGDs were conducted with students and graduates of IT programmes in KP, Balochistan, and G.B, both in higher education and TVET. These discussions provided insights into the student and graduate perspectives on the sector. the respondents of these discussion were either graduates of IT/ICT belonging to the target regions and the second target group were the students currently enrolled in institutes of the target regions, in the disciplines of IT/ICT/CS. FGDs were instrumental in gathering insights from both current IT students and graduates, allowing for a collective understanding of their perspectives on skills. These discussions provided a platform to explore their experiences, expectations, and the perceived value of certifications in their career paths. FGDs are more effective for students and graduates as they can build on each other's thoughts and elaborate on barriers more comprehensively

1.3.3 Consultative workshops: In addition to holding key informant interviews and focus group discussions, Ipsos team participated in the four consultative workshops organized by British council whereby relevant stakeholders from public, private, and academic sectors participated. The workshops had dedicated sessions on i) Master trainers' availability & quality, ii) skills supply-demand gaps, and iii) acceleration and incubation. Ipsos team took notes of the discussions in the workshops and sessions and analysed those active notes to consolidate and triangulate the findings from the FGDs and KIIs.

Stakeholders

Following stakeholders were consulted for informing the study. We're thankful for their contribution and insightful inputs.

Sr. No	Stakeholder Type	Entity
Federal		
1	Private	P@sha
2		S&P Global
3		Arbisoft
4		Corvit System
5		Smart Education Technology Solutions
6	Public/Development	PSEB
7		NAVTTC
8		HEC
9		GIZ
10	Incubation	Freelancers Association Pakistan
11		National Incubation Centre
12		Ignite
13	Academia	NUST
14		FJWU

KPK		
15	Private	Product Box
16		SMSAMI
17		SnP Global
18		Storm Fiber
19		Nayatel
20	Public	Khyber Pakhtunkhwa Information Technology Board
21		Ministry of Commerce, Industries and Technical Education
22		KPK Trade Testing Board
23	Incubation Centre	Arfa Karim Tech Incubator Peshawar
24	Academia	IMSciences
25		GIKI
26		Pak Austria Fachhochschule
27		University of Haripur
28		Shaheed Benazir B. Women University, Peshawar
29		University of Peshawar
30		Univers ity of Swabi
Balochistan		
31	Private	Next Generation Technologies
32		Ultrasoft
33		I Core Business Solutions
34		Al Falah
35		Women 's Chamber of Commerce
36	Public	NAVTCC Quetta
37		TEVTA Balochistan
38	Incubation Centre	NIC Quetta
39	Academ ia	BUITEMS
40		University of Balochistan
41		The Pearls Institute
42		Gawadar Institute of Technology
43		WTTC Tech Training Institute

Gilgit Baltistan		
44	Private	SheDevs
45		Techzoid Private Limited
46		Beeneural
47		Agha Khan Rural Support Programme
48	Public	Gilgit Baltistan Information Technolgoy Board
49		KADO
50	Incubation Centre	NIC Karakoram International University
51	Academia	Karakoram International University
52		the University of Baltistan, Skardu

Focus Group Discussions

KPK		
Group 1	Students	SBBWU + Agriculture University Peshawar
Group 2	Graduates	SBBWU + Agriculture University Peshawar
Group 3	Students	CECOS University + Chitral University
GB		
Group 1	Students	University of Baltistan
Group 2	Graduates	University of Baltistan
Group 3	Graduates	University of Karakoram
Baluchistan		
Group 1	Graduates	Enablers College of Technology
Group 2	Students	BUITEMS
Group 3	Students	Pearl Institute Quetta

Annexure-2 – Supply Data (TVET)

Prime Minister Youth Skill Development Programme

(Batch 1 for 2024)

Courses	No. of Trainees
3D Animation (Realistic rendering)	140
Advance Python Programming & Applications	985
Advance Web application Development	1011
Advanced CAD/CAM	119
Advanced programming / Coding (Ma chine Learning; Data Mining)	120
Amazon Virtual Assistant	3116
Android Java + Database	100
Artificial Intelligence (Machine Learning; Deep Learning; Communication)	352
Artificial Intelligence (Robotics)	220
Big Data Analytic Technique	220
Block Chain Programming	220
Certificate in IT (Web Development)	2945
Certified ScrumMaster (CSM)	20
Cloud Computing	224
Cloud Computing - AWS	892
Cloud Computing - Google	19
Cloud Computing - Microsoft	323
Computer Applications (Jaws Software)	40
Cyber Securi ty (CEH, CHFI)	756
Data Mining / Business Intelligence	160
Database Administration (DBA Track)	180
Digital Forensic & Cyber Security	449
Digital Marketing & Search Engine Optimization (SEO)	4362
Documentary & Film Making (Digital Broadcasting)	189
eC ommerce	3185
Full Stack Development	839
Game Development	209
Google UX Design	59
Graphic Design (Print Media)	1731
Graphic Design and Video Editing	1572
Graphic Designing (UI/UX Designer)	2227
Internet of Things (IoT) System Development & Applicatio ns	270
JavaScript Full stack (e.g. MEAN/MERN)	593
Microsoft .Net + Angular / React	160
Microsoft Certified Azure	60
Microsoft Dynamics 365	220
Mobile Application Development	543
Network Administrator (CISCO, HUAWEI, IBM)	479
Oracle Database SQL or P L/SQL	39
Oracle Java+ Angular	77
Power BI	260
Professional Photography, Documentary Ad Making	617
Python / Django + Angular / React	446
React Native	266
Salesforce Certified Administrator	97
Tableau	20
Unreal Engine Certification	20

Summer of Code Programme

Courses	Number
Advance Python Programming & Applications	345
Advance Web application Development	585
Advanced programming/ Coding (Machine Learning; Data Mining)	255
Android Java + Database	90
Artificial Intelligence (Machine Learning; Deep Learning; Communication)	150
Big Data Analytic Technique	60
Certificate in Oracle (ERP)	30
Certified ScrumMaster (CSM)	15
Cloud Computing	195
Cloud Computing – AWS	240
Cloud Computing - Microsoft	135
Cyber Security (CEH, CHFI)	495
Database Administration (DBA Track)	120
Digital Forensic & Cyber Security	300
Docker Certified Associate	45
Full Stack Development	510
Game Development	45
Google UX Design	255
JavaScript Full stack (e.g. MEAN/MERN)	240
Microsoft .Net + Angular / React	60
Microsoft Certified Azure	60
Microsoft Dynamics 365	30
Mobile Application Development	495
MySQL Certification	30
Power BI	75
Python / Django + Angular / React	90
React Native	15
Unity Certified Game Development	30

Annexure-3 – Supply/Demand Gap Numerical Data (TVET & HE)

Prime Minister Youth Skill Development Programme (Batch 1 for 2024)

Skills indicating shortage:

Skill	Supply	Demand	Shortage	% Shortage
DotNet	Low	1099	1099	100%
iOS Swift	Very low	1098	1098	100%
AR/VR Developer	Very low	1074	1074	100%
SAP	Very low/low	853	853	100%
ISTQB	Medium	831	831	100%
PHP	Medium	814	814	100%
Git Hub	Low	744	744	100%
Qlik	Very low/No supply	482	482	100%
Web Designing	33	746	713	96%
Docker	45	744	699	94%
C++	12	1827	1699	93%
Sensor Technology	52	700	648	93%
User Experience (UX) Designing	59	687	628	91%
Java	190	1876	1686	90%
Salesforce	97	881	784	89%
Azure	120	877	757	86%
Computer Security	141	767	626	82%
Quantum Computing	14	732	591	81%
Block Chain Development	220	1026	806	79%
Robotics	205	742	537	72%
Automation	310	919	609	66%
Microsoft Dynamic 365	250	694	444	64%
Game Development	284	721	437	61%
Scrum Master	35	87	52	60%
JavaScript	833	1970	1137	58%
2D/3D Art	274	595	321	54%
DevOps	15	24	9	38%
Angular	666	1057	391	37%
Data Visualization	656	791	135	17%

Skills indicating saturation:

Skill	Supply	Demand	Surplus	% Surplus
Graphic Design	1849	4	1845	100%
Mobile app development	6321	719	5602	89%
Cybersecurity	6998	1058	5940	85%
Data Analysis	5802	950	4852	84%
Virtual Assistance	3156	539	2617	83%
E commerce	4422	794	3628	82%
Cloud Computing (Azure/AWS)	6546	1302	5244	80%
Artificial Intelligence	6032	1249	4783	79%
Search Engine Optimization	4362	953	3409	78%
Python	8479	1973	6506	77%
UI/UX Design	2278	721	1566	68%
Digital Marketing	4362	1390	2972	68%
Software Testing	3199	1177	2022	63%
Machine Learning	1795	900	895	50%
React	1127	922	205	18%

Freelance Market

Skills indicating shortage

Skills	Total Supply	Freelance Demand	Shortage	% Shortage
Figma	Low supply	30598	30598	100.00%
PHP	Medium supply	19876	19876	100.00%
Generative AI	Low supply	5333	5333	100.00%
Zoho CRM	Low supply	3112	3112	100.00%
AR/VR Developer	Low supply	1901	1901	100.00%
Selenium	Low supply	1318	1318	100.00%
SAP	Medium supply	600	600	100.00%
Qlik	Low supply	197	197	100.00%
Git Hub	Low Supply	155	155	100.00%
Digital Twin	Low Supply	44	44	100.00%
Azure	120	177465	177345	99.90%
Automation	310	438067	437757	99.90%
DevOps	15	3342	3327	99.60%
Angular	666	81063	80397	99.20%
Tableau	20	1584	1564	98.70%
JavaScript	833	27830	26997	97.00%
Graphic Design	1849	43000	41151	95.70%
Salesforce	97	2222	2125	95.60%
React	1127	24247	23120	95.40%
Scrum Master	35	632	597	94.50%
Robotics	205	3263	3058	93.70%
Search Engine Optimization	4362	64409	60047	93.20%
Virtual Assistance	3156	37476	34320	91.60%
Game Development	284	3128	2844	90.90%
Block Chain Development	220	2285	2065	90.40%
Mobile app development	6321	62336	56015	89.90%
UI/UX Design	2287	21409	19122	89.30%
2D/3D Art	274	2062	1788	86.70%
Digital Marketing	4362	29122	24760	85.00%
Machine Learning	1795	6800	5005	73.60%
Data Visualization	656	2194	1538	70.10%
E commerce	4422	14694	10272	69.90%
Microsoft Dynamic 365	250	818	568	69.40%
Python	8479	11219	2740	24.40%

Skills indicating saturation:

Skills	Total Supply	Freelance	Surplus	% Surplus
Quantum Computing	141	33	108	327.3%
Deep Learning	1774	1600	174	10.9%
Computer Graphics	528	245	283	115.5%
Cybersecurity	6998	2862	4136	144.5%
Cloud Computing (AWS, Azure)	6546	1642	4904	298.7%
Software Engineering	9821	1645	8176	497.0%

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