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SWOT analysis of institutional framework for engineering diplomas in technical and vocational education and training system in Pakistan

Aziz Ahmed¹ and A H Khan²

¹Department of Economics, Baluchistan University of Information Technology Engineering and Management Sciences, Quetta, Pakistan
²Department of Economics, School of Economics, Quaid-i-Azam University, Islamabad, Pakistan

Email: barshore2006@yahoo.com

Abstract. The theoretical underpinnings of SWOT analysis for institutional framework of engineering diplomas is used to highlight its components of strength, weaknesses, opportunities, and threats. The technical and vocational education and training (TVET) system disseminates approximately 29 associate engineering diplomas in one, three, and four years of duration in Pakistan. Strength includes the establishment of provincial TEVTAs as apex TVET authorities, TVET system, technical education and vocational training in private and public sectors, trade testing boards, and signatory of ILO and UNESCO. Weaknesses capture TVET deficiency, administrative and legal issues, highly skewed technical education, inadequate number of technical colleges, traditional engineering technologies, trade quality compromises, and non-collaboration among TVET institutions and authorities. Opportunities lie in demand is driven market diplomas, local and international markets for earnings and employment, national skill policies, and economic fortunes of mega projects. The threats are present in low skill formation, technical skill deficiency for females and rural areas, international in-competitiveness in labor markets, Chinese skilled immigrants, expansion of TVET trades to modern and emerging fields, imbalanced technical education in TVET set-ups, and low socio-economic standards of common Pakistanis for the development of TVET system in Pakistan. Policy recommendations are devised to develop TVET system for human resource development in Pakistan.

Keywords. SWOT, TVET, associate engineering diploma, Pakistan

1. Introduction

Pakistan is one of the emerging countries on economic fronts. Its economic performance and new initiations of an economic venture like China-Pakistan Economic Corridor (CPEC) is a multitask project of US$ 60 plus billion. CPEC would probably open avenues of economic fortunes of economic prosperity for the mass population of 21 million Pakistani people to eradicate poverty, conventionality, terrorism, and unemployment in years to come. The skilled labor force of Pakistan is yet 6% skilled in technical and vocational trades that is not enough supply to meet the existing market demands and provide services to upcoming CPEC projects and its demand in Pakistan [1]. The technologically lower labor force of Pakistan may face less likelihood to win economically on competitive productivity and efficiency levels in most of the economic fortunes with the mention of human capital formation of 6%. The number of technical colleges and technical training centers is far less in numbers, enrollment capacity, pass outs, and human capital formation, as compared to general schooling in Pakistan [2, 3].

The comparative advantage with only 6% of technically skilled manpower may possess potential threats for the economy of Pakistan. It will result in lower rewards in trade, industry, services inflows and outflows, and upcoming CPEC projects with Chinese labor force inflow in Pakistan. A complete
analysis is needed for Pakistani TVET system especially; it’s technical education and training, in all the provinces to assess its strengths, weaknesses, opportunities, and threats (SWOT), which has not been assessed in literature concerned. The SWOT analysis may provide a clear picture of existing and deficient TVET system. It will help in devising productive policy options and recommendations for the development of human capital formation in technical and vocational fields of manpower development.

2. Literature review
The system of existing TVET provision for engineering skills consists upon one year, three years, and four years in the shape of associate engineering diplomas in Pakistan. It is disseminated by both the public & private sectors in all the provinces of Pakistan. Both the sectors are working for the sole purpose of achieving the objectives set for skilling Pakistan and formation of human capitalism of technical skills in the labor force of Pakistan [1, 4-7].

National TVET Policy [1] documents have eight objectives for skill development in case of Pakistan. Among these eight objectives, skill development, particularly to the youth of Pakistan, is also aimed at targeting a milestone of 20 million TVET skilled labor force by 2020. The policy focuses upon up-skilling and re-skilling, export of skilled labor, and achieving labor market demand for skilled workers. The policy mentions that skilled labor force will ultimately achieve increased productivity, sustained economic growth, better job opportunities, and earnings to the technical labor force [4-6].

Similarly, all the provincial TVET authorities (TEVTAs) also work for TVET dissemination and skill provisions to the unskilled population in Pakistan. All the TEVTAs are established for the sole purpose of skillful Pakistanis in technology proliferation, skill development, human resource development, and maintaining labor market information systems. Skill development in associate engineering diplomas will yield in job opportunities, reducing unemployment, and prepare skilled youth for mega projects and economic corridors in Pakistan. The provincial TEVTAs are also responsible for managing and promoting TVET systems, collaborating TVET systems, making linkages to labor markets, and many more purposes and functions related to TVET system strengthening for the provinces in Pakistan [1, 4-7].

Private sector TVET institution is also working for a limited number of engineering technologies in all the provinces of Pakistan. Similarly, different NGOs, NPOs, & other organizations registered with NAVTTC and/or other public-sector departments are also functional in Pakistan. These TVET institutions are working in urban and metropolitan areas of big cities to work for those areas of TVET dissemination subject to income earnings and fund hunting from national and international donor agencies. Their programs are mostly irregular and programs functionality are based on funds availability and external financing schemes, which is like the case faced by many developing countries of the world [8-10].

Relevant literature about TVET system for the economy of Pakistan did not mention any kind of comprehensive analysis to highlight SWOT analysis for understanding the existing TVET system and its linkages with the human capital formation and socio-economic development [2, 8, 9, 11-14].

3. Theoretical framework
The theoretical framework of SWOT analysis is used for this study. Acronym “SWOT” is composed of S = strengths, W = weaknesses, O = opportunities, and T = threats. The first two alphabets show internal mechanism in a system and the latter two alphabets show external environment to a system. SWOT analysis gives in-depth analytical underpinnings for strategic exploration, highlighting, modification, formulation, devising, designing, and implementation of a system and series of activities at individual and collective policy levels alike. This approach is commonly used for studies to highlight the strengths, weaknesses, opportunities, and threats to any system or program.

The purpose of SWOT analysis is described to efficiently analyze the existing mechanism for better understanding, formulating, and making policy formulations for system developments. This framework is also used for effective policy options in better development in the areas like education,
businesses, organizational development, science and technology, and technological progress. The theoretical framework of SWOT analysis is used for institutional framework of engineering diplomas to highlight its components of strength, weaknesses, opportunities, and threats in TVET system, following the research conventions mentioned by [15-19], for the case of Pakistan. The theoretical framework of SWOT analysis is shown in the figure below.

![SWOT Analysis of AEDs in TVET System of Pakistan](image)

**Figure 1. SWOT Analysis of Associate Engineering Diplomas in Pakistan**
(Designed for theoretical framework about engineering diplomas in TVET the system of Pakistan by following the studies of [16-18]).

4. Research methodology
Research methodology consists upon baseline survey including field work, desktop survey, and content analysis approaches in this study. Fieldwork is undertaken in multiple personal visits to TVET departments, provincial TVETAs, NAVTTC, brainstorming discussions with subject matter experts of TVET, and contacts with associate diploma holders in the labor markets. The desktop survey consists upon browsing internet sources, web portals, and virtual information related to TVET sector and TVET affiliated institutions in Pakistan. Content analysis is undertaken for official TVET documents, TVET acts and rules and regulations, and TVET policy papers/documents to bring forth the SWOT Analysis, in its true spirit, of engineering technologies and associate engineering diplomas, in overall TVET system of Pakistan [17, 19-23].

5. Research Analysis
The SWOT analysis of institutional framework for engineering diplomas in TVET System for Pakistan was conducted. The detailed analysis of strengths, weaknesses, opportunities, and threats were analyzed and discussed separately in the following paragraphs.

5.1. Strengths
There are legislation and implementation of relevant Rules of Business [9] for technical education and training and its provisions for TVET system in Pakistan. The engineering associate diplomas are disseminated through the provincial TEVTAs, allied technical boards, and technical skill departments in all the provinces of Pakistan. The engineering technologies and a proper mechanism for its propagation are undertaken though government technical colleges in Pakistan. There are mono and polytechnical colleges working at all provincial levels. Private sector and NGOs provision of technical skills are also well established for the provision of technical education and training in Pakistan [1, 3].

The complementary part of technical education is vocational training and the system of the vocational system is also established and properly functional for all the provinces of Pakistan. Both the technical and vocational systems collectively constitute the whole TVET system in Pakistan. National levels of regulatory bodies like, N-TEVTA, NAVTTC, NAVTEC, Skill Development Councils, and other TVET regulatory and apex bodies are present in Pakistan. Donors funded programs for skill development are discontinuously functional in Pakistan. CPEC skill programs are started in the province of Punjab, and these programs are yet to be started in other provinces as well. The accessibility of technological education in Pakistan is a quota based on district level in all the
provinces of Pakistan, that is why a wide range of accessibility to almost all the districts of all the provinces are the strength of national TVET system [1, 24, 25].

Technical boards, trade testing boards, and technical education board are established for quality maintenance, examination system, diplomas and certification systems in each province of Pakistan. Establishment of NAVTTC regional directorates for skill development initiatives of the prime minister programs for skill development and skilling Pakistan in all the provinces are present. Pakistan is a signatory of ILO, UNEVOC, GIZ, and UNESCO TVET Strategy [20], and other international bodies “for technological development, achieving SDG4 and inclusive skill development for greening economies”. It is integrated and a complementary mechanism established for the infrastructure of large number NGOs and private sector TVET institutions across the whole country for TVET system and TVET trades proliferation in Pakistan [3, 25].

There are strong linkages between TVET systems and labor market outcomes of employment generation, livelihood earnings, business start-ups, entrepreneurship, and other economic and labor market fortunes to all the diploma and certificate holders of technical education and training in Pakistan. Almost all the technological based economic sectors of Pakistan’s economy like industry, services, Nanotechnology, computer science and IT, dot.com technology, e-business, banking, building and roads, civil works and construction, petroleum-chemical industry, agriculture and poultry, and many more sub-sectors accommodate and demands for technically expert labor force in Pakistan [1, 3, 25-27].

5.2. Weaknesses

Pakistan is a developing economy in the world of leading economies based on technological progress and development. Low levels of education and other socio-economic indicators present the case of Pakistan not suitable for technological progress and high ventures of technological knowledge. There are very limited numbers of technologies in engineering education and training present in Pakistan. According to NAVTTC that the skill dissemination of technical knowledge is confined to 12 technologies, the highest number, in Punjab province and only six technologies in Baluchistan province [1].

The engineering diplomas are confined to traditional technologies of civil engineering, electronics, mechanical, and computer and IT only in all the provinces of Pakistan. No high technology based engineering diplomas like Nanotechnology and microbiology related programs are started in Pakistan. There is not a unified system of quality assurance in terms of quality measurement of associate diplomas of engineering and their examination systems of theory and workshop assessments in Pakistan. Provincial boards of technical educations are responsible without having a unified and common curriculum and course and practice contents for quality assurance and diploma assessment. National qualifying verification framework (NQVF) for quality assurance of associate diplomas in engineering technologies is not fully implemented in Pakistan. Most of the technical colleges do not possess well-established workshops and laboratory rooms for practical exposure and training for their trainees in almost all the provinces. The conditions of physical infrastructure and scientific equipment are miserable in polytechnic colleges in Pakistan. One of the reports of Asian Development Bank mentions that the targets for technical education promotion in whole Baluchistan and parts of other provinces are not met for its TVET strengthening programs in Pakistan [8, 11, 28].

No memorandum of understandings (MoUs) is signed among provincial TEVTAs for TVET collaborations as mentioned in National Skill Strategy [29]. There is a lack of coordination at provincial levels for TVET programs and terms of references for TVET allied departments in all the provinces of Pakistan. There are strong traces of trust deficit, legal, and administrative issues among TVET departments & provincial TEVTAs, especially for the case of B-TEVTA and allied TVET departments, in the provinces. No coordination and collaboration among the TEVTAs, NAVTTC, NAVTEC, Skill Development Councils, and other bodies for technical education in Pakistan. The are many technical, legal, administrative, and coordination problems and constraints among the TVET ministries and departments and among public and private sector TVET organizations for establishing
one of the coordinated and well established technical education systems in Pakistan. The technical education system has less capacity to meet the demands of technical skills for domestic and international labor markets. The response of markets for conventional and technical engineering diplomas is lower wages, unemployment, lower female participation, and no regular jobs in Pakistan. No collaboration between provincial TEVTAs and NAVTTC regional directorates for the promotion of technical education in the provinces. Skill deficiency in Baluchistan is reported around 80% in case of technical training and 20% in terms of technical education as compared to national levels of technical training and engineering diplomas. The legal and administrative status of B-TEVTA to work and function as a provincial authority for technical education and training is not fully recognized as it is for the functional status of P-TEVTA in Punjab [1, 5, 6, 29].

Private sector and NGOs have very limited scope for the dissemination of technical education and training in Pakistan. They mostly provide computer and IT related certificates and diplomas in Pakistan. Since these TVET sectors mostly depend upon donors and funds from NAVTTC, that is why their TVET programs are seasonal, discontinuous, and often for funds hunting purposes. So, investment in TVET from the private sector is very limited and confined to big cities and market-based in Pakistan. No skill mapping has been done for technical education and training for the provinces, labor market needs, CPEC projects, mega and mono projects, and demand-driven skills in Pakistan. Very limited number of studies highlights the technical and vocational aspects of skill development, human capital formation, human resource development, linking TVET with economy and development, and exploring labor market outcomes for TVET systems in Pakistan. TVET sector in Pakistan is highly skewed in favor of vocational training as compared to technical education and training. Out of 189 trades, only less than 50 skill trades are technical training, and less than 15 skill trades are offered as associate engineering diplomas in Pakistan [1, 26].

5.3. Opportunities
TVET system is present with officially and legally recognized TVET departments, provincial TEVTAs, and NGOs/private sector in all the provinces for the establishment of its effective system in Pakistan. National Skill Policy [1] is designed for quality skill development and skilling Pakistani youth to have internationally recognized and affiliated standards of technical education in Pakistan. In Pakistan, approximately, “6% of the whole population acquires skills (Technical Vocational Education & Training). There are 1,647 public & private TVET Institutes in Pakistan”. The province and ownership-type wise TVET institute are highest in the province of Punjab and the least in Baluchistan. There are approximately one hundred plus (103 to 119) TVET institutions working for associate engineering technologies in Pakistan. The ratio of technical colleges is highest for Punjab and the lowest for Baluchistan, where only five out of total eight technical colleges are functional. NAVTTC has established its regional directorates in all the provincial headquarters of Pakistan. Prime minister programs of technical and vocational for all the four to five phases are successfully completed due to TVET system and its coordinating efforts exerted and initiated by NAVTTC in Pakistan [1, 29].

Private sector colleges of technologies, NGOs, and some international bodies like UNESCO, ILO, UNICEF, GIZ, and UNHCR are also working in technical education and training in very purposive and selected areas of Pakistan. Establishment of all the provincial TEVTAs is no less than a blessing for the regularization of TVET system for the development of skill formation in Pakistan. It may coordinate all the disparities and differences in almost all the TVET study segments of course contents, workshops, diploma quality assurance, institutional development, teachers’ training, technological levels, and other types of innovation for all the engineering technologies in Pakistan. Vibrant labor markets for almost all kinds of engineering diplomas in most of the sub-sectors of industries, agriculture, and services sectors of the economy of Pakistan [7, 26, 27].

Associate engineering diplomas are offered for both genders of male and female in rural and urban areas of all the districts of Pakistan. Labor market opportunities for Pakistani skilled labor force present in Arab & Gulf countries, Central Asian countries and European Union for the export of TVET qualified & skilled labor force to earn handsome remittances and capital inflow to their families in
Pakistan. Similarly, CPEC projects, upcoming FIFA World Cup, Dubai Expo, and Gwadar Deep Sea Port, Energy infrastructure, and three economic corridors of rail, roads, buildings, and civil inside Pakistan are big and prospective opportunities for all the engineering diploma holders. There would be high demand for associate engineering diploma holders in these projects and their technologies will be required and absorbed in these national and international economic projects. The futuristic need of human resource development in engineering technologies is likely to be dynamic and prospective for earnings and employment generating for the technologically equipped Pakistani youth in the contexts of mega projects like, CPEC projects, provincial economic activities, demographic dynamism, and labor market needs that will get flourishing in Pakistan [26, 30].

5.4. Threats

Expert and skilled Chinese labor force and its arrival in Pakistan are one of the potential threats for unskilled and semi-skilled Pakistani labor force to compete with them for skills, expertise, productivity, earnings, and employment opportunities. Less coordination between national and provincial TVET institutions also pose threats to the legal and administrative status of their present premises of working and functional authorities in Pakistan. The differentiation of working and funding status of different TEVTAs in different provinces also pose threats to these provincial authorities in Pakistan. Similarly, there are less coordination and lack of uniform policy designed, devised, implement, and execute for engineering skill development that comes through diverse sources of NAVTTC, Skill Councils, provincial TEVTAs, and technical departments of the provincial governments. Weak educational system and low literacy rate do not support enrollment in technical education and training in Pakistan. Currently, only 6% of Pakistani labor force possesses both technical and vocational skills, of which only 30 to 35% consists upon technical education and training, a very serious threat to technical development for Pakistan [1, 5, 6, 24].

Technical diplomas and technical training for the female of the population are very limited. Only limited and very conventional technical skills are allowed for females to take part due to social, gender, tribal, and low mobility constraints and issues in Pakistan. Provincial authorities are not given full authority to work independently and focus labor markets and conduct independent collaborations with international markets and overseas foundations for technical skill development, institutional collaboration, funds rising, financing higher costs, construction of technical workshops and technical laboratories, teachers’ training, and designing skill course for local trainees. The provincial authorities also face constraints in building industry linkages, increasing graduates’ enrollments, and recruitments of TVET qualified instructors for associate engineering diplomas and linkages building with national and international markets. Challenges of interdepartmental legal issues, administrative tussles, and red tape regulations are yet to be overcome by the TVET sector in Pakistan. The threats are also faced in TVET areas like improper designing and implementation of TVET policies, fragmented TVET programs, lack of coordination between private and public sector TVET sectors, and many more general and issues to any kind in any area of Pakistan. The threat of imbalanced TVET programs for male and females, inclination of vocational trades instead of technical ones, imbalanced rural and urban distribution of TVET institutions and its enrollment practices, and regional disparity exist in Pakistani TVET system. Modern, demand driven, and high-tech engineering skills and associate diplomas are needed in Pakistan. The extension of conventional to modern and demand-driven associate engineering trades is one of the big threats to TVET system for Pakistan. The present number of associate diplomas in approximately 30 in different technologies that seem not enough for fulfilling the economic and national demands for all the emerging and technology-based economic sectors of Pakistan. The threat of demand and supply mismatch for the provision of employment to engineering diploma holders and supplying emerging engineering skills to the market demand is not easy challenges for developing the economy of Pakistan [4-7, 24].

The establishment of a labor market information system (LMIS) for engineering associates is one of the potential challenges for all the provincial TEVTAs in the country. The challenges of skill mapping and transparent and purposeful web-portal for the information of skilled labor force are yet to
be overcome for the local industry, labor markets, domestic and international markets, and all other stakeholders of TVET system in Pakistan. The challenges and threats of TVET sector are mentioned by GIZ [27] and ADB Report [11] that identify TVET institutional weaknesses as a big threat for the development and institutional strengthening of TVET system in Pakistan [11, 24, 27].

6. Conclusion and policy recommendations
TVET system includes technical training and education in all the provinces of Pakistan. Provincial levels TEVTAs are established under their legal acts to work as apex TVET authorities for technical and vocational skills dissemination. The authorities also work as regulatory bodies and are responsible for all the concerned TVET aspects and collaboration with other stakeholders in the provinces. SWOT analysis of TVET system, generally, and that of technical education and training, particularly, has shown an opaque picture of overall TVET system in Pakistan. To eliminate the weaknesses and threats associated with TVET system; the following policy recommendations may help to strengthen the technical and vocational education and training system in Pakistan.

- A TVET system at national level collaborated and unified is recommended for all the provinces of Pakistan is required.
- The legal and financial strengthening of all the provincial TEVTAs are recommended for administering their given authorities to proliferate skill development in associate engineering diplomas in Pakistan.
- Skill quality criteria must be ensured in line with an international framework for quality verifications recommended by ILO and UNEVOC standardization for associate diplomas in engineering, technical certificates, and engineering B-Tech degrees.
- The recommendations of the ADB Report [8], should be addressed properly for technical skill development, especially in the case of B-TEVTA in the province of Baluchistan.
- Introduction of market-driven technical education and engineering technologies should be started with national and international collaborators in line with the ILO and UNESCO list of technical trades.
- Technical technologies and trades for upcoming CPEC projects must be launched on a priority basis for Pakistani labor force to competitively win comparative advantage(s) it works in Pakistan.
- Technical colleges for poly or mono technologies, whichever is suitable, should be established for equitable access to labor force for human capital formation in technical skills in each district of each province of Pakistan.
- Technical education and training must be enlarged and expanded for women segment of the population and rural areas from a number of extensions all over the country.
- Private sector and NGOs should be encouraged through funds, subsidies, public-private partnerships, and other incentives for larger coverage of technical skill acquisitions across rural, marginalized, and deprived segments of the population in all the deprived areas of Pakistan.
- Technical education and training must be enlarged in scope and purpose of trainees’ enrollment, technical skill acquisitions, labor force skilling, manpower development, human capital formation, managing the human resource, and provision of skill development at mass levels for the labor force of Pakistan.
- Labor market information system (LMIS) for technical technologies and associate engineering diplomas are recommended for all the provincial TEVTAs in Pakistan.
- A separate section is recommended to be reserved for associate engineering technologies in public policies that aimed at skill development and human capital formation in Pakistan.
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