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Universities' Contribution to the Creation and Diffusion of Innovation in Punjab, Pakistan: Exploring the Industries' Perspective

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Abstract: *The 21st-century economy thrives on rapid innovation, yet Pakistani universities lag in fostering an innovative ecosystem amid technological advancements. This study investigates the contribution of Higher Education Institutions (HEIs) to innovation creation and diffusion in Pakistan from the industry's perspective, an area previously unexplored. Primary data was collected through in-depth face-to-face interviews of directors, CEOs, and entrepreneurs from export-driven industries in Lahore, Sialkot, and Faisalabad. Thematic analysis was employed using NVivo 14 software. Findings reveal that most research conducted by Pakistani universities is primarily theoretical, outdated, and disconnected from current industrial needs. A lack of university-industry collaboration and the absence of effective public sector intermediaries further hinder technology transfer. This gap between academic research and industrial application stifles innovation diffusion. The study underscored that Pakistani universities are not effectively contributing to the creation and diffusion of innovation necessary for economic advancement. To bridge this gap, Universities should involve industrial representatives in their boards of studies and coordinate policy interventions from government organizations and universities to foster demand-driven research addressing specific industrial needs. Such collaborative efforts will enhance trust, spur innovation, and benefit HEIs, the Higher Education Commission (HEC), the Pakistan Science Foundation (PSF), and policymakers as they work to improve academia's impact on Pakistan's innovation landscape.*

Key Words: Collaboration, Creation, Developing Countries, Diffusion, Innovation

Introduction

The Triple Helix Model (THM) is defined as the interaction between the university, company, and government in the process of innovation, economic growth, and development (Grossman & Helpman, 1991; Leydesdorff & Etzkowitz, 1996; Natário et al., 2012). The THM explains the shift from the industry-government dyad of an *industrial society* to the university-industry-government triadic relationship in the *knowledge society*. In the postmodern era, universities play a pivotal role as knowledge hubs and perform entrepreneurial tasks, creating companies and assisting technology transfer to industries for commercialization and community development (Etzkowitz, 2002; Segatto-Mendes & Mendes, 2006). The benefits for universities include the fulfilment of social development functions, knowledge creation and research, financial benefits to researchers, and the repute of universities. The main benefits to the industry are indigenous solutions to their technical problems, reduction in costs, etc. (Natário et al., 2012).

In the contemporary world, the context of 'technological changes and digitalization' emphasizes the importance of access to higher education for people to become increasingly competitive through research, innovation, and creativity (Akhmat et al., 2014; Creswell, 2009). Thereby establishing a direct link between innovation and the quality of education. Investing greatly in quality education and R&D produces better innovative activities, ultimately adding to a country's innovation capacity (Lau & Lo, 2015; Varsakelis,

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2006). Innovation has been widely acknowledged as key to the economic development of a country, leading to enhanced productivity and competitive advantage (Abrunhosa & Sá, 2008). The knowledge of the innovation process, typology, its determinants, and its impact on social and economic areas has been greatly enhanced (Fagerberg & Verspagen, 2009; Martin, 2012). Innovation studies are a regular area of research field in developed countries. Since the 1990s, low-income countries have also realized the role and impact of innovation in the economy, gross domestic product (GDP), and overall development. Many low-income countries have developed national innovation policies, such as China, the Republic of Korea, Taiwan, India, Malaysia etc. Meanwhile, in some developing countries, the focus of intelligentsia and people in power is on the accumulation of capital rather than innovation. Whereas developing countries, including Pakistan, face the challenges of food security, water shortages, energy crises, lack of healthcare facilities, non-availability of infrastructure for the industry, and many other challenges.

Universities play a pivotal role in postmodern knowledge-based economies. Therefore, most developed countries have taken the initiative to link universities with industries to foster innovation processes. The United States, China, and the United Kingdom are the most productive countries in the field of university-industry linkages in terms of total scientific production and citations (Amarathunga et al., 2023). Most of these initiatives act as a stimulus to the economic development of local communities. The role of universities in the 21st century is to cultivate new ideas and talents to meet the demands of industry and the challenges of knowledge economies. In contemporary society, universities may create companies and take on the social responsibility of community development (Etzkowitz, 2002).

For example, creating science parks located in the close vicinity of the universities, business incubators, seed capital, and other platforms to connect universities and industry. Any other initiative like the US Bayh-Dole Act of 1980, to improve university-industry collaboration and facilitate technology transfer. Therefore, higher education can prove to be a strategic asset if linkages with industry are reinforced and the transfer of technology is accelerated (Mowery & Sampat, 2006).

Rogers et al. (2008) defined diffusion as "the process by which an innovation is communicated through different channels in a certain period among the members of a social system" (Eveleens, 2010; Rogers, 1995; Rogers et al., 2008). Another barrier to innovation creation and diffusion is the lack of interaction between academia and industry. It is argued that government entrepreneurship policies are important factors that can promote or prevent innovation in low-income countries (Hall et al., 2012).

Being a low-income country, Pakistan lacks scientific education and skill development, which is a huge barrier to innovation. Pakistani universities have shifted from their traditional roles of teaching to applied research and entrepreneurship. Although the quality of research in Pakistan has improved significantly, most of the research conducted by the universities comprises mere academic publications. In addition, the lack of trust of industries in the research output of universities is a major obstacle. Due to this, the industry is reluctant to share its problems with Pakistani universities. Instead, they prefer to import solutions from abroad by spending a lot of foreign exchange and resources (Mamoon, 2021). Therefore, this study aims to identify the industries' experiences with universities' contribution to the creation and diffusion of innovation in Pakistan.

The researchers worldwide agree that innovation plays a vital role in determining a country's competitiveness, productivity, and economic growth (Ahmed & Mahmud, 2011). The topic has been researched in the local context to answer the research question 'Main Theme: Research output of universities contribute in creation and diffusion of innovation'. The role of the three actors, i.e., university-industry and government, have been explored in the framework of the THM postulated by Leydesdorff and Etzkowitz (1996). The THM is a widely researched concept that creates synergy in the creation and diffusion of innovation.

Conceptual Framework-Triple Helix Model (THM) and Innovation

The word 'Innovation' has Greek origin and was taken from the word 'Kainos', meaning 'new', which appeared in the 5th century B.C. Innovation is defined as the action or process of innovating new ideas, methods, and products (Oxford Advanced Learner's Dictionary, 2024). From a historical perspective, Schumpeter made the very early definition of innovation in 1936 in the context of economic development

and a new combination of productive resources. Schumpeter defined "innovation as the commercial or industrial application of something new – a new product, process or method of production: a new market or source of supply, a new form of commercial business or financial organization" (McDaniel, 2005). The European Commission (EC) in 1995 defined innovation as the renewal and enlargement of products and services and the associated markets, the establishment of new production methods, supply and distribution, the introduction of changes in management, work organization, and the working conditions and skills of the workforce (European Commission, 2014). In 1967, Knight defined innovation as the adoption of change, which is new to the organization (Knight, 1967). (Later in 2001, Johannessen et al., 2010), argued that the word 'new' in the definition of innovation raises three questions, i.e., what is new, how new, and new to whom? Therefore, a comprehensive definition of innovation involves six types of activities: new products, new services, new methods of production, the opening of new markets, new sources of supply, and new ways of organizing and managing (Johannessen et al., 2001). Innovation may also refer to a process, an attribute, or a result. A few other definitions of innovation include the adoption of an idea or behaviour that is new to the organization (Bon & Mustafa, 2013).

Given multi-dimensional concepts of innovation by different researchers, Spillan (2013) defined innovation as product innovation, process innovation, management system, and organizational innovativeness. Hence, innovation is not referred to as a new idea or outcome but the process through which new ideas emerge. According to Crossan and Apaydin (2010), "innovation is production or exploitation of a value-added novelty in the economic and social sphere; renewal and enlargement of products, services, and markets, development of new management system".

Relationships within the productive structure, between the productive structure and the science and technology structure, directed and facilitated by the government, are essential for the development of a country. These ideas were further developed by Etzkowitz and Leydesdorff and this interrelationship was called the 'Triple Helix Model of Innovation' (Leydesdorff & Etzkowitz, 1996). This model shifted the tilt from an industrial society to a knowledge society. The researchers further reiterate that the THM can capture the reciprocal linkage between the three actors of the THM for capitalization of the knowledge. They further argued that the THM is the main strategy for the 21st century.

The THM postulated by Etzkowitz and Leydesdorff drew attention to the enhanced role of universities in the transition from an industry-based society to a knowledge-based society. Previously, the focus of studies was on government and industry / firm interaction, and the universities had a secondary role in the industrial society (Etzkowitz, 2002). In the 21st century, universities have adopted enhanced roles in technology development and transfer, business incubations, and entrepreneurial activities. This has placed universities in the primary position in a knowledge-based society. The THM motivates and incentivizes universities to play a more active and important role in social and economic development (Etzkowitz, 2002). In this new role, the universities, through their innovative activities, contribute to the development of regional and national economies and provide financial incentives to the researchers (Leydesdorff & Etzkowitz, 1996).

Materials and Methods

The interpretivism and inductive approaches were adopted to qualitatively explore the contribution of universities in the creation and diffusion of innovation in Pakistan.

Sampling

Since the Triple Helix philosophy involves collaboration and overlap among the helixes of university-industry-government therefore, it is logical to obtain the views of one of the key stakeholders i.e. industry, on the appropriateness and implementation of the THM. Purposive sampling was used to select experienced top management officials to participate in the study. CEOs, managers, and entrepreneurs having experience dealing with Higher Education Institutions (HEIs), government organizations, and public sector institutions were considered. The authors aimed to select CEOs, entrepreneurs and managers from renowned industries to gather significant insights from competitive participants who represent key informants (Campbell et al., 2020).

In this study, purposive non-probability sampling was used based on the issue being investigated and prior judgment (Czernek-Marszałek & McCabe, 2024). The primary objective of using purposive sampling is to reach out and urge the potential participants to actively and voluntarily take part in the interview session to provide unbiased and accurate data.

Participants were identified as experts based on their involvement and decision-making roles in university-industry linkages. Four CEOs, two directors, two entrepreneurs, four managers, and two heads of units were selected as samples using the purposive sampling method (Tables 1 and 2). A total of 14 interviews were conducted across various industries of Lahore, Sialkot, and Faisalabad Districts of Punjab province. These cities are significant business hubs in Pakistan and were selected to achieve diversity in participants in different industries and business environments and avoid industry-specific biases.

Table 1

Selected participants' profiles from the industrial sector

No.	Industry Name	District	Industry Type	Designation
1.	Millat Tractors Ltd.	Lahore	Agriculture Machinery Manufacturing	Head of Industrial Product Division
2.	Breeze Fans Concerns	Lahore	Electrical Equipment Manufacturing	Entrepreneur and Director
3.	Mitchells' Food	Lahore	Food Manufacturing	Quality Head
4.	Rafhan Maiz Products	Faisalabad	Food Manufacturing	Plant Manager
5.	Fauji Food Industry	Lahore	Food Manufacturing	Manager-Research & Innovation
6.	Anwar Khawaja Industries Ltd.	Sialkot	Sports Goods Manufacturing	CEO/Chairman
7.	Qadri Group Companies	Lahore	Steel, Foundry & Heavy Engineering Manufacturing	Director Production
8.	Mughal Iron & Steel Industries Ltd.	Lahore	Steel Manufacturing	Senior Manager
9.	Surgical Instruments	Sialkot	Surgical Instruments Manufacturing	CEO, QSA Surgical Ltd.
10.	Kausar Textile Ltd.	Faisalabad	Textile & Garments Manufacturing	Owner/Entrepreneur
11.	Sadaqat Ltd.	Faisalabad	Textile & Garments Manufacturing	Director-Production & Sale
12.	Interloop	Faisalabad	Textile & Garments Manufacturing	General Manager-Research & Innovation
13.	Nadeem Engineering	Faisalabad	Engineering Services	CEO/ Entrepreneur
14.	Pakquensis Eco Friendly (Pvt. Ltd.)	Kasoor	Organic Kitchenware and Furniture	CEO/Entrepreneur

Source: Developed by the author for this study from their primary data

Table 2

Summary of respondents from different industries

No.	Sample Profile of Industries	No. of Samples	Percentage
1.	Textile & Garments	3	21.43%
2.	Food Industry	3	21.43%
3.	Steel	2	14.30%
4.	Engineering & Electrical	1	7.14%
5.	Engineering Services	1	7.14%
6.	Agricultural Machinery	1	7.14%
7.	Sports Goods	1	7.14%
8.	Surgical Instruments	1	7.14%
9.	Organic Kitchenware and Furniture	1	7.14%
Total		**14**	**100%**

Source: Developed by the author for this study from their primary data

Data Collection

The primary data were collected using in-depth, in-person interviews. The interview protocol was developed in the light of the THM postulated by Leydesdorff and Etzkowitz. The questions were framed under the guidance of qualitative research experts and modified after incorporating the views of the experts. The interviews were recorded on an electronic device. The interviews were followed by open-ended questions to further explore the phenomena from the respondents' perspectives and to address the issues of the questionnaire's self-made validity (Leydesdorff & Etzkowitz, 1996). Ethical protocols were followed throughout the study, and the identity and profile of the participants were coded to maintain their confidentiality.

The Question Development

The participants were explained the THM and then asked questions (Table 3).

Table 3

Research questions for the interview and participants' responses

Main-Theme Question	Sub-Theme Questions	Response	Participant (n=14)	Percentage %
Theme-1				
What is the research output of universities' contribution to the creation and diffusion of innovation?	1.1 Is research conducted in a university based on applied or theoretical?	Theoretical	14	100%
		Practical	0	0%
	1.2 Is research in the university based on the latest technologies and areas?	Not latest	13	92.9%
		Latest	1	7.1%
		No comment	0	0%
	1.3 Does the university collaborate with knowledge creation institutes and industry?	No links	11	78.6%
		Yes	0	0%
		No comment	3	21.4%
	1.4 Are research-related activities, seminars, research publications, etc., conducted in universities?	No	0	0%
		Yes	0	0%
		Cannot comment	14	100%
	1.5 Level of university engagement in technology transfer.	Not engaged	12	85.7%
		Engaged	0	0%
		No comment	2	14.3%
Theme 2				
To what extent do industries trust the quality of research/innovation conducted at the HEIs/universities in Pakistan?	2.1 Are researchers linked with the industry?	No links	11	78.6%
		Only for funding	0	0%
		No comment	3	21.4%
	2.2 Quality of research?	No trust	14	100%
		Good	0	0%
		No comment	0	0%
	2.3 Is university research utilized in industry?	Yes	0	0%
		Not utilized	11	78.6%
		No comment	3	21.4%
	2.4 The number of patents used by industry is based on university research.	Nill	0	0%
		Very Few	14	100%
		No comment	0	0%
	2.5 Contribution of universities to the creation of talent.	Creating jobseekers	11	78.6%
		Creating Little Talent	3	21.4%
		No comment	0	0%

Theme 3				
To what extent is the Triple Helix Model (industry-university-government) appropriate for the creation and diffusion of innovation in Pakistan?	3.1 Level of interaction between industry, university, and government:	Yes	0	0%
		No	14	100%
		No comment	0	0%
	3.2 Incentives to universities and firms for the creation of innovation.	No incentives	13	92.9%
		incentives	0	0%
		No comment	1	7.1%
	3.3 Role of government policies to support innovation.	Yes	0	0%
		No Policy	13	92.9%
		No comment	1	7.1%
	3.4 Financial institutions that provide support for innovative activities.	Yes	0	0%
		No	14	100
		No comment	0	0%
	3.5 Collaborative links and facility.	Yes	0	0%
		No	14	100%
		No comment	0	0%
	3.6 Government organizations/ forums/platforms to support industry-university collaboration.	Yes	0	0%
		No Forum	11	78.6%
		No comment	3	21.4%
Theme 4				
Universities and Industries contribute to the Triple Helix Model? Is the Triple Helix Model more appropriate in the manufacturing sector than in the service sector in Pakistan?	4.1 Capacity and contribution of the university in the creation of entrepreneurial talent.	Little contribution	11	78.6%
		Weak contribution	0	0%
		No comment	3	21.4%
	4.2 How many incentives are provided to researchers and innovators for startup accelerators?	Very Few	14	100%
		Many	0	0%
		No comment	0	0%
	4.3 What is the capacity of the universities to generate technology?	Little	13	92.9%
		Good	0	0%
		No comment	1	7.1%
	4.4 Are there R&D innovators in the industry?	Yes	11	78.6%
		No	0	0%
		No comment	3	21.4%
	4.5 Does multi-sphere institutions exist?	Do not exist	11	78.6%
		Exist	0	0%
		No comment	3	21.4%
	4.6 Individual and/or team innovators	No	0	0%
		Yes	13	92.9%
		No comment	1	7.1%
	4.7 Innovation organizers are the 'ORICs' in the universities.	Yes	11	78.6%
		No	0	0%
		No comment	3	21.4%
	4.8 The THM is more applicable in the manufacturing sector than in the service sector in Pakistan.	Yes	0	0%
		Both	14	100%
		No comment	0	0%

Source: Developed by the author for this study from their primary data

Analytical Process

The thematic analysis of the qualitative data was carried out as previously explained by Braun and Clarke (Braun & Clarke, 2006). Responses were stored on a digital voice recorder and transcribed. After transcription, a scheme of coding was developed to identify the themes. The first cycle of coding was indicative of the study's research questions. The codes were re-identified as the key themes to confirm the coherence. For this reason, NVivo 14 computer software was used. Thematic analysis was conducted on the data collected.

Results

Sample Profile of Industries

The sample of manufacturing industries comprises three textile garments (21.43%), three food industries (21.43%), two iron and steel (14.3%), one electrical equipment (7.14%), one engineering services (7.14%), one agricultural machinery (7.14%), one sports goods (7.14%), one surgical instrument (7.14%), and one organic kitchen and furniture (7.14%). These industries are big and engaged in exports, adding significantly to Pakistan's foreign exchange earnings. More specifically, the sample includes (Tables 1 and 2).

Results of Thematic Analysis

For the interviews and thematic data analysis, four themes were defined to capture the opinions of industry experts on the role of Pakistani universities in creating innovations that support our local industry. The concepts were grouped under subthemes. The view of industrial respondents is elucidated in the succeeding paragraphs (Table 3) to understand the role of universities in the creation and diffusion of innovation.

Theme 1: The Research Output of Universities is Applied

Subtheme 1.1, from the interviews, relates to the applied nature of research done by the universities. The thematic analysis of the data revealed that all participants (100%) responded that most of the research conducted by the universities is theoretical and is conducted to fulfil academic requirements or for publications, and it does not resolve the problems of the industry. The views of the respondents were as follows:

- "In universities, entrepreneurship and innovation are secondary things. Usually, the students are more focused on undertaking theoretical research work and completing the requirement of their degrees i.e., for academic purposes".
- "The university's research work is mostly theoretical. The faculty does not take the pain and does not engage in applied research, which is beneficial for the industry".
- "Our universities are weak in research and need improvement".
- "The research output of Pakistani universities is not demand-driven and does not resolve the problems faced by the industries".

On subtheme 1.2 and 1.3, a total of 13 respondents (92.9%) and 11 respondents (78.6%), respectively, were of the view that the research topics and areas are not up-to-date and there is no collaboration between industries and universities. Following are the responses of the participants regarding the collaboration between universities and industries for the creation and diffusion of innovation:

- "The research conducted by the universities is 50% relevant, i.e., new technologies and 50% old technologies".
- "The fields and areas of research of universities are mostly old. Even the curriculum of universities is old and needs to be updated".
- "There is no direct collaboration of universities with industry for research and development". Another participant, an entrepreneur, stated, "I do not have any links with academia. We have no link with any university. Therefore, I think universities are not contributing to the creation and diffusion of innovation".
- "At the moment, there is no link/collaboration between industries and universities". Another respondent commented, "Unfortunately, presently, there is no framework available which can facilitate industry-academia link for more effective results".

- "Government does not provide any forum which facilitates link and interaction with universities' researchers".

Subthemes 1.4 were related to research activities conducted at universities such as seminars, conferences, and resource allocation to the universities. The industrial participants (100%) generally do not have information about the frequency or type of research-related activities of HEIs and resource allocation to the university. Therefore, they could not comment on this subtheme.

Subtheme 1.5 addressed the role of universities in technology transfer. 12 respondents (85.7%) indicated that academia was not engaged in technology development and transfer to industry. A participant remarked, "Our universities are weak in research and need improvement. Therefore, the research output is not contributing to the creation and diffusion of innovation". Another participant stated, "The universities have no contribution in the creation and diffusion of innovation." Notably, none (0%) agreed that academia is engaged in technology transfer, while 2 participants (14.3%) didn't respond.

Theme 2: Industry Trusts the Quality of Research Output of Universities

The thematic analysis of question two, subtheme 2.1, revealed that the majority of the participants, 11 (78.6%), expressed the opinion that researchers of universities are not adequately linked with industries. Meanwhile, 3 participants (21.4%) chose not to respond.

In response to a question about subtheme 2.2, which focused on the trust of industry in universities, all participants (100%) shared that they do not trust the quality of research output produced by universities. The views of the respondents from the textile and garment manufacturing industry were:

- "There is no help from any university in the garment industry. So, the industry does not trust the quality of research conducted by the universities".
- Another very experienced innovator from the industry commented, "In one of the projects, I found that the knowledge of our academia was bookish and not of the level of commercial application. Therefore, generally, the industry does not trust the quality of research and innovation conducted by the HEIs/universities".
- "The research conducted by our universities is theoretical and not applied. Mostly, the researchers are focused on their publications."

Regarding subtheme 2.3, "Utilization of university research in the industry," 11 participants (78.6%) said that research of universities is not utilized by the industry for commercialization. While 3 participants (21.4%) did not respond. In another question of subtheme 2.4, all respondents (100%) shared that very few university patents are commercialized.

As for subtheme 2.5, which discusses whether universities are creating talent, 11 participants (78.6%) respondents shared their experience that universities are not creating talent but producing job seekers who lack creativity and innovative ideas. The remaining three respondents (21.4%) stated that universities are creating only a small amount of talent.

Theme 3: The Triple Helix Model (THM) is appropriate for Pakistan

The thematic analysis of theme 3, subtheme 3.1, revealed that all respondents (100%) agreed that there is no interaction between the three actors i.e. university, industry, and government; there are no collaborative links between university, industry, and government; and there is no forum where the three actors could meet and interact with each other.

Subthemes 3.1 and 3.2 focused on the incentives for universities and firms to foster innovation and the role of government policies in supporting innovative activities. The analysis showed that 13 participants (92.9%) indicated a lack of effective incentives for universities and firms to create innovative solutions, as well as government policies that do not encourage or support innovation. One of these 13 participants stated, "According to my experience, the government policies are not supportive of innovators... In fact, it is the opposite. The government policies are barriers." The remaining 1 participant (7.1%) did not respond.

Subthemes 3.4 and 3.5 focused on financial support from institutions and the collaborative links and facilities supporting innovative activities. All 14 participants (100%) indicated that there are no financial institutions offering support for innovative activities and that there are no collaborative links or facilities provided by the government.

Subtheme 3.6 addressed government organizations, forums, and platforms aimed at supporting industry-university collaboration. 11 respondents (78.6%) expressed the view that there are no forums bridging the gap between universities and industry, except for the Chamber of Commerce and Industries and the Small and Medium Enterprise Development Authority (SMEDA), which provide opportunities for industry and academia to meet in various programs. However, it was noted that these meetings are not policy-focused on innovation. The remaining 3 participants (21.4%) did not respond.

Theme 4: Universities and Industries Contribute to Innovation. The Triple Helix Model (THM) is Appropriate for Manufacturing as Compared to the Service Sector

Subtheme 4.1, addressing the "Contribution of universities in the creation of talent," revealed that 11 participants (78.6%) opined that there is little contribution from universities in developing entrepreneurial talent. The remaining 3 respondents (21.4%) did not respond to this question.

Subtheme 4.2 examined incentives for startup accelerators. All 14 participants (100%) indicated that there are very few incentives for researchers and innovators and noted that the capacity for creating innovation is low.

Subtheme 4.3 focused on the capacities of universities to generate technologies. 13 participants (92.9%) indicated that HEIs have limited capacity to generate technologies due to a lack of laboratory facilities and resources. The remaining 1 participant (7.1%) did not respond.

Subthemes 4.4 and 4.5 examined the existence of R&D innovators in industry and multi-sphere institutions. For both subthemes, 11 participants (78.6%) indicated that they have their internal R&D teams of innovators engaged in innovation activities while also noting that multi-sphere institutions do not exist to encourage and facilitate collaboration between the three actors of the THM. The remaining three respondents (21.4%) refrained from responding to these subthemes.

Subthemes 4.6 and 4.7 addressed individual and team innovators, as well as the role of innovation organizers (ORICs) within universities. In response to both questions, 13 participants (92.9%) stated that renowned industries have their R&D departments that encourage and reward innovators. In response to the theme 4.7, 11 participants indicated that there are no innovation organizers in this context. For example, Interloop and Sadaqat Industries in Faisalabad, Fauji Food Industries in Lahore, Khwaja Sports, and QSA in Sialkot have their R&D departments and allocate substantial budgets for innovative activities and projects. The remaining participants chose not to respond.

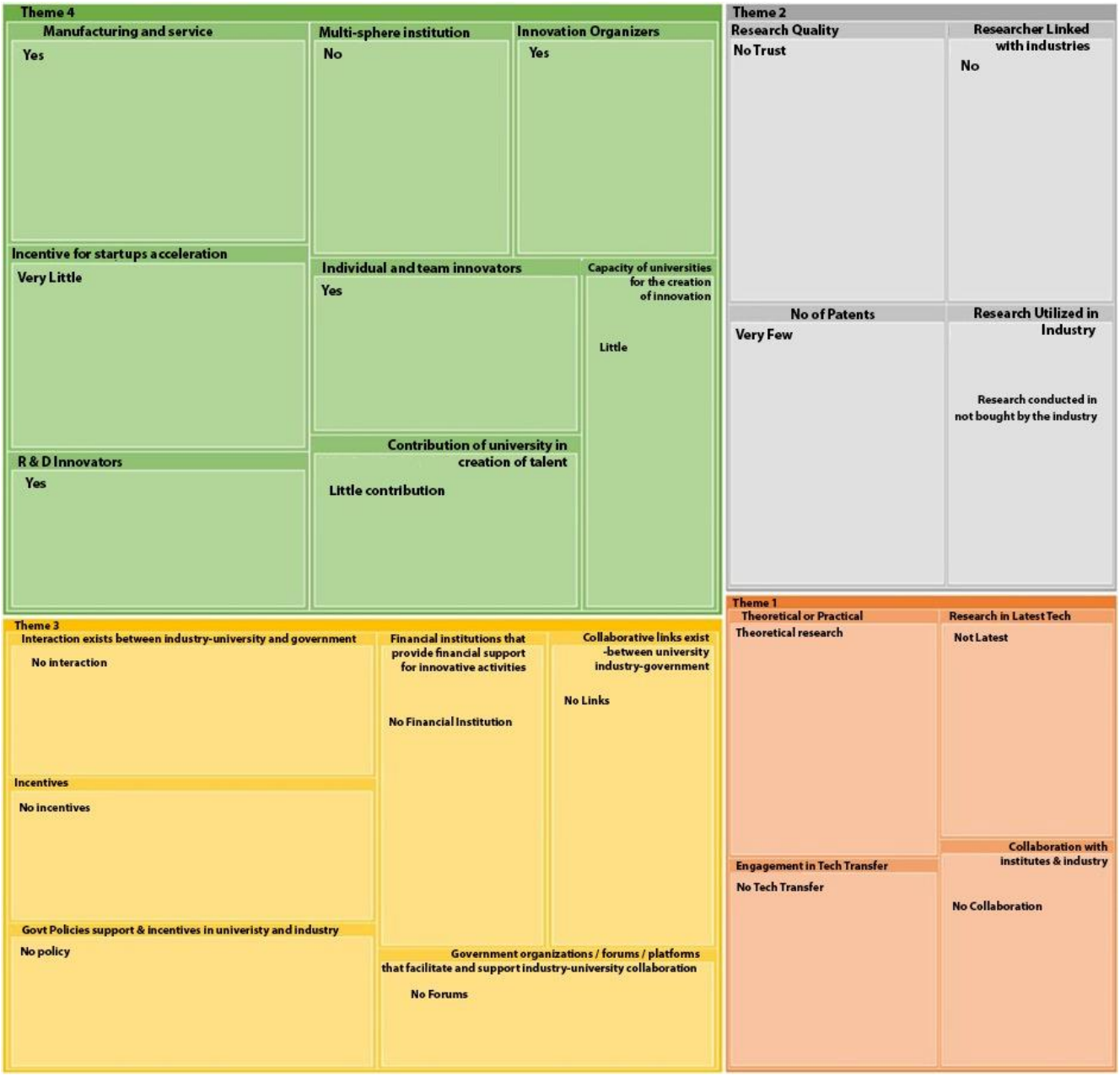
Subtheme 4.8 focused on a comparison of the applicability of the THM in the manufacturing sector versus the service sector in Pakistan. All participants (100%) responded that this model is equally applicable in both manufacturing and service sectors.

Discussion

This present explorative study highlights the contribution of universities in the creation and diffusion of innovation in the context of Pakistan, a developing country. The respondents holding key positions from renowned industries that are engaged in exports and earn foreign exchange for the country have expressed their candid opinions about the contribution of HEIs in the creation and diffusion of innovation (Figure 1). In the 21st-century knowledge economy, the role of universities has changed from teaching to entrepreneurial universities. The universities are engaged in knowledge creation, technology development, and transfer to industry. In Pakistan, however, universities select research projects based on the interests of the researcher rather than on the demands of the industry. The histories and traditions of universities make them resistant to change (Chen et al., 2022).

Figure 1

Hierarchy chart of themes derived from the triple helix model (THM) questionnaire, generated using NVivo 14 software. The size of each box represents the frequency of the corresponding theme, with larger boxes indicating more commonly discussed themes.



The analysis of the data has revealed that all the respondents said that researchers are not linked with industries, which is an indicator that universities are not contributing to the creation and diffusion of innovation. The consensus of the participants is that the university curriculum is mostly old and does not relate to the demands of the industries. One of the reasons for the lack of applied research could be that the Higher Education Commission (HEC) measures the performance of university faculty based on publications and not innovation. For example, the HEC Research Awards recognize and reward excellence in research, contributions to intellectual development, and social welfare mostly based on the publications, their impact factors, and citation numbers (HEC, 2023b). With three disciplinary domains, social sciences, physical sciences, and life sciences, the award includes a certificate and a cash prize for the three categories of best researcher, best young researcher, and best publication, in each disciplinary domain, policy should be revised to highlight applied research and innovation.

The findings drawn from the analysis show that the majority of the respondents are of the view that academia is not engaged in technology development and transfer to industry. In addition, there is no

linkage and collaboration between academia and industry. The industry is of the view that the research conducted by the universities is mostly theoretical, lacks quality, and does not contribute to the creation and diffusion of innovation. The overall picture that emerges for industries and from the analysis of theme one is that the research output of universities is mostly theoretical and does not contribute to the creation and diffusion of innovation. The resource constraints, inadequate lab facilities, and low capacity of universities are barriers to the creation and diffusion of innovation.

The second research question explores the industry's trust in the quality of research conducted by the universities in Pakistan. The basic elements of trust building are communication, competency, goodwill, and reliability. The overall analysis of theme two from the industry's perspective is that the industry does not trust the quality of research conducted by the universities. Most of the respondents shared their concern about the quality of research conducted by the universities; therefore, they do not trust the research output of universities.

Moreover, mostly academia is not linked with industry, and communication links do not exist. Lack of connection between universities and the private sector is a barrier to the diffusion of innovation (Kruss, 2012). In addition, the universities are producing job seekers and are not creating talent.

The analysis leads to the findings that the industry does not have a good impression of the competence of academia; therefore, the industry does not trust the quality of research output of universities. Very few universities have a limited number of patents, but they are usually not commercialized. The industry does not approach universities to resolve their problems due to a lack of trust.

The third research question explored the appropriateness of the THM for the creation and diffusion of innovation in Pakistan. The responses of the industry participants indicated that there is no interaction between the three actors of the THM and that there is no forum that acts as a bridge to create a link between the university, industry, and government. Another study from Khyber Pakhtunkhwa (KPK) Province (Previously known as North West Frontier Province (NWFP), Pakistan, found that weak private-public interaction is a reason for the lack of innovation activities (Bashir et al., 2010). Political instability and government short-term policies are barriers to innovation and creativity. This question has also revealed that there are no financial institutions or venture capital for the startups and commercialization of their innovation activities and projects. Moreover, no policy or financial institution provides grants or loans to innovators to encourage and support innovation activities. The only support available is in the form of bank loans for different government schemes, e.g., 'Kamyab Jawan' and Kamyab Khatoon (Youth Entrepreneurship Scheme) started by the Pakistan Tehreek-e-Insaf (PTI) government (SBP, 2020). This program was a self-employment scheme to reduce the unemployment in the country. Few scheduled banks offer loans for business on soft terms under this scheme.

The Start-Up Research Grant Program (SRGP) by HEC, beneficial for early-career researchers, was terminated on December 24th, 2021 (HEC, 2021). The discontinuation has seized a valuable opportunity for emerging researchers to launch research projects, potentially hindering their ability to pursue innovation. Without such initiatives, early-career researchers may struggle to secure essential funding, emphasizing the need for sustained programs to nurture their growth and ensure continued scientific development. Similarly, the National Research Program for Universities (NRPU), a flagship Research Program of HEC for funding research grants on competitive merit for high-quality and promising scientific research projects demonstrating strategic relevance impacting the local industry and society, has not issued a call for proposals since 2022 (HEC, 2023a).

The findings from the analysis of theme 4 informed the researcher about the capacity of universities for creative and innovative activities and to produce entrepreneurial talent. The general consensus of respondents is that universities have made little contribution to knowledge creation and its commercialization. Universities are deficient in modern lab facilities and do not have adequate funding for technology development and its transfer to industry. A case study done by Mian et al. (2010) argues that both Mexico and Pakistan have limited success in creating an innovation environment due to limited financial resources and poor relations between universities and industries. There are no government incentives for innovators. A few big industries have their R&D teams and teams that work on innovative projects for product development. Under the new Science, Technology and Innovation (STI) policy, 'Offices

of Research, Innovation and Commercialization' (ORICs) have been established in most universities to promote research and innovation and produce entrepreneurs instead of job seekers. National Science and Technology Park (NSTP), launched in December 2019, is the first fully integrated Science and Technology Park (STP) in Pakistan. Accommodating more than 40 companies, the park is the country's largest innovation and research ecosystem (IASP, 2019). The initiative meticulously aims to boost the country's knowledge economy by nurturing innovation-driven development and growth of high-tech enterprises. From the thematic analysis, we found that the THM is equally applicable in the manufacturing and service sectors.

Conclusions

This study has identified the gaps among the stakeholders of the THM in Pakistan. The gap between universities and industry, primarily due to ineffective government policies, must be bridged to actualize the innovative potential of academia. By highlighting these gaps, the research offers insights that can assist policymakers in formulating more effective policy instruments.

Although the terms creativity, innovation, and entrepreneurship are widely used in HEIs and government offices of Science and Technology, this study reveals that Pakistan's lagging performance in the global innovation index is due to a weak innovation policy. While the government has approved the STI Policy-2022, which emphasizes applied research, innovation, and technology transfer to industries, the Ministry of Science and Technology (MoST) has yet to finalize the rules to enforce it. Furthermore, the study highlights that a suitable mechanism to implement the policy on innovation is lacking. This instrument should promote collaboration between universities and industries and allocate sufficient resources to incentivize both innovators/firms and academic institutions.

The findings of this study may guide policymakers in developing policy instruments that foster collaboration between universities and industry and provide adequate resources to encourage innovators/firms and universities. Considering the crucial role of industry in the commercialization of innovative ideas generated by academia, it would be highly beneficial if the government supported university-led innovative projects and provided dedicated spaces for startups and technology development. Additionally, industries should allocate venture capital to universities to foster innovative activities.

Recommendations and Implications for Policy Makers

Pakistan has a long history of political instability, a fragile economy, inconsistent government policies, terrorism, and non-supportive business laws. Therefore, universities cannot contribute to the knowledge economy. Additionally, the low quality of education and research conducted by the universities is a barrier to bringing industries to the universities to resolve their problems. Following recommendations may be helpful for the policy makers:

i. The government must create forums where the stakeholders can sit together to resolve their problems. Moreover, the government of Pakistan must formulate and implement policies that encourage and support university-industry collaboration.
ii. Universities must update the curriculum and include industrialists in the academic committees.
iii. Universities must undertake research projects that are demand-driven and resolve the industry's problems.
iv. The government must provide funding to the universities and industries for innovative projects.
v. The government should immediately re-organize the efforts of organizations like HEC, Pakistan Science Foundation (PSF), and MoST, and the task of innovation be given to MoST to improve the implementations of the policies on innovation.
vi. The government must provide adequate resources to the universities in the form of grants and lab facilities that promote innovation. The government should replace discontinued funding opportunities like SRGP and NRPU with new incentives aimed at supporting research and innovation.

vii. Revision of HEC Research Awards 2023, by introducing additional award categories would encourage researchers and provide incentives for innovators.

viii. The government should have more initiatives like the NSTP to motivate researchers and equip them with a platform for conducting research and fostering innovation.

Limitations and Future Directions

The main limitation of the study is the use of non-probability sampling, which restricts the generalizability of the results. Additionally, respondent bias may have influenced the interview outcomes. From a theoretical perspective, the study highlights the reasons for the low contribution of universities to the creation and diffusion of innovation. Future research should employ probability sampling and use multiple interviewers or standardized protocols to mitigate bias. Moreover, the study's scope should be expanded beyond Punjab to include other provinces of Pakistan.

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Appendix

List of Abbreviations

- **HEC:** Higher Education Commission
- **HEIs:** Higher Education Institutes
- **MoST:** Ministry of Science and Technology
- **PSF:** Pakistan Science Foundation
- **THM:** Triple helix Model