Emerging Innovation Ecosystem of China Pakistan Economic Corridor under One Belt One Road Initiative; Stakeholders Perspective

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ARTICLE INFO	ABSTRACT
	The current study analyzed the emerging innovation ecosystem of China Pakistan Economic Corridor (CPEC) under One Belt One Road (OBOR). The purpose of this study was to analyze the inputs, processes, and outcomes of the CPEC innovation ecosystem. The mixed research method was applied to achieve the objective. A literature review of the CPEC and innovation ecosystem was used to build solid grounds. Semi-structured interviews were conducted with 89 stakeholders (business managers, industrialists, academicians, researchers, and government officials) from different areas of Pakistan. Advanced text analytic and content analysis software along with mathematical procedures were further used to extract the anchors (stocks or fixed assets) and processes (changes related to various anchors, or stocks). The innovation ecosystem of CPEC is based on six processes namely Chinese people's involvement, other countries' connectivity, project development, economic activities, trade enhancement, and industrial development. Upon the disruption of any process, this ecosystem would not sustain. The combination of these processes further generates a unique structure to lead CPEC as an innovation ecosystem. Therefore, such type of infrastructure development project is essential for the economic prosperity of this region which makes the CPEC a demand-driven project. So far, it is the first study conducted on CPEC as an innovation ecosystem by exploring the relationship between anchors and processes.

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1.   Introduction

In 2013, China revealed an initiative, named One Belt One Road (OBOR) to recover the antiquated Silk Road by considering the necessary frameworks of projects and enhancing ports around it. It goes for reciprocal advancements, mutual benefits, and maintains the security of energy with the total cost of USD 120 billion (Jetin, 2018). The OBOR is one of the leading mega project in south Asian region to boost the economic activities (Hassan, Mahmood, Janjua, & Asif, 2022). However, the two key projects are "the Maritime Silk Road" (MSR) and the "Silk Road Economic Belt" (SREB). Fang & Zhang holds the view that the critical activities of China, to fabricate the SREB and the MSR would enhance the economic and global development of the whole region (Fang & Zhang, 2015). The main objective of the OBOR initiative is to develop the western part of China (Ferdinand, 2016; Malik, 2012).

China Pakistan Economic Corridor(CPEC) is a flagship project of the OBOR initiative. The Chinese government is going to invest 46 billion dollars in Pakistan in order to develop the infrastructural projects for rebuilding of Silk Road. Pakistan would beat its economic crisis by this

help and its macroeconomic markers would likewise improve (Chattha & Sayed, 2019). China, in the meantime, enjoys some advantages as it would use Gwadar port to increase its trade, get access to hot waters, and a way to the worldwide marketplace. The CPEC is, to be sure, as a pathway partner, the SREB in the north to south, which represents the current MSR. The CPEC would open ways to tremendous economic activities for Pakistan and create China's physical link to the world markets of Asia, Europe, and Africa (Abbas, Liu, Wasti, Munir, & Abbas, 2019). On the other hand, CPEC will allow China to extend its connectivity with other countries like India, Iran, Afghanistan and Saudi Arabia (Jamali et al., 2023).

Three billion individuals are connected through the part of a trans-Eurasian venture from Asian, African, and European regions and the new MSR. When the Gawadar port would become fully operational, it would act as a central transportation hub to facilitate the whole region for import and export via the Arabian sea. It would eventually raise the economy of Pakistan (Barron, 2017; Malik, 2012). In addition to the Gawadar port, 27 Special Economic Zones (SEZ) would be developed throughout Pakistan to establish new industries. According to the World Bank report 2019, the CPEC is a poverty elimination project for Pakistan. Even after the Covid-19, the CPEC still would have a very positive affect on Pakistan especially in term of addressing the issues of food security (Baig, Khan, Bashir, & Ma, 2023). It would boost the economy of Pakistan by increasing the gross domestic product (GDP), foreign direct investment (FDI), employment opportunities, industrial development, and trade enhancement (Ramay, 2020). Moreover, people of Pakistan are very optimistic about CPEC. They strongly believe that CPEC will bring economic stability in Pakistan (Aman, Abbas, Shi, Ain, & Gu, 2022).

The ecosystem is a biological term that refers to an interrelationship among the living and non-living components. These components affect each other in complex exchanges of energy, nutrients, and wastes. These complex interdependencies cannot be singled out (Jackson & Apostolakou, 2010). On the contrary, researchers still did not provide a specific definition of the innovation ecosystem (Marcos-Pablos, García-Holgado, & García-Peñalvo, 2018; Yaghmaie & Vanhaverbeke, 2020). The concept of the innovation ecosystem is based on the business ecosystem. However, the architectural model of the business innovation ecosystem is different from that of a nation, region, or project (Tomás et al., 2020). According to Jackson (Jackson & Apostolakou, 2010), an innovation ecosystem is a complex relationship among actors or entities. The functional objective of an innovation ecosystem is technological development and innovation. It includes substantial resources and human capital. To make this ecosystem sustainable, the participation of the related government institutions is indispensable.

In this study, CPEC has been considered as an emerging innovation ecosystem. According to Ahmed and Zahid (Ahmed, 2019), CPEC is widely known as the "nation-building project". In this study, firstly, the background of CPEC was presented along with its financial structure, cooperation mechanism, and literature review. Secondly, the key anchors and processes of the CPEC innovation ecosystem were presented that emerged from detailed interviews with real stakeholders. The "anchors" are essentially similar to what economists call "stocks", or fixed assets, while processes are similar to what economists call "flows" (changes related to various anchors, or stocks) (Frenkel & Maital, 2014). For the identification of "gap" in the market, the processes were divided into "demand-driven" and "supply-side" aspects of innovation. These stakeholders are to be considered as the experts because CPEC directly or indirectly influences them. After identification of key anchors and processes, cross-impact analysis was conducted which shows the relationship between anchors and processes. Finally, based on the interrelationship among anchors and processes, a bird view of the CPEC innovation ecosystem was presented after the analysis. To concertize this bird view, the detail of the main programs in the innovation ecosystem on an empirical base was also described.

To achieve the objective of the current study, the remainder of this paper was organized as follows: Section 2 presents the detailed prologue of the CPEC and innovation ecosystem. Section 3 outlines the research methodology. Section 4 presents the results and discussion. Section 5 concludes this research study. Finally, Section 6 provides recommendations, limitations, and future directions.

2. Background and Literature Review

The Heritage Foundation[1] published the report on 180 countries named as "The index of Economic Freedom analysis| in its research." This report is based on 12 factors under four pillars: 1) the rule of law (property rights, judicial effectiveness, and government integrity); 2) Government size (tax burden, government spending, and fiscal health); 3) Regulatory efficiency (business freedom, labor freedom, and monetary freedom), and 4) Market openness (trade freedom, investment freedom, and financial freedom). To compute the economic freedom score, they assigned an overall score ranging from 0 to 100 on each of the 12 components. The high levels of economic freedom depict a high ratio of political stability and income as well as a good working environment by high levels of innovation and experimentation (Li, 2008).

Pakistan[2] is located in South Asia with a population of 197.3 million and is the sixth most populous country in the world. The land area is about 881,913 square kilometers, making it the 33rd largest country. Its GDP was $1.1 trillion measured in terms of purchasing power parity (PPP) in 2017 and the GDP growth rate was 5.3% in 2017, and the 5-year compound annual growth was 4.3%. Its unemployment rate is 4.0% and the inflation rate is 4.1% . The FDI is $2.8 billion and public debt is 67.2% of GDP. As per the 2019 index, the average economic freedom score of the world is 60.8 and the Asian-Pacific regional countries score is 60.6. However, the economic freedom score of Pakistan is 55.

Pakistan's economy is 131st in the world and 32nd out of 43 regional countries. Due to judicial effectiveness, property rights, monetary freedom, and fiscal health, its overall score has increased by 0.6 points. The political and social instability hinders the development process and makes the slow growth in FDI. The reason behind the slow economy is the unnecessary interference of state and law enforcement agencies (Freedom, 2018). The difficult process of getting loans and business licensing undermines entrepreneurship. The financial sector is isolated from the outside world, which causes a slow process of innovation. Corruption, inadequate security, bribery, nepotism, patronage, and backlog are the hurdles of the judiciary system. Judicial processes are very slow and inefficient.

The textile sector of Pakistan is the most export earning sector, but due to informal economic activities, unemployment rate is still high. China is going to invest $60 billion on infrastructure and energy sector under CPEC. The tax system is very complex. The top corporate tax and top personal tax rates are 30%. The budget deficit is 5.1% of GDP as the government spending is 20.3% of GDP. The government spending on subsidies is high. The total imports and export value is equal to 25.8% of GDP with a 10.1% average applied tariff rate (Freedom, 2018). China is a progressing country because it provides ample resources for investment in Research and development (R&D) and innovation. Furthermore, China is putting its efforts to produce the goods and services locally instead of somewhere else. The leadership of China is aware of the fact that the stamp of "invented in China" is far better than "made in China". China has the basic scientific infrastructure and a massive labor force with entrepreneurship quality. The rate of Chinese exports in the world is ranked 15th just after the USA. Even China has already overtaken America in patenting (Frenkel & Maital, 2014).

CPEC is articulated as a colossal associating way and a flagship project on the OBOR chessboard (Zia, Malik, & Waqar, 2018). This project is mostly bonded with the Xinjiang (that is, province of China) and Baluchistan (that is, province of Pakistan) at Gwadar port. The Chinese government is going to invest 46 billion dollars in Pakistan in developing and infrastructural projects for the recreation of Silk Road. The financial structure of CPEC is categorized into four types of financial instruments (Chattha & Sayed, 2019), as mentioned in Table 1.

Table 1: Financial structure of CPEC

Financial Instrument	Purpose	Rate of Interest
Investment by Chinese companies	Infrastructure development	4 to 5%
Concessional loans	Given to Government of Pakistan	2 to 2.5%
Interest free loans	Small portion of overall financing	0%
Grants	Improving state capacity	0%

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[1] http://www.heritage.org/
[2] https://en.wikipedia.org/wiki/Pakistan

In Table 1, the top most category is the investment by Chinese companies for the infrastructure development where the interest rate on this investment is 4% to 5%. Concessional loans depict the type of loan, given to the Government of Pakistan at the interest rate of 2% to 2.5%. The period of this loan is 25 to 30 years. Interest-free loans are a small portion of total financing with zero interest payments. Grant is the last category with a purpose to improve the state capacity and cooperation (Chattha & Sayed, 2019).

The cooperation mechanism[3] of CPEC is shown in Figure 1. To execute the CPEC project smoothly, both China and Pakistan have set up a committee with the name of joint coordination committee (JCC). JCC works under the ministries of National Development and Reform Commission of China (NDRC) and Ministry of Planning Development and Reforms of Pakistan (MPDR). JCC is responsible for the construction of CPEC with the coordination and communication of both secretariats. Furthermore, five joint working groups (JWG), under the supervision of JCC, have been established for the detailed planning and implementation of CPEC projects. JWG consists of long term planning, energy, transport infrastructure, industrial cooperation, and Gwadar port projects.

Figure 1: Cooperation mechanism of CPEC

CPEC and its social, economic, and environmental influence has been considered the popular topic since 2013 before it there are fewer literature available of this phenomena (Bhattacharjee, 2015), mentioned that to address Pakistan's energy crisis, CPEC has become a new chapter in economic growth. In the view of Pakistani infrastructure development, China signed 21 agreements in the power sector for energy generation. These projects would generate energy using gas, coal, and solar power (Ali, Rasheed, Muhammad, & Yousaf, 2018).

In the literature, (Ali et al., 2018), studied the energy projects of CPEC and recommended which projects should be completed on a priority basis. They also suggested that the solar system is the best solution to overcome the energy crisis in Pakistan. Development of SEZs under CPEC projects is a big opportunity for Pakistan to uplift its economy and essential to build a national image in the world (Tong, 2014). Similarly, Zia et al. Presented an analysis of SEZ under CPEC and concluded that the export volume of Pakistan is not significant because of unskilled labor.

With the help of CPEC, Pakistan can develop its infrastructure to increase its exports. CPEC would create 46 industrial cities in Pakistan that would heal Pakistan's battling economy and provide some relief (Ahmed, 2019). These economic zones are located in different locations according to the economic trends of different provinces. Farooq and Nadia (Farooq, 2016) mentioned that CPEC would create more than 2 million jobs in different sectors immediately. Besides this, Pakistan's GDP ratio would rise at the level of 7.5%. These jobs are related to manufacturing and services industries, whereas around 0.7 million jobs are related to direct employment and to remain related to indirect jobs. According to (Rizvi, 2014), CPEC can develop the socio-economic and transportation infrastructure in Pakistan and the western part of China.

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[3] http://cpecinfo.com/10-questions-on-CPEC/#1569236889035-6a31be73-16fb

The realization of CPEC is not only to bring economic avenues for Pakistan, however, it can also help China with a fast, secured, and economical route for oil imports (Alam, Li, & Baig, 2019). They also observed that it can foster regional and cross regional trade integration among regional countries. (Abid & Ashfaq, 2015) analyzed the challenges and opportunities of CPEC. They pointed out that this project would solve the energy crises and develop transport and communication infrastructure in Pakistan. It would boost the economy of Pakistan along with improving the regional connectivity in the region. (Butt & Butt, 2015) studied the impact of CPEC on regional and extra-regional actors and found CPEC can offer long term benefits to Pakistan, China, and other regional countries.

Many studies have already analyzed the environmental effects of CPEC on Pakistan. For instance, (Nabi, Ullah, Khan, Ahmad, & Kumar, 2018) studied that due to heavy transportation, CPEC can harm the natural environment in the northern areas of Pakistan. They suggested that electric vehicles should be employed to make this corridor eco-friendly. The local governments and people must be involved in the CPEC's development to make it successful (Chen, Joseph, & Tariq, 2018). No doubt, CPEC is beneficial for the whole region, but political instability and corruption can undermine the success of this project (Age et al., 2017). (Hussain, 2017) studied the sustainability of CPEC by rational choice theory and identified that CPEC faces so many internal and external challenges, that is, political instability, religious extremism, and terrorism. (Ahmad & Mi, 2017) discussed the conflict between provincial level and political parties in Pakistan on CPEC. In the end, the author proved that CPEC is a nation-building project for Pakistan.

The term "innovation ecosystem" has been the topic of discussion among researchers, academicians, industrialists, and even governments. Many challenges and risks are involved in the innovation ecosystem apart from these definite opportunities and sustainable paths for long-term growth (Leavy, 2012). (Gürlük, 2006) investigated the ecosystem of the Misi Rural Development Project (MRDP) in Busra-Turkey. The authors further conducted a survey to collect the data and applied multiple regression analysis and found that this type of project offers a sustainable ecosystem in developing countries. The innovation ecosystem of any country is dependent on the available resources, especially the quality of skilled labor (Shrotriya & Dhir, 2018). The authors used the qualitative method to integrate skilled labor with the innovation ecosystem. Sun and Wei (Sun & Wei, 2019), evaluated the innovation ecosystem of Haier and applied the qualitative analysis to find the gap between the actors of the ecosystem and innovative coordination of Haier and proved that the gap is from proactive intervention to reactive self-evolution.

The study, related to the dynamics of the digital entrepreneurship and innovation ecosystem, was investigated through exploratory analysis in (Beliaeva, Ferasso, Kraus, & Damke, 2019). They proved that higher to low levels, authorities are an integral part of the innovation ecosystem. (Pucci, Runfola, Guercini, & Zanni, 2018) studied the role of actors in the innovation ecosystem through literature review and Industrial Marketing and Purchasing approach. They found that the actors of innovation ecosystems play an important role at every step of the ecosystem. The innovation ecosystem can become a smart system if there is integration among all the levels of an organization's hierarchy (Jucevičius & Grumadaitė, 2014). (Morrison, Barrett, & Fadden, 2019) developed an entrepreneurial ecosystem in the Muscle Shoals region of northern Alabama. They got positive results from the students' participation, who raised more than one million USD.

The concept of an ecosystem can also be applied to mobile banking systems. Mustafa and Rozeia (Mustafa, 2015), developed an ecosystem of Easypaisa of Telenor mobile company working in Pakistan. The author used Porters' view and suggested that the ecosystem can be used to develop a business model innovation. (Al-Sayed & Yang, 2018) applied the innovation ecosystem on Chinese manufacturing companies in conjunction with the OBOR initiative. They collected the data through semi-structured interviews from experts and the managers of different companies and then used the multivariate analysis. They proved that in the ecosystem, industrial clusters and information technology performed a key role in the sustainability of the innovation ecosystem. In this context, (Ojaghi, Mohammadi, & Yazdani, 2019) provided 63 documents that can be applied to the innovation ecosystem of any business. They developed these documents by a thorough study of the literature provided on the internet.

Another study on Insigma's innovation ecosystem discussed the role of government policies in the innovation ecosystem (Su, Zheng, & Chen, 2018). They further stated that a healthy innovation ecosystem could create more value for a business. Agency issues in any organization can also affect the innovation ecosystem. The actors of the hub/agents and the principal/firm must be aligned on the innovation ecosystem (Longo & Giaccone, 2017).

The actors of the innovation ecosystem may vary from region to region. For instance, Heller studied (Heller, 2013) the innovation ecosystem of Russia and compared it with the innovation ecosystems of other emerging markets. He further investigated that the innovation ecosystem depends on six factors, that is, market, capital, infrastructure, regulations, culture, and people. The importance of these actors varies from region to region, even within one region varying from industry to industry. The stakeholders of a firm are the co-creators of innovation. They can also affect the inter-organizational service ecosystem (Jonas, Boha, Sörhammar, & Moeslein, 2018).

Fukuda and Watanabe (2008) studied the national innovation ecosystems of Japan and the US. They identified that four principles governed innovation ecosystems of both countries, that is, sustainable development through substitution, self-propagation through co-evolution, organizational inertia, and inspired learning from the competition and heterogeneous synergy. While developing a model of the innovation ecosystem, (Engler & Kusiak, 2011) illuminated the dynamic forces of innovation and their roles in the global economy. It indicated that it is an essential need to adopt the rapid changes that occurred in the market.

Xiao and Feng (2023) studied the innovation ecosystem of Chinese shipbuilding industry. They argued that shipbuilding industry not only required own investment in the innovation, but also need to have a strong association with the environment outside the industry. Innovation is also a competitive edge. Therefore, three main elements can become part of the innovation ecosystem namely organizational culture, employee behavior, and skilled labor (Smith & Humphreys, 2006). Chesbrough, Kim, and Agogino (2014) studied the ecosystem of Chez Panisse and found that suppliers, food writers, staff members, and all other stakeholders are part of innovation. The above literature shows that different studies were conducted on the ecosystem and innovation ecosystem, however, none of the previous research attempted to analyze the innovation ecosystem of CPEC. Even no one else analyzed the innovation ecosystem of any under progress projects by using the mix-method approach.

3. Methodology
3.1 Study Context
The current study determined to find out the emerging innovation ecosystem of CPEC through stakeholders' perspectives. This multi-varied project mainly integrates four dimensions, that is, infrastructure; energy supplies, develop the workforce, and economic growth.

There are specific reasons to choose the emerging innovation ecosystem of CPEC, where the most important reason is that China is going to invest huge funds on this project and China has a skilled labor force with entrepreneurship quality employed on CPEC. Besides this, China has an experience of infrastructure development, especially in transportation, communication, and energy sectors. Another important factor is that Pakistan lies at the junction between South, Central, and East Asia. Therefore, Pakistan can act as a bridge to provide logistic routes and administrations to the landlocked focal Asian nations. It certainly has the potential to furnish Pakistan with a profitable chance to improve its economy. Furthermore, the governments and ministries of both countries are directly involved in the development of CPEC.

3.2 Data Collection
To analyze the emerging innovation ecosystem of CPEC, the data was collected from different sectors of Pakistan. The objective of the interviews was to identify the key anchors and processes that can be transformed into a visual innovation ecosystem. The respondents included business managers from different industries, policymakers, researchers from academia, and some experts of the economics discipline of Pakistan, as listed in Table 2. The respondents were selected by applying the "snowball" sampling technique which is appropriate for such types of studies. This technique suggests the sample to be taken from the place where a phenomenon exists (Coyne, 1997). After conducting the interview with the subject, a memo is written to

capture the respondents' opinions and analyses of the information. All memos are translated and converted into an English language script before being analysis.

Table 2: Respondents' profiles

Sr. No.	Financial Instrument	Purpose	Rate of Interest
1	Secretariats	Assistant / Deputy Directors	Public
2	Education	Assistant / Associate Professors	Private / Public
3	Poultry	CEO	Private
4	Agriculture Exporters	CEO / Managers	Private
5	Pesticides / Chemical	Directors / Managers	Private
6	Textile	CEO / Managers	Private
7	Electric Power	Directors	Private / Public
8	Automobiles	Managers	Private
9	Edible Oil	CEO	Private
10	Petroleum/ Oil/ Lubricants	Regional Managers	Public
11	Electronics	Managers / Authorized Dealer	Private
12	Bank	Assistance Vice President/Managers	Public

3.3 Data Analysis

The Leximancer semantic analysis tool, which offers a visual presentation that allows a bird's eye view of the data, was utilised to conduct this analysis (Harvey, 2018). To instigate the analysis, Leximancer eliminated common stop words, transitive verbs, prepositions, and conjunctions that did not add to the understanding of the text. Then it comes up with a list of terms that distinguishes between each concept in the data. Each concept is represented by a node in the concept network. Each node has a direct connection to any other nodes or concepts that co-occur. The concepts of the Co-occur commonly together constitute a region, and in a region, the concept with the greatest number of connections is known as the theme or parent of that thematic region. A concept network of CPEC is shown in Figure 2.

Figure 2: Semantic Network of Emerging Innovation Ecosystem CPEC
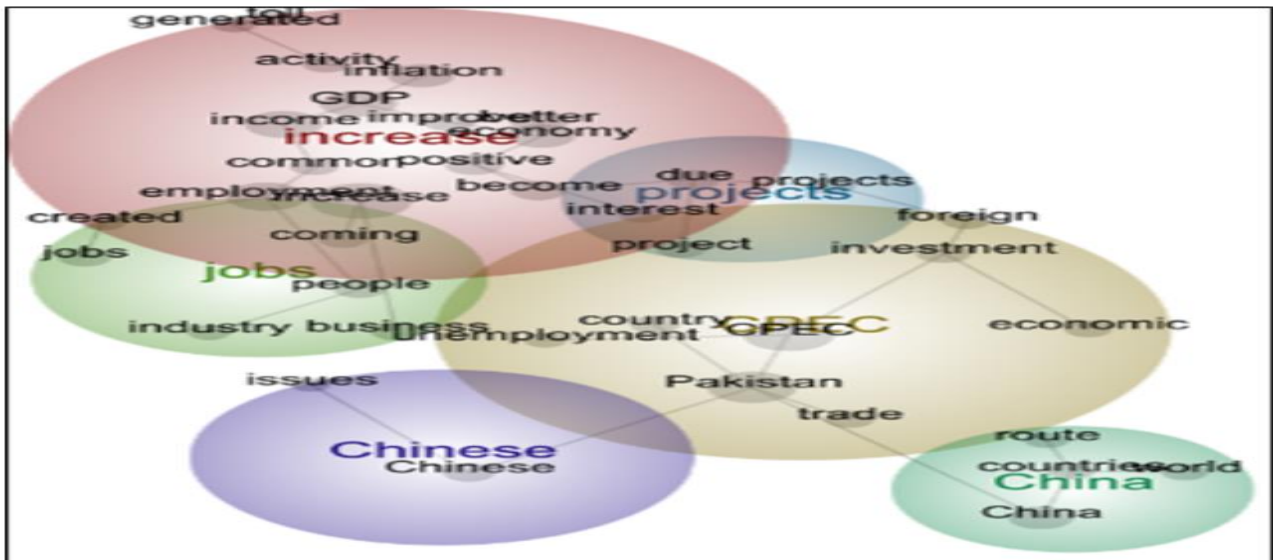
In Figure 2, The notion "CPEC" is the focus of the region represented by the circle in the center of the map. For example, "CPEC" and "Projects" are semantically related when two or more circles cross (Harvey, 2018). On the idea map, concepts that are directly related but may not necessarily be strongly semantically linked may be far apart. In Figure 2, for instance, the terms "China" and "Chinese" are immediately related but not closely semantically linked. As seen in Figure 2, the concepts "Pakistan" and "CPEC" are close to each other on the idea map because they are closely semantically related.

4. Results and Discussion

The current study intended to explore how CPEC can be seen as an innovation ecosystem for the economy of Pakistan. The results of the research showed the implications of the CPEC on the economics of Pakistan. The current dynamics of the relationship between economic corridors and the regional economy were identified. The current study suggested that the Government

should revisit its policies about the revolution in manufacturing and agricultural industries of the country. These findings clarified the doubts and reservations of stakeholders. The results of the study further assist local manufacturers and industrialists in handling the affairs and problems being confronted today and reshape their industry on modern technology. The findings further guide the policymakers and practitioners to develop economic policies in the best interest of the country.

4.1 Concepts Comparison

Table 3 displays the concepts generated by Leximancer related to CPEC as an innovation economy of Pakistan. Concepts such as "CPEC", "Increase", "Pakistan", "China", simultaneously raked at the top of the list among the interviews. In Table 3, when comparing all the concepts, the concept CPEC is the most frequent one. It shows that the business community of Pakistan frequently utilizes the concepts "CPEC", "Increase", "Pakistan", "and China".

Figure 3 has six themes, that is, CPEC, increase, Chinese, Jobs, Projects, and China. In the CPEC theme, the concepts "Pakistan," "trade," "unemployment," "country," "economic," investment," and "foreign" are very close and interconnected with the concept "CPEC." It shows that CPEC is a project which would be developed in Pakistan. The purpose of this project was to connect with the whole world in order to expand the trade. Due to this project, there is a negative impact on unemployment in Pakistan. CPEC is foreign investment in Pakistan with economic benefits for the country and its whole region. In the theme "increase," the concepts "economy," "income," "positive," "employment', "GDP," "inflation," "activity," "generated," "toll,' "improve," "created," and "jobs" are closely related to the concept "increase.' The theme "increase" is also overlapping with the themes "projects," "jobs," and "CPEC." The overlapping in Figure 3 shows that these themes are relevant which is because of CPEC.

Moreover, there is a positive impact on GDP, the income of common persons, employment and, job opportunities, and economy as well. As far as the theme "jobs" is concerned, the concepts "people', "business," "industry," "increase," "employment," "created," and "jobs" are closely related to the concept "jobs." The theme "jobs" have relevance with the themes "increase" and "CPEC," as these are overlapping to each other which shows that CPEC also has an industrial revolution in Pakistan. The industrial revolution can produce more business activities and job opportunities in Pakistan. The theme "Chinese" has only two concepts, that is, "Chinese" and "issues," which is overlapping with the theme "CPEC." Therefore, this project is not only beneficial for the people of Pakistan but also for the people of China as well. Furthermore, it also shows that Chinese people are working on the development of CPEC.

The next theme, that is, "China," having four concepts, such as "China," "world," "countries," and "route," are closely related to each other. The theme "China" is also overlapping with the theme "CPEC".

Table 3: Concepts generated by Leximancer software; the research aspect of Innovation ecosystem of CPEC

Concepts	Count	Relevance	Concepts	Count	Relevance	Concepts	Count	Relevance
CPEC	157	100	positive	39	25	improve	27	17
Increase	149	95	become	37	24	common	26	17
Pakistan	146	93	business	36	23	coming	24	15
China	121	77	country	35	22	unemployment	23	15
GDP	88	56	economic	35	22	industry	22	14
employment	88	56	countries	34	22	interest	20	13
Income	81	52	Due	33	21	route	20	13
Chinese	58	37	better	31	20	activity	19	12
economy	56	36	trade	31	20	created	19	12
Inflation	50	32	projects	31	20	generated	15	10
investment	44	28	foreign	29	18	toll	14	9
People	44	28	world	29	18	-	-	-

Note: A concept's total occurrences are referred to as its count, and significance is measured as the percentage frequency of text segments (in this case, two sentences) coded with that concept as compared to the frequency of the concept that appears the most frequently. To determine the relative prominence of a notion in terms of frequency of occurrence[4].

[4] https://www.leximancer.com/faq/display_and_output.html

It shows that China is developing this route to stretch trade with the entire world. The theme "Projects" is overlapping with the themes "CPEC" and "increase' which means that the CPEC is a trade route which is going to be developed by China by investing a huge amount of funds. This trade route is beneficial for Pakistan, China, and other countries in the world. All the themes in Figure 2 are overlapping with each other that reflects the relevance in all of them.

4.2   The CPEC's Ecosystem (Visualization Map Methodology)

The ecosystem of a project can be different from other projects, however, it may have few similarities or maybe identical. The ecosystem of human beings is applied only to CPEC according to the available data. Both "Themes" and "Concepts" have already been built by Leximancer. At this stage, two complementary analyses are involved. The first comprises "cross-impact" analysis where the relationship between "themes" and "concepts" is evaluated. The relationship between "themes" and "concepts", provided by Leximancer also determines factor analysis as shown in Figure 3. The values to "themes" and "concepts" are assigned on a bipolar five-point Likert scale ranging from the strong negative link (1) to strong positive link (5).

Figure 3: Semantic Network of Emerging Innovation Ecosystem of CPEC with Interconnection of Concepts
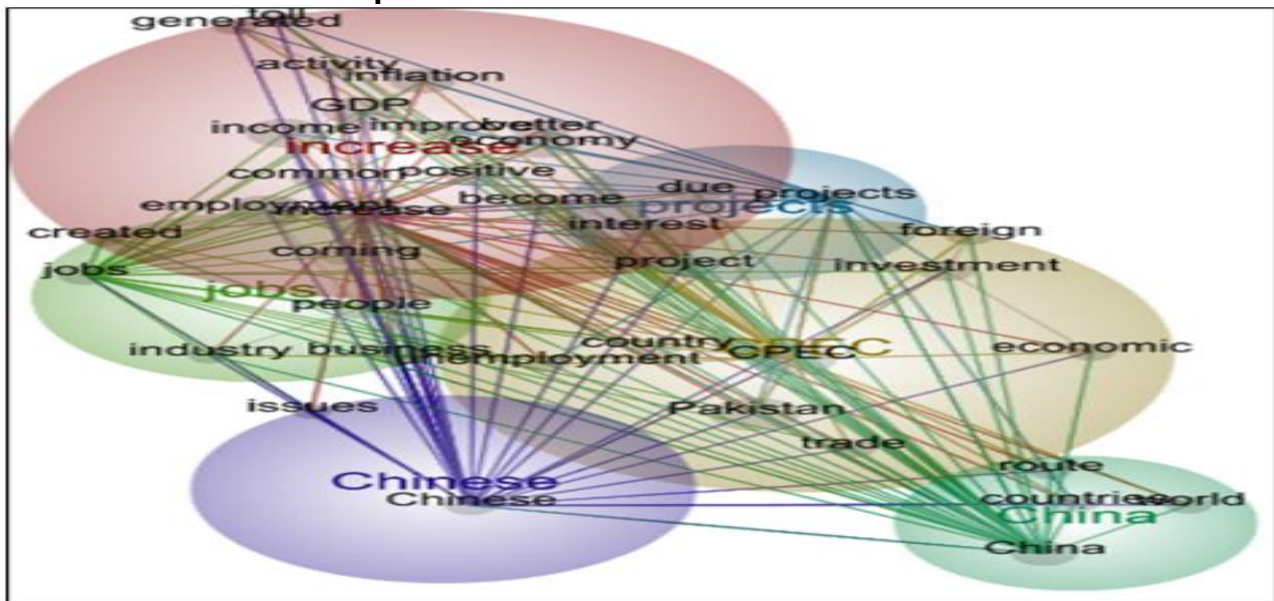
For instance, the theme "increase" has a direct and strong relationship with the concept "income," so, it was assigned (5). The concept "increase" does not have a direct relationship with the concept "toll" but has an indirect relationship, so it was assigned (3). The concept "increase" has a weak relationship with the concept "world" and assigned as (4).

The next step includes the classification of "concepts" into groups. The formation of groups of "concepts" is performed with the opinion of experts. These experts are related to the education sectors, for instance, university teachers and research scholars. These concepts were divided into six groups, that is, economic activities, trade enhancement, industrial development, Chinese people involvement, other countries connectivity, and projects development.

A mathematical procedure was employed to compute the relationship between "themes" and "concepts." Firstly, the cells were transformed in Table 6 by using the cross-impact key as mentioned in Table 4. Secondly, two indicators were computed for each "concept" and "theme" aggregation. The first one is weighted linkage indicator as depicted in

$$\frac{Sum\ of\ values\ in\ aggregation}{Number\ of\ non\frac{N}{A}\ cells\ \times 4} \tag{1}$$

In Equation 1, the values are ranging from 0.25 to 1 as mentioned in Table 5. The second indicator is the neutral linkage indicator as shown in Equation 2.

$$\frac{Number\ of\frac{N}{A}\ cells\ in\ aggregation}{Total\ number\ of\ cells\ in\ aggregation} \tag{2}$$

In equation (2), if the number of N/A cells is $> 50\%$ of the total number of cells in aggregation, then the decision rule is no linkage (NL). To determine the direction and strength of the linkage, the weighted linkage indicator was used. As mentioned in Table 5, If the values are lying between 0.82 to 1 then SPL (++); 0.62 to 0.81 WPL (+); 0.37 to 0.61 ML (+/-); 0.29 to 0.36 WNL (-); 0.25 to 0.28 SNL (−) . Based on this analysis, a matrix was produced in which major lineages were identified between "concepts" and "themes." This matrix is visualizing the map of CPEC's ecosystem in Figure 4.

Table 4: Cross Impact Key

Old Value	New Value
1	1
2	2
3	N/A
4	3
5	4

Table 5: Weighted Linkage Indicator

Strong Negative Link (SNL)	Weak Negative Link (WNL)	Mixed Link (ML)	Weak Positive Link (WPL)	Strong Positive Link (SPL)
0.25	0.5	0.63	0.75	1

The interactions between the "themes" and "concepts" are shown in the ecosystem map, that is, Figure 4. The theme "increase/improve/positive/better" has a strong positive link with the group of concepts "economic activities, industrial development, and Chinese people involvement." These groups

Table 6: Cross Impact Results and Decision Rule of Concepts are Related to the "Economy, GDP, Employment, Jobs, Business, Industry, Income, and toll Taxes."

Cross Impacts Results

Themes	List of Concepts	Economic Activities									Trade Enhancement							Industrial development					Chinese people involvement		Other countries connectivity				Projects development		
		economy	FDI	GDP inf*	toll	inc*	emp*incr*	CPEC	unemp*	country	Pak* trade	econ*inv*	foreign	jobs	coming	created	people	industry	bus	chinese	issues	route	count* world China				projs* int*	project		
Theme A	Increase/Improve /Positive/better	4	4	3	4	3	5 5	4	4	4	4 4	4	4	4	5 5	5	4	4	4	3	5	4	4 4 4				4 4	4		
Theme B	CPEC	4	4	4	4	4	4 4	4	3	5	4 4	4	4	4	4 4	4	4	4	4	4	3	5	5 4 4				4 4	4		
Theme C	Jobs	4	4	4	3	4	4 4	4	4	4	4 3	4	3	3	4 5	4	4	4	4	4	3	3	3 3 4				3 3	4		
Theme D	Chinese	3	3	4	3	4	4 4	4	3	4	4 4	4	4	3	4 4	3	4	4	4	3	5	4	4 4 4				3 4	4		
Theme E	China	4	4	3	4	3	3 4	4	4	4	4 4	4	4	3	4 4	4	4	4	4	4	3	5	4 4 3				4 4	4		
Theme F	Projects	4	4	4	4	4	5 4	4	4	4	4 3	4	4	3	4 3	3	3	3	3	3	3	3	4 3 4				3 3	3		

Decision Rules

Themes	List of Concepts	Economic Activities									Trade Enhancement							Industrial development					Chinese people involvement		Other countries connectivity				Projects development		
		economy	FDI	GDP inf*	toll	inc*	emp*incr*	CPEC	unemp*	country	Pak* trade	econ*inv*	foreign	jobs	coming	created	people	industry	bus	chinese	issues	route	count* world China				projs* int*	project		
Theme A	Increase/Improve /Positive/better			0.85 = SPL* = ++							0.75 = WPL* = +							0.875 = SPL = ++					1=SPL= ++		0.75 = WPL = +				0.75 = WPL = +		
Theme B	CPEC			0.75 = WPL = +							0.79 = WPL = +							0.75 = WPL = +					0.75=WPL= +		0.875 = SPL = ++				0.75 = WPL = +		
Theme C	Jobs			0.75 = WPL = +							0.75 = WPL = +							0.80 = WPL = +					0.75=WPL= +		NL = n/a cells > 50%				NL = n/a cells > 50%		
Theme D	Chinese			0.75 = WPL = +							0.75 = WPL = +							0.75 = WPL = +					1=SPL= ++		0.75 = WPL = +				0.75 = WPL = +		
Theme E	China			0.75 = WPL = +							0.75 = WPL = +							0.75 = WPL = +					0.75=WPL= +		0.83 = SPL =++				0.75 = WPL = +		
Theme F	Projects			0.75 = WPL = +							0.75 = WPL = +							NL* = n/a cells > 50%					NL = n/a cells > 50%		0.75 = WPL = +				NL = n/a cells > 50%		

* inf=inflation, inc= income, emp= employment, incr= increase, unemp= unemployment, Pak= Pakistan, econ= economic, inv= investment, bus= business, count= countries, projs= projects, int= interest, SPL= Strong Positive Link, WPL= Weak Positive Link, NL= No Linkage

Most of these concepts are related to the uplifting of the economy.

Figure 4: Emerging Innovation Ecosystem MAP of CPEC
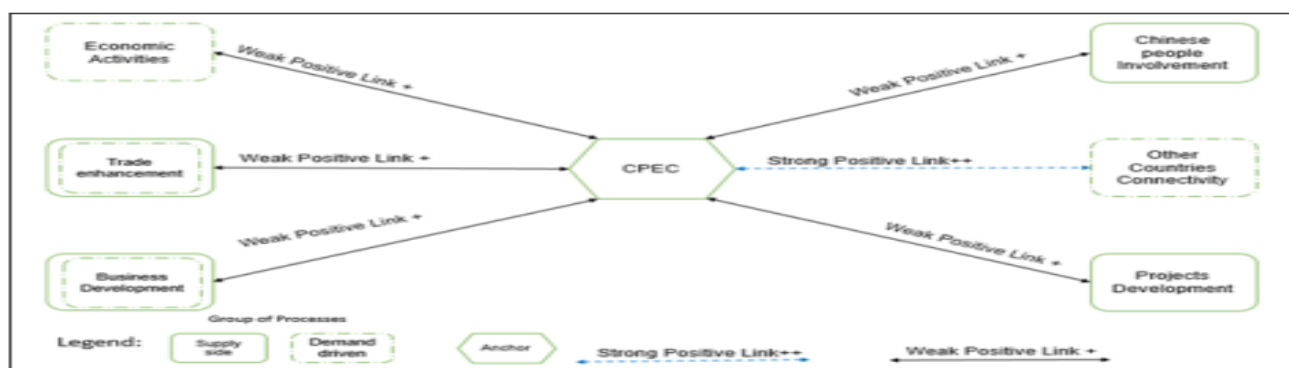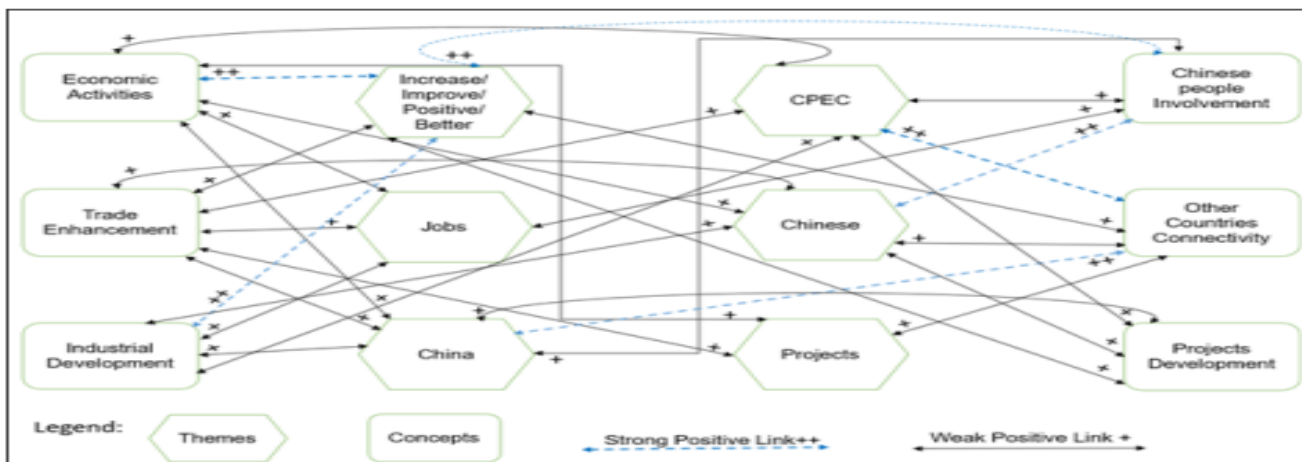
Moreover, the theme "increase/improve/positive/better" has a weak positive linkage (WPL) with the group of concepts "trade enhancement, other countries connectivity, and projects development". These group of concepts is related to the "CPEC, unemployment, trade, route, foreign investment, other countries, and the world." The theme "CPEC" has an SPL with the group of concepts "other countries connectivity" and WPL with the other five groups of concepts. The theme "jobs" has a WPL with the group of concepts "economic activities, trade enhancement, industrial development, and Chinese people involvement", however, NL with "other countries connectivity and projects development". The next theme, "Chinese" has a WPL with all the groups of concepts except has an SPL with "Chinese people involvement". The second last theme, "China" has a WPL with all the groups of concepts but has an SPL with "other countries connectivity." The last theme, "projects" has NL with three groups of concepts "industrial development, Chinese people involvement, and projects development." But those have a WPL with the other three groups of concepts.

4.3   Emerging Innovation Ecosystem of CPEC

Figure 4 shows the relationships of "themes" with the "concepts." Now, CPEC is considered as an anchor and all of the other concepts as processes. The "anchors" are essentially similar to what economists call "stocks," or fixed assets. At the same time, processes (demand-driven and supply-side) are similar to what economists call "flows" (changes related to various anchors, or stocks). The interactions among anchors and processes are computed on the mathematical procedure. In the map, it can be seen that CPEC has a strong positive link that shows the connectivity with regional countries. The other countries' connectivity is a demand-side element. On the other hand, CPEC has weak positive ties with other processes; Chinese people involvement, projects development, economic activities, trade enhancement, and business development. Innovation ecosystem map of CPEC shows that two processes are from supply-side; Chinese people involvement and Project development. Two processes are taken from demand-driven, connectivity with other countries, and the economic activities. Two processes are from both sides of demand and supply elements.

The strong association of CPEC and regional connectivity shows that the main objective of CPEC is to connect China and Pakistan with the regional countries. Weak positive ties between CPEC and projects development means China's substantial investment for the development of CPEC. For the creation of human capital for this project, there is a weak positive tie between CPEC and Chinese people's involvement. The unique entrepreneurship quality of Chinese people and substantial investment in this project are important factors in the success of this project. Chinese people have the quality to perform their work in different environments. This quality can have a significant and positive impact on this innovative activity. The differences in culture, knowledge, and capabilities of workers from different nations can improve the performance in the innovation ecosystem (Alesina & La Ferrara, 2005; Fujita & Weber, 2004).

The weak positive ties should not be overlooked. The growth in economic activities, trade enhancement, and industrial development are the demand for regional economies. Such type of capital investment has a significant impact on national and regional level economic performance (Lina & Kun, 2016).

4. Conclusion

In the current study, an innovation ecosystem of CPEC was developed based on the linkages between concepts and themes identified by qualitative analysis of data using Leximancer. As a new project, CPEC is still a "work in progress," shifting from a planning model to its implementation stage so that it seems to be an emerging innovation ecosystem. The results showed that economic activities and connectivity of other countries are integral parts of this innovation ecosystem. It shows that the demand-side interactions in the system are much more critical than the supply-side. Since no such type of project exists in this region that develops the connectivity among regional countries to grow the economic activities, this only can be possible by developing business and enhancing trade in this region. For this purpose, SEZs are going to be developed, which further enhances the trade activities in this region so that demand-driven processes are essential pillars of this ecosystem to achieve the objectives of this project.

The pure supply-side processes, such as Chinese people's involvement and project development have significant effects on the sustainability of this ecosystem. Skilled labor and ample resources of funds are the backbones of any project. Without these two factors of production, no such project can be developed. These two factors of production are supplied by China in this innovation ecosystem. Chinese people, having entrepreneurial quality and advanced technology, are investing capital in this project. China already has an experience of infrastructure development in the country. To fulfill the demand-side aspects of this ecosystem, China is supplying huge funds, skilled labor, human resource with entrepreneurial qualities, advanced technology, and experience in infrastructure development. Under the CPEC project, various vocational institutes are going to be constructed which would offer scholarships to Pakistani students as well. These students would become part of this ecosystem after the completion of their degrees.

The innovation ecosystem of CPEC is highly integrated with human capital, financial resources, entrepreneurship, governments and, local and foreign markets. Most of the nations want to develop these types of projects only for earning profits and value creations. However, China is developing this project for the prosperity in the region. It can be a benchmark for other nations. CPEC innovation ecosystem shows a great promise for the future to fulfill the demand of the region that makes it as a demand-driven project.

4.1 Recommendations

- Time management is a significant part of any project development. CPEC should be completed within the time frame, as mentioned in the layout of this project. We have a witness that some of the projects are delaying. Delay in the projects may affect the innovation ecosystem.
- For the sustainability in the innovation ecosystem, there is no room for mistakes. The governments of both the countries should develop a matrix of past mistakes and develop a future strategy accordingly.
- Planning without implementation is nothing and vice versa. Since this project is not for one country's prosperity, it is for the best interest of all the regional countries. Proper planning is necessary before the implementation of any decision. Six processes of CPEC's innovation ecosystem are much important. If one of the pillars is derailed, then this project can sink into the valley of death.
- Pakistan is an agricultural-based economy. The agriculture sector is the backbone of the industries. Raw materials are supplied to the industries from the agricultural sector, that is, cotton to the textile industries. There should be a backward integration of roads and railway lines to connect the small towns and villages with the industrial zones. To make the innovation ecosystem successful, the supply of raw materials should be cheaper and fast.
- Since 1947, the political system of Pakistan is unstable. Political and social instability hinders the developmental process of the innovation ecosystem. There is a need to improve the political and social system in Pakistan.
- The difficult process of getting loans and business licensing undermines the entrepreneurship. Moreover, there is also a need to improve the loan approval and business licensing process in Pakistan.
- The nepotism, corruption, poor security, and bribery are the root causes of the downfall of any innovation ecosystem. Since last year, the government of Pakistan is trying to evaporate these problems. But still, there is a need to take further action.
- The tax system in Pakistan is very complex. It must be easy and simple for the taxpayers.

4.2   Limitations and Future Direction

The scope of this study was limited to the respondents from Pakistan, which can be further enhanced at regional and international levels, that is, China, Iran, Russia, India, and Afghanistan. Government officials, ministers, and bilateral trade from other regional countries must also be contacted.

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