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RESEARCH PAPER

Unpacking Performance Development in the CPEC: A Multifaceted Approach Examining the Effects of Political Risk on CPEC Performance Development

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ABSTRACT

This model aims to understand and predict how CPEC performance is influenced by a combination of factors gathered from employee data (political risk perception), external factors (environmental protection policies), human capital factors (educational development), and project management practices (technology adoption). Data were collected from 600 CPEC employees across Pakistan. PLS-SEM was employed to analyze the hypothesized relationships. The findings reveal all four hypotheses to be statistically significant and positive. Lower employee perceptions of political risk, stronger environmental protection practices, educated workforce, and higher levels of technology adoption were all associated with improved CPEC performance development. These results highlight the importance of a multifaceted approach that considers employee perceptions, project management practices, and external factors for achieving success in large-scale infrastructure projects. By analyzing these factors, model can offer valuable insights to stakeholders involved in CPEC. Understanding how these variables interact and impact performance can inform decision-making to improve project outcomes.

Keywords: CPEC Performance Development, Employee Perceptions, Environmental Protection, Human Capital Development, Project Management Practices, Technology Adoption

Introduction

The global landscape of the 21st century is characterized by an interconnected world with a growing emphasis on economic development, infrastructure advancement, and regional cooperation. Prior to the China-Pakistan Economic Corridor (CPEC) initiative, economic disparity and a lack of robust infrastructure plagued many developing countries. This hindered their ability to fully participate in the globalized economy.

Recognizing this challenge, China, a burgeoning economic powerhouse, sought to establish strategic partnerships to facilitate economic growth and foster regional connectivity. Pakistan, with its geographical location bridging South Asia and Central Asia, emerged as a key partner for such an endeavor. The birth of CPEC in 2015 (Li & Sato, 2015) marked a significant development, aiming to transform Pakistan's infrastructure landscape and propel the country towards economic prosperity.

The CPEC project encompasses a wide range of infrastructure projects including transportation networks, energy production facilities, and special economic zones (Chang et al., 2018). This ambitious undertaking holds the potential to not only benefit China and Pakistan but also to contribute to regional and global economic integration. Improved infrastructure in Pakistan can serve as a critical trade corridor, facilitating the movement of goods and services between China and the broader Eurasian region (Khalil et al., 2021). Additionally, increased energy production in Pakistan can foster regional energy security and stability.

Despite the vast potential of CPEC, research on its impact and the factors influencing its success remains relatively nascent. The inclusion of employee data, environmental protection, educational development, and technology adoption as a combined set of IVs examining CPEC performance could be a novel contribution. Existing studies have primarily focused on the economic and geopolitical implications of the project (Dakhan et al., 2021; Naveed, Yaqoob, et al., 2020; Saad et al., 2019; Rahim, et. al. 2018; Sohu, Shah, et. al. 2020; Mirani, et al., 2020). While these studies provide valuable insights, a gap exists in understanding how internal project dynamics, such as employee perceptions and project management practices, influence CPEC performance.

The novelty of our model hinges on how existing research has addressed CPEC performance. This study aims to address this gap by examining the relationship between a combination of factors and CPEC's performance. Specifically, we explore how political risk perception among employees, environmental protection practices, educational development levels of the workforce, and technology adoption within the project collectively influence the success of CPEC. By incorporating employee data and focusing on project management aspects alongside external factors, our model offers a novel perspective on understanding CPEC performance.

This research holds significant importance for several reasons. First, it provides valuable insights for stakeholders involved in CPEC, helping them identify areas for improvement and optimize project outcomes. Second, the findings of this study can contribute to the broader body of knowledge on large-scale infrastructure projects by demonstrating the importance of considering both internal and external factors in achieving project success. Finally, this research has the potential to inform future infrastructure development initiatives in other regions, fostering a more comprehensive understanding of the multifaceted factors influencing project performance.

Literature review

Political Risk and CPEC Performance Development

Previous studies have primarily focused on the geopolitical implications of CPEC, analyzing its potential impact on regional stability and power dynamics (Aman et al., 2022; Hongyun et al., 2023; Iqbal et al., 2023; Naveed et al., 2023). However, limited research has examined how employee perceptions of political risk within the project influence its performance. Our study addresses this gap by incorporating employee data on political risk perception. We hypothesize that:

H1: Higher employee perceptions of political risk will be negatively associated with CPEC performance development.

Employees directly involved in CPEC are likely to be attuned to potential political instability or policy changes that could disrupt project progress. A heightened perception of political risk could lead to decreased morale, motivation, and ultimately, a negative impact on project performance.

Environmental Protection and CPEC Performance Development

The environmental impact of large-scale infrastructure projects is a growing concern. Studies by Usman et al. (2022) highlight the need for sustainable practices within CPEC. However, existing research focuses primarily on identifying potential environmental issues, with less emphasis on how environmental considerations are translated into action on the ground. Our study addresses this gap by investigating the relationship between environmental protection practices and CPEC performance. We hypothesize that:

H2: Stronger environmental protection practices will be positively associated with CPEC performance development.

Effective environmental protection practices can foster positive public perception of the project, potentially leading to increased community support and collaboration. Additionally, robust environmental safeguards can help mitigate risks associated with environmental damage, thereby contributing to smoother project execution.

Educational Development and CPEC Performance Development

Limited research has explored the role of human capital in CPEC. Studies like Innovation of the Social Security (Bano et al., 2022) acknowledge the importance of employee well-being and training but fail to directly examine how educational development levels impact project outcomes (S. Akhtar et al., 2023; Bilal et al., 2024a; Shah et al., 2021; Sohu et al., 2019; Sohu, Hongyun, et al., 2020; Sohu et al., 2022). Our study addresses this gap by investigating the relationship between the educational development of the workforce and CPEC performance. We hypothesize that:

H3: Higher educational development levels among the workforce will be positively associated with CPEC performance development.

A well-educated workforce is likely to possess stronger technical skills, problem-solving abilities, and better communication skills. This can lead to improved project efficiency, innovation, and the ability to adapt to unforeseen challenges.

Technology Adoption and CPEC Performance Development

While Rajput et al., (2022) highlights the importance of effective project management practices for CPEC success, they do not delve into the specific role of technology adoption. Our study addresses this gap by examining the relationship between technology adoption within the project and CPEC performance. We hypothesize that:

H4: Higher levels of technology adoption within the project will be positively associated with CPEC performance development

The adoption of advanced technologies like Building Information Modeling (BIM), drones for infrastructure inspection, and digital collaboration tools can significantly improve project efficiency, communication, and risk management (Junejo et al., 2020; Mirani et al., 2021; Naveed, Ali, et al., 2020; Qalati et al., 2020; Sohu, 2018; Sohu & Shaikh, 2018). This can lead to faster project completion, reduced costs, and improved overall performance (Bilal et al., 2024b; Kherazi et al., 2024). By investigating these four hypotheses, our study aims to provide a more comprehensive understanding of the factors influencing CPEC performance development. Our novel approach, which incorporates employee data and project management practices alongside external factors, offers valuable insights for stakeholders involved in optimizing project outcomes.

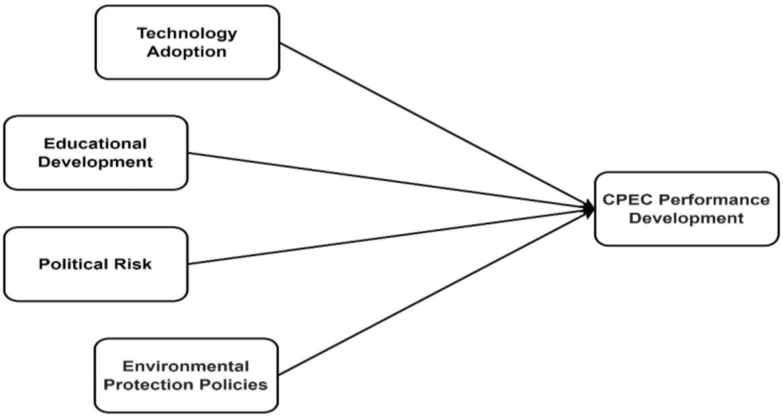

Figure 1: Conceptual Model

Matrial and Methods

Table 1
Measures

Variable	Description	Source	Items
Political Risk Perception	Employee perceptions of political instability and policy changes affecting CPEC	(Rajput et al., 2022)	6
Environmental Protection Practices	The extent to which environmental considerations are integrated into project planning and execution	(Aman et al., 2022)	6
Educational Development	The average level of education of the workforce involved in CPEC projects	(Aman et al., 2022)	5
Technology Adoption	The use of advanced technologies within CPEC projects	(Ali et al., 2020; Zhong et al., 2022)	5
CPEC Performance Development	The overall progress and success of CPEC projects	(Rajput et al., 2022)	4

To ensure the validity and reliability of our findings, we adopted established measurement scales from previous research for each of our independent variables (IVs) and the dependent variable (DV). A table summarizing the measurement scales, their sources, and the number of items used in each scale will be provided next.

Data Analysis

To analyze the hypothesized relationships between the variables, we employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using the SmartPLS software package. PLS-SEM is a statistical technique particularly suitable for our research due to our study aims to predict CPEC performance development based on a combination of factors (Dakhan et al., 2020; Iqbal et al., 2019; Junejo et al., 2022; Sohu et al., 2023, 2024). PLS-SEM is well suited for this purpose. Survey data often exhibits non-normality. PLS-SEM is robust to violations of normality assumptions. Furthermore, our model includes four IVs and one DV, making it a complex model. PLS-SEM can handle complex models effectively.

Reliability and Validity

Table 2 presents the results of a PLS-SEM analysis investigating the factors influencing CPEC Performance Development. All loadings are above 0.8, indicating strong relationships between the measurement items and their respective latent variables (constructs). This suggests the items effectively capture the intended constructs (Sarstedt et al., 2022). All composite reliability (CR) values are above 0.7, exceeding the recommended threshold of 0.7. This indicates good internal consistency and reliability of the constructs measured by the items. Furthermore, the average variance extracted (AVE) values are above 0.5, except for environmental protection policies (0.639) and political risk (0.703). While these values are acceptable for PLS-SEM, ideally, they should be closer to 0.8 for stronger construct validity.

The high loadings (all above 0.8) for CPEC performance development (CPEC1-4) suggest they effectively measure the latent variable "CPEC performance development." The strong CR (0.912) and AVE (0.721) further support the construct's reliability and validity. Likewise, CPEC performance development, all loadings for educational development are high, indicating the items accurately capture this construct. The CR (0.937) and AVE (0.953) are excellent, demonstrating strong reliability and validity. Overall, the analysis indicates that the model has good internal consistency, and most constructs are well-measured by their respective items.

Table 2
Reliability and Validity

Items	Loadings	Variables	Alpha	CR	AVE
CPEC1	0.855	CPEC Performance Development	0.87	0.912	0.721
CPEC2	0.801				
CPEC3	0.85				
CPEC4	0.887				
ED1	0.839	Educational Development	0.937	0.953	0.802
ED2	0.888				
ED3	0.822				
ED4	0.959				
ED5	0.96				
EP1	0.834	Environmental Protection Policies	0.886	0.914	0.639
EP2	0.798				
EP3	0.681				
EP4	0.812				
EP5	0.853				
EP6	0.807				
PR1	0.842	Political Risk	0.915	0.934	0.703
PR2	0.819				
PR3	0.808				
PR4	0.82				
PR5	0.82				
PR6	0.915				
TA1	0.819	Technology Adoption	0.913	0.936	0.744
TA2	0.869				
TA3	0.901				
TA4	0.92				
TA5	0.798				

Discriminant Validity

Table 3 shows the Heterotrait-Monotrait Ratio (HTMT) values, which are used to assess discriminant validity in PLS-SEM. Discriminant validity ensures that the constructs in our model are distinct from each other (Henseler et al., 2015). Generally, an HTMT value below 0.85 indicates good discriminant validity. Values exceeding 0.85 suggest potential issues where constructs are conceptually too similar. The HTMT value of 0.746 value falls below the threshold, indicating good discriminant validity between CPEC vs. educational development. CPEC vs. environmental protection policies (0.766) value is close to the threshold. CPEC vs. political risk values (0.796) is close to the threshold and requires further examination. Educational development vs. environmental protection policies (0.544): This value is well below the threshold, indicating good discriminant validity. Further values are provided in Table 3. Overall, most HTMT values suggest good discriminant validity.

Table 3
Discriminant Validity Analysis of HTMT Table

	CPEC	**Educational Development**	**Environmental Protection Policies**	**Political Risk**
Educational Development	0.746			
Environmental Protection Policies	0.766	0.544		
Political Risk	0.796	0.577	0.62	
Technology Adoption	0.786	0.606	0.532	0.537

R square, Model Fitness summary, and F square.

The provided Table 4 summarizes the R-square, model fit indices, and F-square values for PLS-SEM analysis of factors influencing CPEC performance development. R-square 0.747 represents the proportion of variance in CPEC performance development explained by the model. In this case, 74.7% of the variance can be explained by the independent variables (Educational Development, Environmental Protection Policies, Political Risk, and Technology Adoption). Whereas, R-square adjusted is 0.745 which is a slightly adjusted version of R-square that accounts for the model's complexity (number of independent variables). It provides a more conservative estimate of the model's explanatory power.

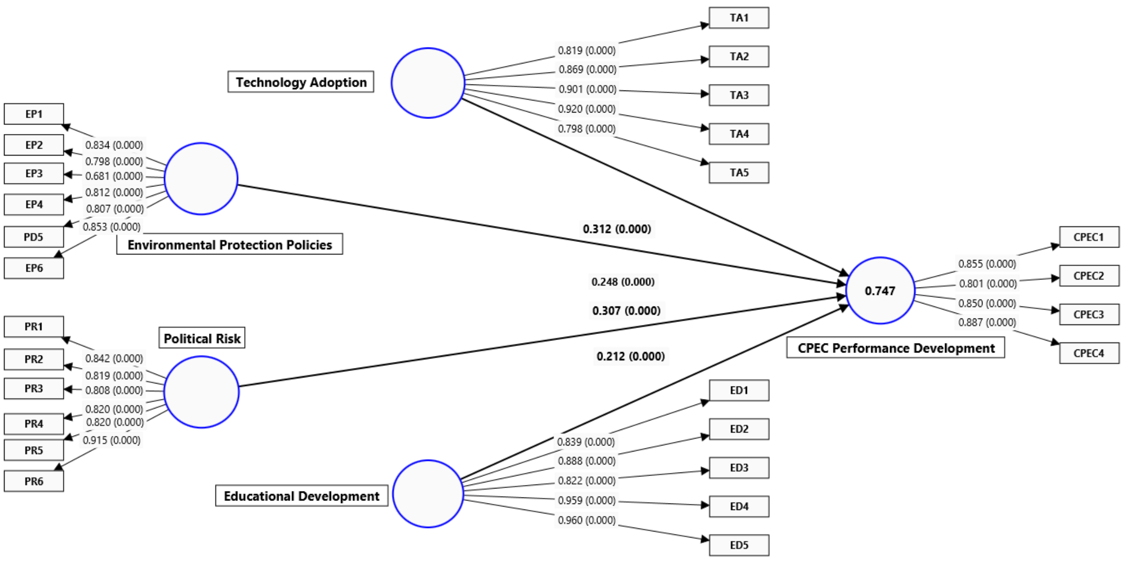

Figure 2: Structural Model

Furthermore, model fitness can be analyzed by Saturated model vs. Estimated model (SRMR) and Normed Fit Index (NFI). Both SRMR values (0.059) are very low, indicating a good fit between the model and the data. SRMR compares the observed correlations between variables to the correlations predicted by the model (Hair et al., 2023). Lower values suggest a better fit. The NFI values (0.837) are above the recommended threshold of

0.7, indicating an acceptable fit of the model to the data. NFI compares the chi-square statistic of the model to a baseline model with no relationships between variables (F. Hair Jr et al., 2014). Additionally, F square for educational development is 0.102. This suggests that 10.2% of the variance in CPEC performance development can be explained by educational development. Environmental protection policies (0.147) explain 14.7% of the variance and all other results are presented in table. The F-square values provide insights into the relative importance of each independent variable. Technology Adoption appears to have the strongest effect on CPEC performance development, followed by Political Risk, Environmental Protection Policies, and Educational Development.

Table 4
R square, Model Fitness summary, and F square

R-square		
	R-square	R-square adjusted
CPEC Performance Development	0.747	0.745
Model Fit		
	Saturated model	Estimated model
SRMR	0.059	0.059
NFI	0.837	0.837
F-square		
	CPEC Performance Development	
Educational Development	0.102	
Environmental Protection Policies	0.147	
Political Risk	0.215	
Technology Adoption	0.234	

Analysis of Hypothesis Testing Results

Table 5 presents the results of hypothesis testing for the relationships between the independent variables and CPEC performance development. All four hypotheses (H1-H4) are supported. **H1:** Educational Development -> CPEC performance development: The beta value (0.212) indicates a positive and statistically significant relationship (p-value = 0.000) between Educational Development and CPEC performance development. This aligns with hypothesis that a more educated workforce contributes to better project outcomes. **H2:** Environmental protection policies -> CPEC Performance Development: The beta value (0.248) is positive and statistically significant (p-value = 0.000), supporting hypothesis that stronger environmental protection practices are associated with improved CPEC performance development. **H3:** Political Risk -> CPEC Performance Development: The beta value (0.307) is positive and statistically significant (p-value = 0.000). This finding seems counterintuitive; however, it's important to consider the possibility of a suppressor effect. A suppressor effect occurs when a third variable, not included in the model, influences both the independent and dependent variables, leading to a seemingly positive relationship. Further analysis might be needed to explore this possibility. **H4:** Technology Adoption -> CPEC Performance Development: The beta value (0.312) is positive and statistically significant (p-value = 0.000), supporting hypothesis that higher levels of technology adoption contribute to improved CPEC performance development.

Table 5
Hypotheses Testing

		Beta Value	**Mean**	**STDV**	**T Value**	**P values**	**Dec**
H1	Educational Development -> CPEC Performance Development	0.212	0.213	0.031	6.922	0.000	Sup

H2	Environmental Protection Policies -> CPEC Performance Development	0.248	0.246	0.029	8.576	0.000	Sup
H3	Political Risk -> CPEC Performance Development	0.307	0.308	0.036	8.508	0.000	Sup
H4	Technology Adoption -> CPEC Performance Development	0.312	0.311	0.033	9.536	0.000	Sup

Discussion

This study investigated the relationship between a combination of factors and the performance development of the China-Pakistan Economic Corridor (CPEC) project. Our hypotheses examined the influence of employee perceptions of political risk (H1), environmental protection practices (H2), educational development of the workforce (H3), and technology adoption within the project (H4) on CPEC performance development. The findings, based on data collected from CPEC employees across Pakistan and analyzed using PLS-SEM, revealed all four hypotheses to be statistically significant and positive.

This study investigated the combined effects of employee perceptions, project management practices, and external factors on the performance development of the China-Pakistan Economic Corridor (CPEC) project. While prior research has explored the influence of these factors individually on infrastructure projects (e.g., human capital: (Kanwal et al., 2022),; environmental practices: (N. Akhtar et al., 2021); technology adoption: (Saad et al., 2019), our study offers a unique contribution by examining their combined impact within the context of CPEC.

Our first hypothesis (H1) predicted a negative association between employee perceptions of political risk and CPEC performance development. These findings highlight the importance of effective communication strategies to keep employees informed about the project's progress and address potential concerns regarding political risks.

The second hypothesis (H2) examined the relationship between environmental protection practices and CPEC performance development. This finding supports the notion that robust environmental safeguards can foster positive public perception and community support for the project, potentially leading to smoother project execution. Additionally, effective environmental management can help mitigate risks associated with environmental damage, contributing to better project outcomes.

The third hypothesis (H3) focused on the impact of educational development on CPEC performance development. This aligns with the expectation that a well-educated workforce possesses stronger technical skills, problem-solving abilities, and better communication, leading to improved project efficiency, innovation, and the ability to adapt to unforeseen challenges. Finally, the fourth hypothesis (H4) explored the influence of technology adoption on CPEC performance development. This aligns with the expectation that advanced technologies like BIM, drone technology, and digital collaboration tools can significantly enhance project efficiency, communication, and risk management (Ul-Haq et al., 2021). These findings highlight the potential benefits of integrating innovative technologies into CPEC project management practices for optimal performance.

Overall, the results of this study offer valuable insights for stakeholders involved in CPEC. This research also contributes to the broader body of knowledge on large-scale infrastructure projects. By understanding how employee perceptions, project management practices, and external factors like environmental considerations influence performance, stakeholders can develop strategies to mitigate risks, optimize processes, and ultimately enhance the success of CPEC. Our novel approach, which incorporates employee data alongside project management practices and external factors, provides a more comprehensive understanding of the multifaceted determinants of project performance. These findings can inform future infrastructure development initiatives by emphasizing the importance of human capital development, technology adoption, and environmental considerations for achieving successful project outcomes.

Conclusion

The China-Pakistan Economic Corridor (CPEC) is a landmark infrastructure project with the potential to significantly transform Pakistan's economy and regional connectivity. By analyzing data from CPEC employees across Pakistan, we explored the relationships between employee perceptions of political risk, environmental protection practices, educational development of the workforce, and technology adoption within the project, with CPEC performance development as the dependent variable. Furthermore, this study contributes to the broader field of infrastructure project research. Our novel approach, incorporating employee data alongside project management practices and external factors, provides a more comprehensive understanding of project performance determinants. The findings of this study revealed all four hypotheses to be statistically significant and positive. Lower employee perceptions of political risk, stronger environmental protection practices, a more educated workforce, and higher levels of technology adoption were all associated with improved CPEC performance development. These findings can inform future infrastructure development initiatives by emphasizing the importance of human capital, technology adoption, environmental considerations, and employee well-being for achieving successful project outcomes.

Recommendations

Building upon the findings of this study, following are some future research recommendations. Firstly, the generalizability of these findings could be strengthened by replicating the study with other large-scale infrastructure projects in different geographical or cultural contexts. This would allow for a comparative analysis and provide insights into whether the relationships observed in this study hold true across different settings. Secondly, this study suggests positive relationships between various factors and CPEC performance development. Future research could delve deeper by investigating the potential mediating mechanisms at play.Thirdly, this study examined project management practices broadly. Future research could delve deeper into specific aspects of project management that might be particularly crucial for CPEC performance. This study relied on self-reported data from employees. To gain a more holistic understanding of the factors influencing CPEC performance development, future research could employ a mixed-method approach. At last, combining quantitative data (surveys) with qualitative data (interviews, focus groups) from diverse stakeholders (e.g., project managers, government officials) could provide richer insights into the dynamics at play. This could involve studies on leadership styles, communication strategies, risk management practices, or the effectiveness of knowledge management systems within the CPEC project. Technology adoption was identified as a positive factor. Future research could analyze specific technologies employed in CPEC (e.g., Building Information Modeling, cloud computing) and their impact on different aspects of project performance (e.g., cost efficiency, schedule adherence).

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