

The Impact of Hyperloop Technology on Enhancing Logistics Services and Their Sustainability in Saudi Arabia

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Abstract— *The logistics industry grapples with challenges in meeting the growing demands for efficient, sustainable, and cost-effective goods transportation. Hyperloop technology, utilizing low-pressure tubes for high-speed transport, emerges as a potential solution. Employing a mixed-methods approach, this study combines quantitative analysis and qualitative interviews to assess the impact of Hyperloop on enhancing logistics services.*

The comprehensive literature review identifies key benefits and challenges of Hyperloop implementation. Quantitative analysis evaluates potential improvements in transportation efficiency, cost reduction, and environmental sustainability, comparing key indicators to existing modes. Qualitative interviews with logistics stakeholders provide insights into perceptions and expectations, addressing factors like infrastructure and adoption barriers.

Preliminary findings suggest Hyperloop's potential to significantly enhance logistics services by reducing transit times and promoting environmental sustainability. However, challenges such as infrastructure and regulations require attention. This study offers empirical evidence for logistics stakeholders, policymakers, and researchers to make informed decisions about adopting Hyperloop in logistics.

In the Saudi Arabian context, the study assesses Hyperloop's feasibility for enhancing logistics in food production. Saudi Arabia's strategic location positions it as a potential global logistics center. The Vision 2030 initiative aligns with the exploration of innovative technologies like Hyperloop for efficient transportation. Saudi Arabia considers Hyperloop as a group transportation solution for various Gulf region destinations, aligning with the broader vision of fostering technological advancements for economic growth and sustainability. The paper explores technical and environmental feasibility, emphasizing energy efficiency and sustainable transportation.

Keywords: *Hyperloop Technology, Sustainable Transportation, Logistics Services, Feasibility Study, Saudi Arabia.*

I. INTRODUCTION

The Hyperloop, introduced as a groundbreaking mode of transportation by Elon Musk in 2012, has emerged as the fifth mode of transportation, offering a transformative approach to commuting and goods transportation. This innovative system operates as a vacuum tube train, propelling people or products at remarkable speeds, and presenting an unparalleled combination of speed and cost-effectiveness. In comparison to conventional transportation methods, the Hyperloop stands out due to its energy efficiency, quiet operation, and self-contained design (Noland, 2011). The most striking advantage of the Hyperloop lies in its ability to revolutionize cargo delivery, providing an unprecedented boost to the speed of transporting goods. Beyond its role in expediting logistics, the Hyperloop holds immense promise in contributing to environmentally friendly supply chains (Griffith et al. 2023). By serving as a carbon-free transportation method, it has the potential to reshape not only inland freight transportation but also the transit of goods through maritime and air routes. What sets the Hyperloop apart is its versatility, capable of transporting freight below, above ground, and even underwater, making it a versatile solution for various logistical challenges.

The implementation of Hyperloop technology in Saudi

Arabia is of great importance due to the numerous benefits it offers. Hyperloop is a futuristic mode of transportation that involves high-speed trains traveling in vacuum-sealed tubes. With a top speed of up to 760 miles per hour, Hyperloop could reduce the travel time between major cities in Saudi Arabia from hours to minutes. This could have a significant impact on the country's economy by facilitating faster and more efficient transportation of people and goods. Additionally, Hyperloop is an environmentally friendly mode of transportation that runs on renewable energy sources, reducing Saudi Arabia's dependence on fossil fuels. Finally, the implementation of Hyperloop technology in Saudi Arabia would showcase the country's commitment to innovation and progress, positioning it as a leader in technology development and implementation (Kassebi et al., 2022). In the context of the logistics landscape in the Kingdom, the Hyperloop has the potential to play a pivotal role in the development of a green supply chain (Majchrzak et al., 2018). As Saudi Arabia strives towards sustainability goals, the Hyperloop offers an opportunity to revolutionize transportation practices, contributing to the reduction of carbon emissions in the logistics sector.

The primary objective of this research paper is to delve in-depth into the intricacies of the Hyperloop technology and its role as a significant driver of progress in the field of

logistics. To achieve this objective, we will comprehensively analyze the various dimensions of Hyperloop technology and its implications for the evolution of logistics concepts.

Our focus will be on exploring the environmental benefits of Hyperloop technology and its potential to revolutionize the logistics industry, particularly in the context of the green supply chain in Saudi Arabia. We will examine how this innovative technology can potentially reduce environmental disruptions, cut down transportation costs, and improve overall operational efficiency. Additionally, we will also explore the challenges and limitations that come with the implementation of this technology in a real-world setting.

II. PURPOSE OF THE STUDY

The primary objective of this study is to examine the potential of Hyperloop technology in enhancing logistics services within the broader context of the Saudi Arabian logistics industry. Hyperloop technology, which uses low-pressure tubes for high-speed transport, has emerged as a transformative solution for the logistics sector facing challenges in efficient, sustainable, and cost-effective goods transportation. Employing a mixed-methods approach, the study integrates quantitative analysis and qualitative interviews to assess the impact of Hyperloop on logistics services comprehensively.

The quantitative analysis focuses on evaluating potential improvements in transportation efficiency, cost reduction, and environmental sustainability. By comparing key indicators to existing transportation modes, the study aims to provide empirical evidence on the viability of Hyperloop in enhancing logistics services. On the other hand, qualitative interviews with logistics stakeholders contribute valuable insights into perceptions and expectations, addressing factors such as infrastructure requirements, adoption barriers, and industry readiness for embracing Hyperloop technology.

The primary objective of this study is to evaluate the possibility of utilizing Hyperloop technology for enhancing logistics services within the unique context of Saudi Arabia. The study aims to explore the practicality and feasibility of implementing this innovative transportation solution, taking into account the country's specific needs and challenges. Overall, by providing a detailed understanding of the Hyperloop technology and its implications for logistics, this research paper aims to contribute to the ongoing discourse on sustainable logistics and pave the way for further research in this field.

Saudi Arabia's strategic location, as a gateway between Asia, Africa, and Europe, makes it a critical hub for global trade and commerce. Moreover, the country's ambitious Vision 2030 initiative, which aims to reduce dependence on oil and diversify the economy, emphasizes the importance of technological advancements in achieving these goals. Therefore, this investigation is particularly relevant and timely, as it seeks to identify the potential benefits and challenges of introducing Hyperloop technology in Saudi

Arabia's logistics sector. Through a comprehensive analysis of the current transportation infrastructure, logistical requirements, and regulatory environment, this study aims to present a detailed assessment of Hyperloop's feasibility and suitability for enhancing the country's logistics services.

III. IMPORTANCE OF THE STUDY

This study holds paramount importance for the Kingdom of Saudi Arabia, as it delves into the potential implications of Hyperloop technology on the nation's logistics landscape and its broader implications for green supply chain management. The Kingdom's Vision 2030 initiative, with its ambitious goals of economic diversification and technological advancement, makes this research particularly pertinent.

Firstly, the study addresses the pressing challenges faced by the logistics industry in Saudi Arabia, including the need for more efficient, sustainable, and cost-effective goods transportation. Hyperloop technology, with its promise of high-speed transport using low-pressure tubes, represents a potential game-changer in addressing these challenges (Notteboom, 2020). By understanding the feasibility and impact of Hyperloop adoption, the Kingdom can position itself at the forefront of innovative logistics solutions, enhancing its competitiveness on the global stage.

The study delves into the implications of Hyperloop technology on green supply chain management in great detail. Hyperloop is a revolutionary transportation system that can significantly reduce transit times and lower carbon footprints by operating in an energy-efficient manner, making it a promising alternative to traditional modes of transport. The study highlights how technology can help organizations achieve their sustainability goals by contributing to a more ecologically responsible and resilient logistics sector. Furthermore, the study emphasizes the need for global sustainability goals to be aligned with the transportation industry's practices. The findings of the study suggest that Hyperloop technology's adoption can play a pivotal role in achieving these goals. By providing a more environmentally sustainable and efficient mode of transport, Hyperloop can help to reduce carbon emissions, which are a significant contributor to global warming.

The study's results provide valuable insights into the Kingdom's commitment to green practices in its supply chain management. It can help the Kingdom's logistics sector to foster a more ecologically responsible and resilient industry. In conclusion, the study highlights the potential of Hyperloop technology to revolutionize the transportation of goods, offering a more environmentally sustainable and efficient alternative to traditional modes of transport. As Saudi Arabia aspires to become a global logistics center, the findings of this study can guide strategic decisions for policymakers and stakeholders. By embracing Hyperloop technology, the Kingdom can enhance the efficiency and cost-effectiveness of its logistics services and position itself as a leader in sustainable and innovative supply chain practices. This study,

therefore, serves as a crucial tool for informed decision-making, laying the groundwork for a more resilient, technologically advanced, and environmentally conscious logistics sector in Saudi Arabia's future.

IV. RESEARCH QUESTIONS/ HYPOTHESIS

In examining the potential impact of Hyperloop technology on logistics services in the Kingdom of Saudi Arabia, our research question aims to investigate whether the implementation of Hyperloop results in a statistically significant improvement across various facets of the logistics landscape.

Research Question: Does the implementation of Hyperloop technology result in a statistically significant improvement in various aspects of logistics services in the Kingdom of Saudi Arabia?

In examining the potential impact of Hyperloop technology on logistics services in the Kingdom of Saudi Arabia, our research question aims to investigate whether the implementation of Hyperloop results in a statistically significant improvement across various facets of the logistics landscape. These comprehensive questions aim to guide the investigation into the nuanced aspects of the Hyperloop's potential impact on logistics services in Saudi Arabia

A. Sub-Questions:

1. Transportation Efficiency:

- How does the implementation of Hyperloop technology affect the speed and reliability of goods transportation in the Kingdom of Saudi Arabia?
- Are there measurable improvements in delivery times and overall transportation efficiency when Hyperloop is integrated into the logistics network?

2. Cost Reduction:

- To what extent does the adoption of Hyperloop technology lead to cost reductions in logistics services in Saudi Arabia?
- Can the implementation of Hyperloop be correlated with specific cost-saving measures, such as reduced operational expenses, maintenance costs, or fuel consumption?

3. Environmental Sustainability:

- What are the environmental sustainability implications of introducing Hyperloop technology to the logistics sector in Saudi Arabia?
- How does Hyperloop contribute to lowering carbon emissions and promoting eco-friendly practices in comparison to current transportation modes?

4. Comparative Analysis:

- In a comparative analysis, what are the key differences in mean levels of logistics services between the existing transportation modes and the potential adoption of

Hyperloop technology?

- Are there specific logistics metrics that show a statistically significant difference when comparing the current system with the proposed Hyperloop implementation?

5. Stakeholder Perspectives:

- How do key stakeholders, such as government authorities, logistics companies, and environmental agencies, perceive the potential impact of Hyperloop on the logistics landscape in Saudi Arabia?
- What are the key considerations and concerns raised by stakeholders regarding the adoption of Hyperloop technology, and how might these influence its successful integration into the logistics infrastructure?

B. Research Hypothesis:

Null Hypothesis (H0): There is no statistically significant difference in the mean levels of logistics services, encompassing transportation efficiency, cost reduction, and environmental sustainability, between the current transportation modes and the potential implementation of Hyperloop technology in the Kingdom of Saudi Arabia. Any observed differences are due to random chance or factors unrelated to the adoption of Hyperloop technology.

Alternative Hypothesis (H1): The implementation of Hyperloop technology significantly enhances logistics services in the Kingdom of Saudi Arabia. The mean levels of transportation efficiency, cost reduction, and environmental sustainability are expected to be higher with the adoption of Hyperloop technology compared to the current transportation modes. Any observed differences are not likely due to random chance but indicative of a real and meaningful impact on logistics services. This enhancement is anticipated to contribute to a more efficient, cost-effective, and environmentally sustainable logistics infrastructure in the Kingdom.

Assessing Hyperloop Transport Optimizing Cost with Different Designs of Capsule	
Study	Hamad Almujiabah, 2023
Aim of study	The study aims to identify a hyperloop capsule with maximum capacity based on the design and speed for the comfort of passengers with efficient energy.
Dependent variable	Optimized cost of hyperloop system
Independent variable	Average distance, unit cost, and capacity of the capsule.
Methodology	The capsules were designed with AutoCAD for 28, 40, and 50 seats. Then the capsules were connected with solar power. The optimized

	costs for the capsules were calculated.
Results of the study and recommendations	The findings suggest that the hyperloop with the lowest number of seats (28) has the highest optimized cost due to the number of required capsules. The recommendations suggest further research on layout design and capsule capacity (Almujibah, 2023).

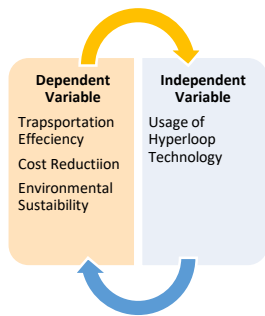


Fig. 1. Dependent and Independent Variables

In the context of the research on the potential impact of Hyperloop technology on logistics services in the Kingdom of Saudi Arabia, it is crucial to understand the concepts of dependent and independent variables. The dependent variable in this study refers to the various facets of logistics services, including transportation efficiency, cost reduction, and environmental sustainability. These metrics serve as indicators of the performance and effectiveness of the logistics system and are influenced by external factors. On the other hand, the independent variable is the implementation of Hyperloop technology, representing the intervention or change introduced to the existing logistics infrastructure. The potential link between the two lies in the examination of how the adoption of Hyperloop, as the independent variable, affects and brings about statistically significant improvements in the dependent variables, namely transportation efficiency, cost reduction, and environmental sustainability. By exploring this relationship, the research seeks to establish a nuanced understanding of how the introduction of Hyperloop technology can shape and enhance logistics services in the Saudi Arabian context.

V. LITERATURE REVIEW

The emergence of Hyperloop technology, proposed by Elon Musk in 2012, marks a significant breakthrough in transportation innovation, with the potential to revolutionize speed, cost-effectiveness, and sustainability in transit systems. As the global quest for faster, efficient, and environmentally friendly transportation intensifies, the implementation of Hyperloop technology has garnered considerable attention. This literature review aims to explore existing research on

Hyperloop implementation, focusing on its efficiency in terms of speed, energy consumption, and broader implications for the transportation sector.

This literature review exclusively incorporates peer-reviewed journals, emphasizing a scholarly approach rooted in empirical evidence. By confining the review to rigorously scrutinized, peer-reviewed articles, we aim to construct a foundation of reliability and credibility in our synthesis of findings concerning the implementation of Hyperloop technology. This method underscores our commitment to scholarly rigor, ensuring a comprehensive and robust understanding of empirical evidence related to the efficiency of Hyperloop systems within various facets of transportation. The reliance on peer-reviewed journals serves as a testament to the meticulous evaluation and synthesis of the existing body of knowledge, aligning with the standards of academic excellence inherent in conference paper presentations. By synthesizing insights from various sources, this review contributes to a comprehensive understanding of the current state and prospects of Hyperloop technology in the context of modern transit systems.

Effects of the Introduction of the Hyperloop on Existing Supply Chains	
Study	Malick Ndiaye, Philip Jarouj, Hassan Sobh, Ali Eisa Almheiri, Anas Azzouz, 2022
Aim of study	The study aims to provide evaluate the effects of the hyperloop on the current supply chain
Dependent variable	Speed, carry capacity, and launch rate
Independent variable	Mode of transportation
Methodology	A simulation-based arena is conducted to model a hyperloop supply chain in the Middle East and Germany.
Results of the study and recommendations	The findings suggest that the hyperloop can transport 8% more cargo and save time in the Middle East and Germany (Ndiaye et al., 2022).

Development of Smart Mobility Infrastructure in Saudi Arabia: A Benchmarking Approach	
Study	Fayez Alanazi, 2023
Aim of study	The study aims to provide insights into hyperloop technology in Saudi Arabia based on the mobility systems in Singapore, South Korea, and Japan.

Dependent variable	It does not mention a dependent variable, however, it explains the evaluation of different indicators
Independent variable	The independent variables are the indicators including mobility modes, governance, regulations, emerging technology, and data analytics.
Methodology	The smart mobility indicators were compared for the three countries and Saudi Arabia for private, public and emergency transport systems.
Results of the study and recommendations	The findings suggest that Saudi Arabia should implement hyperloop technology through standardization, policy-driven strategies, and inclusive development. In addition, artificial intelligence, machine learning, and data analytics are recommended to evaluate smart mobility systems (Alanazi, 2023).

Towards sustainable transportation: The Development of Hyperloop Technology in Saudi Arabia	
Study	Ashraf Alwy Balabel and Hamad Raja Almujiabah, 2022
Aim of study	The study aims to assess the feasibility of hyperloop systems in Saudi Arabia
Dependent variable	Total cost of hyperloop system
Independent variable	The energy system, projected cost
Methodology	The cost for three types of energy systems (fossil fuels, solar, and green hydrogen) were analyzed
Results of the study and recommendations	The findings suggest that the estimated cost for the hyperloop hydrogen system is higher than the electric and solar hydrogen systems. The study recommends further research on the efficiency and cost of the hyperloop hydron systems (Balabel & Almujiabah, 2022).

Kingdom of Saudi Arabia: Era of Smart Cities	
Study	Afnan Alotaibi; Dalal Alsubaie; Hailah Alaskar; Latifah Alhumaid; Rahaf Bin Thuwayni; Rawan Alkhalifah; Sarah Alhumoud, 2022
Aim of study	The study aims to explore the dimensions of smart cities including the environment, economy, transportation, and governance.
Dependent variable	Not specified
Independent variable	Environment, economy, transportation, and governance
Methodology	The dimensions of smart cities are reviewed and analyzed, elaborating the efforts of Riyadh to become a smart city.
Results of the study and recommendations	The findings suggest that Riyadh, Saudi Arabia, is aspiring to be fully smart in each dimension (Alotaibi et al., 2022).

A Comparative Assessment of Intercity Transport Technologies, with a Saudi Arabian Case Study	
Study	Hamad Almujiabah, 2021
Aim of study	The study aims to identify the most suitable transport technology for Riyadh-Dammam with the lowest social and operator costs.
Dependent variable	Average cost per passenger
Independent variable	Unit cost of High-speed Rail, Magnetic Levitation, and Hyperloop.
Methodology	Four models: total social model, demand forecast model, stated preference model and elasticity of demand model were used to assess the three modes of transportation.
Results of the study and recommendations	The findings suggest that Hyperloop is the best high-speed ground transportation for Riyadh-Dammam with the lowest social cost per passenger (Almujiabah, 2021).

Future Vision For Improving Riyadh City To Become A Smart Mobility City	
Study	Talal Obaid Alshammari, 2021
Aim of study	The study aims to enhance urban mobility in Riyadh city to improve the fuels and environment of the city, using real data and adoption strategies.
Dependent variable	Sustainability of the mobility system of Riyadh
Independent variable	Number of traffic and accidents.
Methodology	The deductive research approach is used to find the accidents and traffic in Riyadh based on real data
Results of the study and recommendations	The findings suggest that smart mobility like hyperloop systems has reduced accidents in Riyadh city. More such projects are recommended for public and environmental safety (Alshammari, 2021).

VI. STUDY METHODOLOGY

In undertaking a thorough exploration of the potential impact of Hyperloop technology on logistics services in Saudi Arabia, a mixed-methods approach will be implemented, encompassing quantitative survey analysis and qualitative insights.

A. Quantitative Survey Analysis:

Survey Design and Administration: A survey will be designed to collect quantitative data on existing transportation modes, logistics metrics, and environmental impact. This survey will be distributed among logistics companies and stakeholders involved in the transportation sector.

Performance Metrics: Key performance metrics, such as transportation efficiency, cost reduction, and environmental sustainability, will be quantitatively assessed for both current transportation modes and the hypothetical implementation of Hyperloop technology.

Statistical Analysis: Employing statistical tests, including t-tests and regression analysis, the study will evaluate the significance of differences in mean levels of logistics services between existing transportation modes and the potential Hyperloop implementation.

B. Qualitative Insights:

In-Depth Interviews: Qualitative insights will be obtained

through in-depth interviews with key stakeholders, including representatives from logistics companies and environmental organizations. These interviews will delve into perceptions, concerns, and expectations regarding the adoption of Hyperloop technology.

Thematic Analysis: Qualitative data from interviews will undergo thematic analysis to identify recurring themes and patterns related to stakeholder perspectives on Hyperloop implementation.

C. Integration of Findings:

Synthesis: The study will integrate both quantitative survey results and qualitative insights to provide a comprehensive understanding of the potential impact of Hyperloop technology on logistics services in Saudi Arabia.

Comparative Analysis: A comparative analysis will be conducted to highlight differences and similarities in perspectives and performance indicators between current transportation modes and the proposed Hyperloop usage.

VII. LIMITATIONS AND ETHICAL CONSIDERATIONS

Data Collection Limitations: The study recognizes possible challenges regarding the accessibility of data, especially concerning the hypothetical Hyperloop scenario. It commits to exerting efforts in utilizing the most precise and current information gathered through the survey.

Stakeholder Bias: To prevent potential biases in stakeholder interviews, we will take necessary measures to ensure that we include a diverse range of perspectives from various stakeholders. This will help us to gather a more comprehensive and well-rounded understanding of the topic at hand. Additionally, we will ensure transparency in our reporting, which will help to build trust among stakeholders and ensure that our findings are accurately represented.

Ethical Approval: To ensure the integrity and ethical standards of this study, we will take the following steps. First, we will obtain all necessary approvals for survey data collection. This will include any required institutional review board (IRB) or ethics committee approvals. Once these approvals are obtained, we will move forward with the data collection process. Secondly, we will ensure that all participants' confidentiality and anonymity are protected. This means that any personal identifying information will be kept strictly confidential and will not be shared with anyone outside of the research team. Additionally, we will use secure and encrypted methods to store all data collected during the study. Finally, we will adhere to all ethical standards when conducting the study. This includes obtaining informed consent from all participants, and ensuring that they are fully aware of the study's purpose and their role in it. We will also be transparent with any potential risks or benefits associated with participation, and provide clear instructions on how to withdraw from the study at any time without penalty.

VIII. RESULTS

Following are the results that we acquired from interviewing 50 officials from the logistics and transportation department in Saudi Arabia.

Figure 2. shows the results of the responses about the cost reduction of the current transportation and the proposed cost insights of the Hyperloop transportation system.

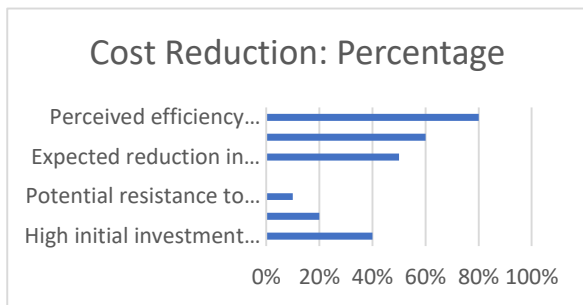


Figure 2. Responses about the cost reduction

The percentage of respondents expressing initial investment concerns was 40%. Stakeholders uncertain about the return on investment (ROI) of Hyperloop adoption constituted 20%. Additionally, 10% of respondents showed potential resistance to changes in existing processes. Those anticipating cost reduction in operational expenses were 50%. Resources allocated for expected long-term cost savings with Hyperloop were set at 60%. Furthermore, 80% of respondents favored perceived efficiency leading to cost reduction. Figure 3. shows the responses about the efficiency insights of the Hyperloop system.

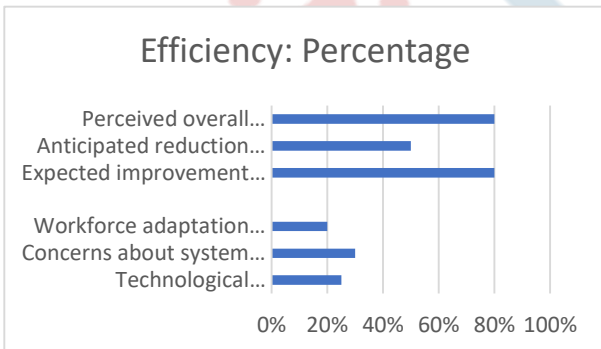


Figure 3. Responses about the efficiency of the Hyperloop system

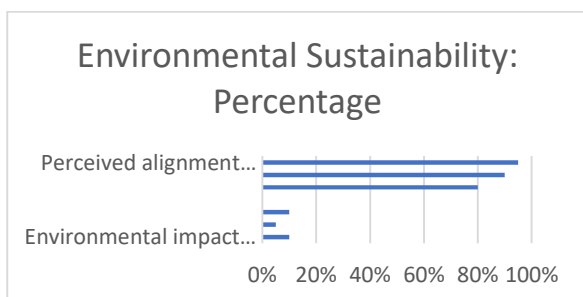


Figure 4. Responses about the environmental sustainability

The respondents who were concerned about the environmental impact assessment concerns were only 10%. The ones predicted potential backlash from environmental groups were 5%. The respondents who showed uncertainty about the long-term sustainability benefits of the hyperloop were 10%. The percentage of the respondents that responded in favor of the reduction of the carbon footprint from the proposed hyperloop technology was 80%. The ones that predicted positive public perception of sustainability were 90%. In addition, the ones that favored the perceived alignment with corporate social responsibility from the proposed system were 95%.

The respondents were asked if they were satisfied with the current transportation system and there were three types of responses. Figure 5. Shows the results of the analysis.

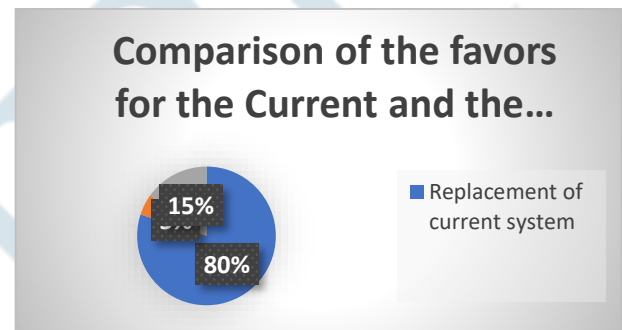


Figure 5. Responses in favor of the current system and the proposed system

The responses to the question of whether the respondents are satisfied with the current system do not show that 80% of the respondents were not satisfied with the current system due to higher cost, low speed, and carbon footprint. Only 5% were satisfied because they thought it was easy to run the system like it already is. 15% of the respondents were in favor of the improvements in the already existing system in terms of efficiency and carbon footprint reduction.

IX. CONCLUSION

The findings of this research reveal a high level of dissatisfaction among stakeholders with the current system. Furthermore, a significant number of respondents view the proposed system as sustainable, positioning the Hyperloop as an environmentally friendly project in Saudi Arabia. Additionally, 80% of respondents believe that future Hyperloop projects will result in cost reduction and an efficient system. This underscores the need for a new system that aligns with stakeholder satisfaction. The establishment of the proposed Hyperloop transportation system in Saudi Arabia is recommended, given the favorable stance of the majority of stakeholders towards future proposed projects.

RECOMMENDATIONS

The proposed Hyperloop transportation system in Saudi Arabia is envisioned to be intricate, featuring numerous

technological advancements and the integration of new operational systems. As a crucial step before the actual implementation of the project, it is imperative for the country to assess the existing expertise within its workforce. Adequate training programs should be initiated to equip the workforce with the necessary skills and knowledge required for the successful deployment and operation of the Hyperloop technology.

Moreover, in tandem with workforce development, it is essential for the Saudi Arabian government to take a proactive role in raising public awareness. This includes organizing informative sessions about the reduction of carbon footprint and the broader implications of climate change. These awareness campaigns are crucial to garner public support and approval for the implementation of the Hyperloop system. By engaging the public and addressing their concerns, the government can foster a sense of collective understanding and support for this innovative and environmentally friendly transportation initiative in Saudi Arabia.

REFERENCES

- [1] Alanazi, F. (2023). Development of Smart Mobility Infrastructure in Saudi Arabia: A Benchmarking Approach. *Sustainability*, 15(4), 3158.
- [2] Almujiabah, H. (2021). A comparative assessment of intercity transport technologies, with a Saudi Arabian case study (Doctoral dissertation, University of Southampton).
- [3] Almujiabah, H. (2023). Assessing Hyperloop Transport Optimizing Cost with Different Designs of Capsule. *Processes*, 11(3), 744.
- [4] Alotaibi, A., Alsubaie, D., Alaskar, H., Alhumaid, L., Thuwayni, R. B., Alkhalifah, R., & Alhumoud, S. (2022, January). Kingdom of Saudi Arabia: Era of Smart Cities. In *2022 2nd International Conference on Computing and Information Technology (ICCIIT)* (pp. 285-292). IEEE.
- [5] Alshammari, T. O. (2021). Future Vision For Improving Riyadh City To Become A Smart Mobility City. *NVEO-NATURAL VOLATILES & ESSENTIAL OILS Journal| NVEO*, 398- 417.
- [6] Balabel, A. A., & Almujiabah, H. R. (2022). Towards sustainable transportation: The development of hyperloop technology in Saudi Arabia.
- [7] Global Hyperloop Technology Market 2021 | Research analysis, market size, competitive landscape, and current trends by 2029 | Hyperloop One (U.S.), hyperloop transportation technologies (U.S.) (2021). Normans Media Ltd.
- [8] Griffith, T. L., Majchrzak, A., & Giustiniano, L. (2023). Hyperloop transportation technologies:
- [9] Practices for open organizing across VUCA contexts. *Journal of Organization Design (Aarhus)*, 12(3), 99-120. <https://doi.org/10.1007/s41469-023-00141-1>
- [10] Kassebi, O., & Siegfried, P. (2022). The hyperloop: The innovative logistic technology. *Puti Saobraćaj*, 68(1), 11-16. <https://doi.org/10.31075/PIS.68.01.02>
- [11] Majchrzak, A., Griffith, T. L., Reetz, D. K., & Alexy, O. (2018). Catalyst organizations as a new
- [12] organization design for innovation: The case of hyperloop transportation technologies. *Academy of Management Discoveries*, 4(4), 472-496. <https://doi.org/10.5465/amd.2017.0041>
- [13] Ndiaye, M., Jarouj, P., Sobh, H., Almheiri, A. E., & Azzouz, A. Effects of the Introduction of the Hyperloop on Existing Supply Chains.
- [14] Noland, J. K. (2021). Prospects and challenges of the hyperloop transportation system: A
- [15] systematic technology review. *IEEE Access*, 9, 28439-28458. <https://doi.org/10.1109/ACCESS.2021.3057788>
- [16] Notteboom, T., van der Lugt, L., van Saase, N., Sel, S., & Neyens, K. (2020). The role of seaports in green supply chain management: Initiatives, attitudes, and perspectives in Rotterdam, Antwerp, north sea port, and Zeebrugge. *Sustainability (Basel, Switzerland)*, 12(4), 1688. <https://doi.org/10.3390/su12041688>
- [17] Rajendran, S., & Harper, A. (2020). A simulation-based approach to provide insights on
- [18] hyperloop network operations. *Transportation Research Interdisciplinary Perspectives*, 4, 100092. <https://doi.org/10.1016/j.trip.2020.100092>