A Multi-Stakeholder Perspective on the Limitations of Implementing Artificial Intelligence in Highway Transport

Glory Chinwe Ugo [a*], A. C. Apata [a] and Praise Onimisi Dawodu [a]

[a] *Department of Civil and Environmental Engineering, University of Lagos, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

This research paper explores stakeholders' perspectives on the challenges associated with implementing Artificial Intelligence (Ai) in highway transport. The investigation focuses on three main areas of limitation: technical, regulatory, and ethical barriers. The study, backed by an in-depth survey analysis, reveals key limitations identified by stakeholders, including limited access to Ai technology (42.6%), lack of government support (27.9%), the absence of industry-wide regulations (27.4%), concerns about job displacement (29.4%), privacy implications (25.5%), and cybersecurity risks (30.2%). Additionally, the paper provides recommendations for policymakers, industry stakeholders, and researchers to address these challenges [1].

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*Corresponding author: Email: ugoglory5@gmail.com;

1. INTRODUCTION

One of the prime areas where Artificial Intelligence (Ai) will make its most paradigm-shifting impact is transport [2,1]. Highway transportation is the backbone of the global transportation system, accounting for more than 90% of total transportation worldwide. However, the highway transport system is facing numerous challenges, including traffic congestion, air pollution, accidents, and deteriorating infrastructure. Ai has the potential to revolutionize highway transport by improving safety, efficiency, and sustainability. Ai is a rapidly growing technology that is changing the face of transportation industries worldwide. The application of Ai in the transport field is aimed at overcoming the challenges of an increasing travel demand, CO2 emissions, safety concerns, and environmental degradation [3].

However, Ai successful implementation requires careful consideration of technical, ethical, and regulatory issues. As such, continued research and development in this field are essential to ensure that Ai is used to its full potential while minimizing any potential negative impacts. While there are many potential benefits to using Ai in highway transport, there are also some criticisms and limitations to consider [1]. The experts noted that the growth of the world market for Ai in the coming years will be accompanied by ethical and social problems. These problems are called - unintended consequences of the use of Ai technologies [4].

Artificial Intelligence (Ai) systems rely on vast amounts of data and complex algorithms to operate, which can increase the risk of system failures or errors. Also, the use of Ai-powered sensors and communication networks can make transportation systems more vulnerable to cybersecurity threats, potentially compromising the safety and security of the system. One of the most significant criticisms of Ai in highway transport is the potential for system failures and cybersecurity risks. With more data being shared and a larger dependency on data, cybersecurity is getting more important [5,1]. Another limitation is the potential for bias in decision-making. Ai algorithms are only as unbiased as the data used to train them, and if the data is biased or incomplete, the resulting decisions may also be biased. This can lead to discrimination against certain groups of people or communities [6-8]. Therefore, Ai solutions have the potential to support or even take over control of humans to deal with the large amount of data and the complexity of control in (real-time) situations [5]. Furthermore, the implementation of Ai-powered transportation systems requires significant investment in infrastructure and technology, which may not be feasible for all communities or regions. Rural areas or developing countries e.g. Nigeria may not have the resources or expertise to implement and maintain Ai-powered transportation systems, leading to disparities in access to transportation [9-11]. Technologies like Ai are in potential ground-breaking, but applications are only just starting to use them, discovering what is already possible and what still needs to be developed [1]. Another limitation is the potential impact on employment in the transportation sector. The automation of transportation through the use of Ai-powered autonomous vehicles may lead to job losses for drivers and other transportation workers [5].

Interest in Ai is growing from the side of science and practice. At the same time, it is difficult to predict the rate of penetration of Ai technologies into the lives of people and the activities of companies [4,12,13-14]. The findings of this research will provide insights into some of the limitations of implementing Ai in highway transport from a stakeholders perspective and also offer mitigation measures. Ai, like any other innovation, changes the content of processes and allows you to get a slightly better result. There is still a lot of time and effort to spend on researching the results of using Ai technologies [4].

2. METHODOLOGY

This research aims to research the limitations of implementing Artificial Intelligence (Ai) in highway transport from a multi-stakeholder perspective and ways to address them. The study will use an online survey as the data collection method. In 2020, experts from the Gartner agency conducted a survey of respondents in order to identify the sentiments of company leaders regarding the use of Ai-technologies. The result showed that more than 50% of managers plan to deploy the use of Ai technologies in their companies. This is 14% more than in the last year's survey [4].

2.1 Method of Obtaining Data

Data was collected from a total of 100 highway transport stakeholders using a survey

questionnaire which was designed to encompass diverse aspects of Artificial Intelligence (Ai) applications in highway transport including the different limitations/barriers facing its adoption and implementation in highway transport. The questionnaire consisted of a total of 20 questions, divided into four sections. For the purpose of this paper we will focus only on some of the charts from the first and fourth section.

Section 1: Demographic Information (3 questions)

This section collects information about the participants, such as their age, gender, and occupation.

Section 4: Challenges and Limitations (5 questions)

This section investigates the challenges and limitations of implementing Artificial Intelligence in highway transport, such as technical, regulatory, and ethical limitations. The survey consists of closed-ended questions and are designed to ensure that the responses provide the necessary information to achieve the objectives of this research paper.

2.2 Survey Distribution

Utilizing digital platforms like Jotform, the survey was disseminated across various online channels, including transportation forums, academic networks, and industry-specific groups.

The survey was accessible for a predetermined period to obtain a broad and representative sample.

2.3 Data Analysis

The data collected through surveys, was analysed using descriptive statistics and Microsoft Excel as the tool for analysis. Descriptive statistics was used to summarize and present the survey results.

3. RESULTS AND DISCUSSION

3.1 Occupation

The results in Fig. 1 shows the occupational diversity of the respondents with "Engineers" constituting the largest professional segment, with 60 respondents. "Government Officials" making up the least segment with 4 respondents. The "Other" category encompassed 17 respondents, potentially including various professional backgrounds not explicitly listed.

3.2 Technical Limitations

The survey findings highlight various technical challenges perceived by respondents in implementing Ai within highway transport. A significant proportion raised concerns about the limited availability of Ai technology (42.6%), followed by data privacy issues (29.4%) and the absence of standardization (27.9%).
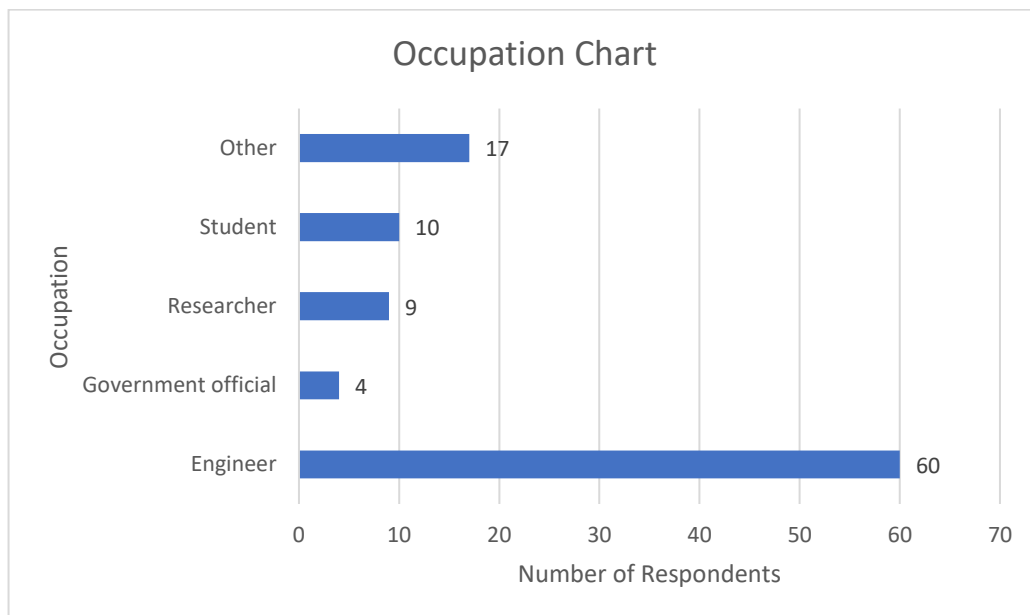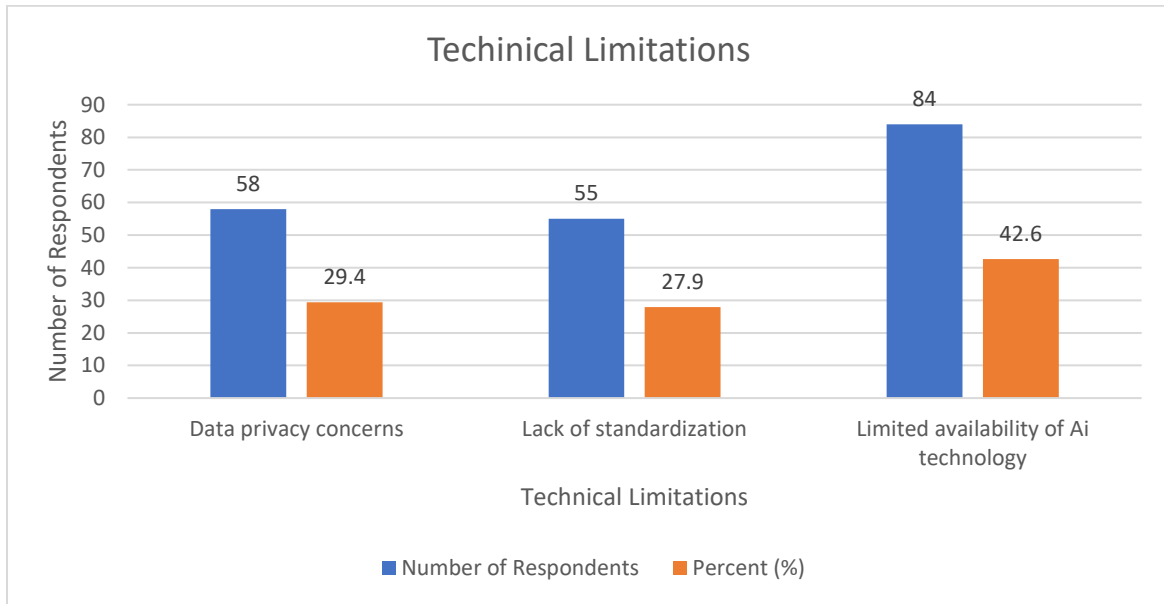

Fig. 1. Occupation Chart

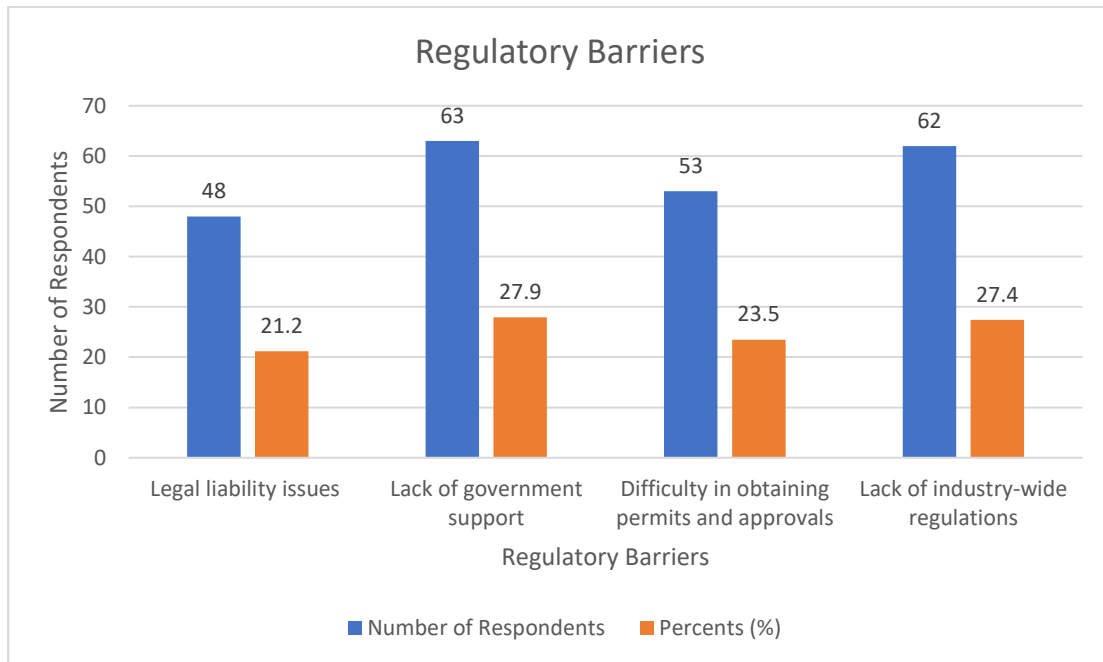**Fig. 2. Technical Limitations Chart**

Fig. 3. Regulatory Barriers Chart

3.3 Regulatory Barriers

The results show various regulatory hurdles perceived by respondents in implementing Ai within highway transport. Legal liability concerns (21.2%), lack of government support (27.9%), challenges in obtaining permits (23.5%), and the absence of industry-wide regulations (27.4%) were the primary issues highlighted.

3.4 Ethical Considerations

The insights from Fig. 3 emphasize various ethical concerns associated with integrating Ai in highway transport. Concerns about job displacement (29.4%), biases in Ai algorithms (14.9%), privacy implications (25.5%), and cybersecurity risks (30.2%) were the prominent issues highlighted by the respondents.
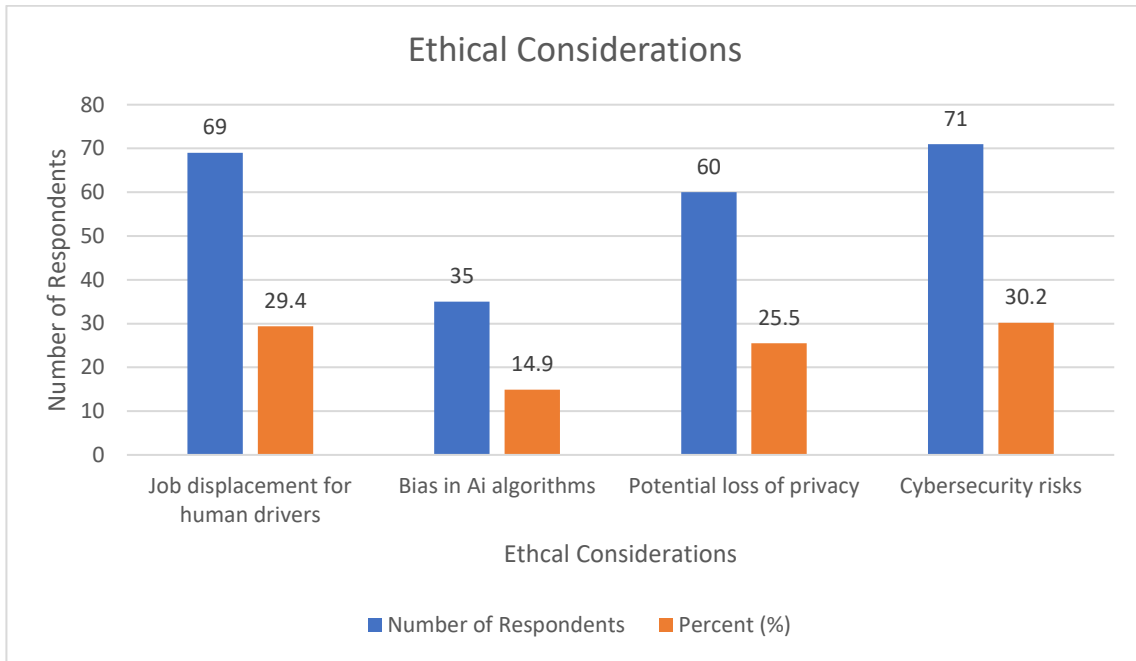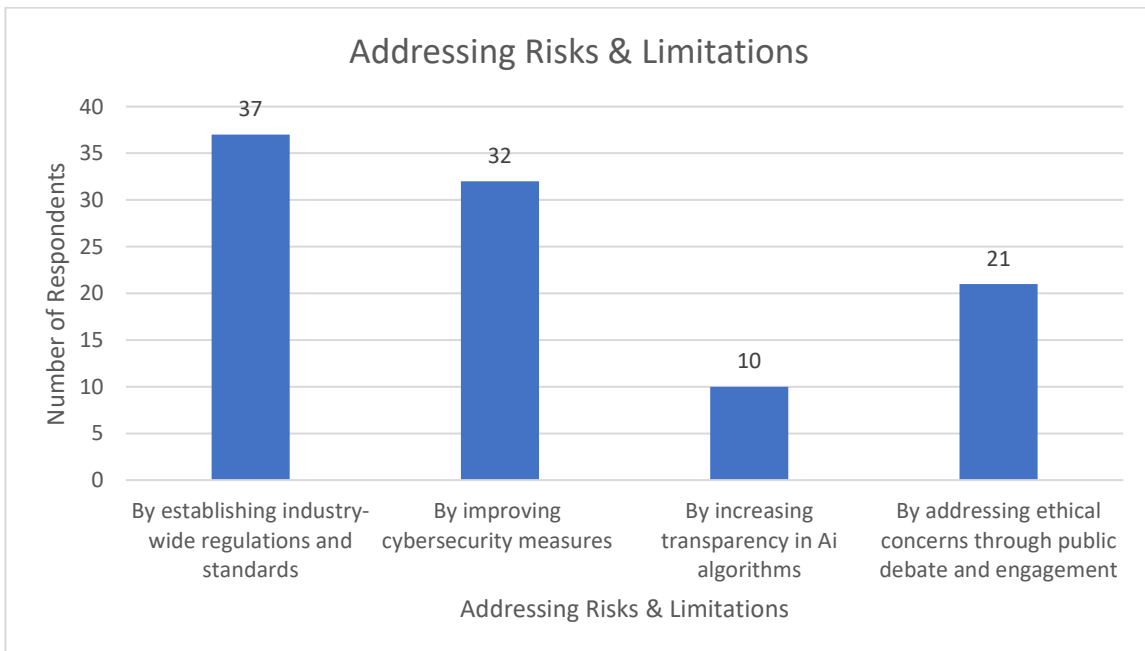
Fig. 4. Ethical Considerations Chart

Fig. 5. Addressing the Limitations Chart

3.5 Addressing the Limitations

The responses from research survey signify various strategies suggested by respondents to mitigate the limitations and challenges associated with implementing Ai in highway transport (Fig. 5). The recommendations largely centre on regulatory frameworks, enhanced cybersecurity, algorithm transparency, and public engagement to address ethical concerns.

4. CONCLUSION

The demographics results of this research survey shows that the participants in the survey were majorly highway transport professionals which is

evident in the occupational distribution with 60% responses from engineers. This research focused on technical, regulatory, and ethical barriers from stakeholders perspective. The results of the survey conducted, shows the diverse perception of barriers to implementing Ai in highway transport and more importantly various ways to address these issues which are; establishing industry-wide regulations and standards, improving cybersecurity measures, increasing transparency in Ai algorithms, addressing ethical concerns through public debate and engagement.

5. RECOMMENDATIONS

The recommendations for policymakers and transportation authorities are as follows;

- Raise awareness about the benefits of Ai in highway transport and allocate resources for further research.
- Foster collaboration between research institutions and automotive companies to tackle technical challenges like data privacy.
- Establish industry-wide standards and guidelines to advance the use of Ai in highway transport.
- Provide training and resources to develop skills in current Ai technologies for industry professionals.
- Encourage cooperation between the public, government, and the transport sector to address ethical concerns, such as potential job displacement for human drivers.

6. LIMITATIONS

- Reliance on MS Excel for descriptive analysis may limit the depth of data interpretation.
- The study's sample size of 100 respondents raises concerns about the generalizability of findings to the broader stakeholder population in highway transport.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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