https://doi.org/10.65025/ICAIC26102n

Artificial Intelligence, Smart Cities, And Internet of Vehicles: Buılding Manitoba's Intelligent Mobility Future

Emmanuel Judicael Nguingui
https://orcid.org/0009-0001-4312-1094

Abstract

Immigration in Manitoba continues to create unprecedented challenges in the city of Winnipeg as population mobility has become an increasingly significant challenge. To address these issues and find a reliable, effective, and sustainable solution, collaboration between lecturers, researchers and government officials is needed to implement smart city technologies, especially Artificial Intelligence (AI) and autonomous driving systems. Initially, the internet of things (IoT), was aimed to advance quality of life through interconnected systems. Today, it has evolved into the internet of vehicles (IoV), which has transform transportation ecosystems and enable vital exchange of data between road networks and vehicles. The IoT has given rise to the Internet of Vehicles (IoV), a rapidly emerging technology that generates significant buzz in the transportation sector. The IoV has completely transformed the transportation ecosystem and enable the dynamic exchange of data and information through a connection between vehicles (Vehicle Network) as well as all components of the road network. It enables vehicle manufacturers to design autonomous cars and ensure smart driving. To address the challenges, it is best to integrate AI in Manitoba. Integrating AI into Manitoba's transportation system would not only enhance traffic management, regulation, but real-time decision-making, while supporting Sustainable Development Goals (SDGs). Smart cities focus more on improving and optimizing various models by integrating motion detectors and sensors into exchange systems specifically communication networks as well as various information and data infrastructures, with the aim of conducting in-depth analyses. Smart projects, in Winnipeg, have laid the foundation for the application of IoT and IoV. This has help to not only increase but empower the monitoring of road capacity, efficient traffic flow, and also, integration of public and private transport systems. These technological innovations are particularly significant because Manitoba has a harsh climate and vast geography. Therefore, the paper incorporates a mixed-methods approach (that is, qualitative and quantitative) to develop a model which presents the realities of Manitoba. This model provides policymakers, technology stakeholders and urban planners with practical strategies for building a robust, sustainable smart transportation system that addresses the unique challenges of Manitoba. Finally, the study encourages global debates on smart cities by showing how AI, IoT, and IoV can strengthen mobility and resilience in metropolitan areas like Winnipeg.

Keywords: Artificial Intelligence (AI); Smart city; Internet of Vehicles (IoV); intelligent transport system

1. Introduction

Transportation systems in the 21st century are undergoing rapid transformation in major cities around the world at a pace comparable to the speed of light Priyanka M and Ghanshyam maintain that transportation systems is a perception inspired by the expansion of towns and the growth of population or population increase. To them, there is an upsurge need for increased capacity and productivity optimization with the goal of providing the best possible user experience (Priyanka M and Ghanshyam S, 2025).

There is rapid advances in technology particularly AI, digital connectivity, and innovations as well as progress in the urban context. Due to the relentless expansion of metropolitan areas and the ever-increasing demand for transportation, we can confirm that conventional transportation systems have become obsolete and inadequate, rendering them incapable of addressing various challenges, including traffic congestion, road safety measures, sustainable development, and infrastructure efficiency or performance issues. Given these obstacles, it is important for us to note that the concept of smart transportation is a key driver of urban modernity, as it involves integrating digital technologies into transportation networks to build increasingly robust, stable, and efficient cities.

Smart cities, as far as global urban development is concerned, are the main focus as they are platforms that operate through connectivity, leverage web-based and robotic data to enhance and optimize the well-being of users and residents. Just like IoV, the digital metropolis system depends so much on a sophisticated transportation network and leverages AI. The Internet of Vehicles has as its primary function to enable seamless and harmonious interconnection between vehicles (V2V) and infrastructure (V2I). Through AI-focused research, we have found that this technology is a tool that can improve mobility coordination (traffic), minimize the frequency of accidents, and assist in the contribution of immediate and continuous decision-making across the entire transportation ecosystem. For instance, in the province of Manitoba, (the city of Winnipeg) we have identified a dire and unique need to establish or implement a smart city project focused on smart transportation. This region faces numerous challenges, such as periodic intense weather events, a road network that has defective and obsolete infrastructure, the expansion of new urban areas, and a significant reliance on personal automobiles. The province has intense seasons which are consistently marked by constant snowfall, which subsequently forms mountains of ice that prevent inhabitants from freely walking and creates limited visibility. Consequently, the safety of the road network and its transportation ecosystem becomes a major issue that needs investigation as it poses additional challenges for both traditional transportation methods and emerging technologies. This local situation requires an in-depth inquiry and vigorous, dynamic, vibrant, tailored approaches that goes beyond conventional standards of smart cities. It should be noted that all the tools contributing to smart transportation models rely on AI and IoV technologies. These two technologies provide us with a reliable path to achieving our goal by maximizing energy efficiency through smarter route planning while supporting the transition toward autonomous, interconnected vehicles.

This work examines and presents the existing interactions that link AI, smart city models, and technologies encompassing the IoT particularly IoV to explore the transportation ecosystem in Manitoba. The goal is to conduct a thorough and detailed analysis to assess how these innovations can be integrated into existing infrastructure, taking into account the compatibility of each technology to create a more efficient, robust, and smart transportation system while addressing the various challenges, the opportunities provided by existing technological advancements, and the constraints. It suggests a structured approach specifically designed to adapt to Manitoba's realities and priorities. This work will add value to broader discussions on smart cities and sustainable transportation by offering a perspective tailored to specific local conditions, demonstrating how large-scale regions face climate challenges as exemplified by Manitoba while also being capable of integrating cutting-edge technologies to modernize their transportation ecosystems, enhance their operational efficiency, as well as maximize the quality of transportation within the urban living environment.

2. Background and Motivation

Over the years, digital advancements and the rapid development of cities throughout the world have drastically and significantly transformed the vitality of cities, the way they operate, and how the residents move from one place to another globally. There have been increased pressure faced by the transportation infrastructure and the entire transportation ecosystem, largely as a result of population growth, the expanding vehicle fleet, and the need for a faster, more economical, and sustainable modes of transportation. In the 21st century, conventional traffic flow management techniques, have become progressively inadequate to recent technological advancements and are no longer capable of addressing the challenges of urban traffic. Maybe this is due to the fact that rely primarily on static systems and various dynamic control devices. Thus, this has led to the development of different intelligent transportation tools which are centered on AI techniques, in-depth data analysis, and information processing that takes all details and particulars into account, as well as constant interconnectivity.

The Internet of Vehicles (IoV) is considered the most significant technology in this sector; we should note here that the IoV is an innovative extension of the Internet of Things (IoT). The IoV applies the principles of the IoT to transportation networks. The goal of IoV is to enable the transportation ecosystem and users to communicate in real time, thereby, creating a dynamic, connected transportation environment. Combined with AI, these two technologies have the capacity to manage large amounts of data and information to anticipate traffic, optimize routes, enhance road safety, and facilitate the operation of autonomous vehicles. This implementation forms the technological foundation of smart cities, offering a deployment that is not only efficient but also flexible and capable of responding to real-time situations.

According to the Honorable Evan Solomon, Minister of Artificial Intelligence and Digital Innovation and the Minister responsible for the Federal Economic Development Agency for Southern Ontario, in a press release issued on October 15, 2025, in Winnipeg, Manitoba, PrairiesCan “Businesses and digital innovations are the pillars of our economy, and many of them want to use artificial intelligence to improve productivity.” The latter adds that “the Government of Canada is committed to developing our country’s AI sector, promoting the adoption of AI, and establishing a sovereign digital infrastructure. “Leveraging AI while building trust in its responsible development and deployment will foster growth and shared prosperity in Manitoba.” (SorayaLemur, 15 October 2025).

In Canada, particularly in the province of Manitoba, the growing demand for smart transportation options has become a priority for urban centers such as Winnipeg, which face transportation challenges increasingly marked by traffic congestion, infrastructure overload, and insufficient public transit networks. These difficulties are further exacerbated by factors specific to the region. Manitoba’s harsh winters that come every year provides dangerous conditions, as well as reduced visibility, slippery roads, and an increase in accidents that make vigorous and flexible transportation systems overbearing. Traditional control and management systems are generally unable to adapt dynamically to climatic and geographic conditions that change so rapidly.

Furthermore, the structure of the town, Winnipeg is made up of relatively a small population size and the widespread expansion of built-up areas that rely heavily on private cars. This phenomenon encourages rising greenhouse gas emissions, and has led to an increased in the consumption of fuel and more significant environmental impacts, even as global and national commitments to combat the growing climate crisis intensify. Regions such as Manitoba are increasingly being encouraged to implement sustainable transportation solutions that are capable of meeting the goals of the environment without compromising economic growth or access to services.

Technologically, rapid innovations in various fields today such as AI, machine learning, ultra-sensitive sensors, detection systems, and wireless networks have greatly transformed the landscape of transportation systems worldwide in towns as cities now incorporate the advancements called digital technology in their day-to-day operations. Traffic lights capable of dynamically adjusting their cycles based on the flow of vehicle, fleets of interconnected cars exchanging real-time traffic information, instant data streams to optimize routes, and predictive analytics algorithms anticipating traffic jams before they even occur. Despite global efforts, the integration of digital solutions in towns that are mid-sized especially those that have extreme climates remains limited. This situation highlights a research gap in innovation that needs to be filled. Therefore, it is crucial to conduct research that is focused on specific regional contexts, paying attention to the economy, the environment, and in particular, the existing infrastructure, so as to create inclusive and resilient transportation systems.

3. Literature Review

Recent studies on smart mobility and smart transportation highlight the synergy between artificial intelligence, smart city standards, and the Internet of Things specifically, the Internet of Vehicles (IoV). AI and IoV are seen as drivers of innovation and implementation for various modern transportation systems. Researchers and experts in these fields have conducted in-depth analyses of how these various techniques and technologies positively enhance people's daily lives in terms of the safety and sustainability of urban mobility. Previous studies have demonstrated the importance of AI and the IoV in the development of smart cities.

Edith. N et al. (2021) conducted a study titled "Artificial Intelligence (AI)-Empowered Intelligent Transportation Systems." In the study, the authors explore how AI can be integrated into the transportation ecosystem with the aim of making it safer, more efficient, modern, and even more flexible in real-time contexts. Several challenges were identified during their research, including high-intensity transportation applications requiring significant computing power, real-time communication between vehicles, efficient resource allocation, transportation safety, traffic congestion and urban mobility, as well as cyber security in transportation networks. It is within this set of challenges that the authors seek to answer the question: how can AI contribute to transforming transportation systems into intelligent, flexible, secure, and autonomous systems?

To answer this question, they utilized every AI technique available for solving these problems by combining edge computing and fog computing. They decided to implement these various AI technologies, including deep learning and computer vision systems. The goal was to ultimately optimize the transportation ecosystem by enhancing its safety, stability, analytical capabilities, security, and ability to operate in real time. The study conducted by these researchers encompasses 58 different studies on AI, specifically in the field of transportation, highlighting its ability to maximize the smart transportation ecosystem through forecasting specifically automation, communication, safety, and traffic regulation. This research did not demonstrate a fully operational, fully integrated AI-driven transportation environment operating under real-world conditions on a large scale. Thus, they recommended a greater focus on AI integration regarding real-time management, autonomous driving, cyber security, resource optimization, and the phased implementation of smart transportation systems for connected cities (Edith N, Chao C, Amr M, Mohammad S, Fanzhao W, 2021) This, our study intense to fill this gap.

According to Manta .M et al. (2022), Artificial Intelligence (AI) is set to become an indispensable technology for the design of future smart cities. They go on to cite a study by the

United Nations Population Fund, in 2014, where cities were home to 3.3 billion people, or 54% of the global population. By 2050, they think nearly 5 billion people or 68% will live in urban areas. In 2022, these researchers published a paper titled "The Adoption of Artificial Intelligence in Smart Cities: A Comprehensive Study" and had as their goal to address the sustainability challenges of smart cities and adopt a human-centered approach in light of the growing population complexity. To address this issue, the authors utilized artificial intelligence techniques such as Machine Learning (ML), Deep Learning (DL), Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Deep Reinforcement Learning (DRL), Deep Belief Networks (DBN), IoT+AI Integration, and more. Our study is similar to theirs since it focuses on AI capable of leveraging machine learning, deep learning, the Internet of Things, big data, cybersecurity systems, and intelligent automation to improve transportation, safety, and handles disaster management, and environmental sustainability. In their paper, they only conducted an in-depth analysis, examine, and summarize current AI programs related to smart cities across various fields. However, it has not established a new AI architecture, developed a novel neural network model, or designed a new AI architecture. According to these authors, future research should focus much more on the evolution of AI infrastructures for smart cities, the optimization of cybersecurity, the integration of AI and the IoT, real-time device processing, robust city management, autonomous mobility, and unified frameworks dedicated to smart cities (Herath h, 2022) Their study helps lay a groundwork for this study as it fills the gap presented by the authors.

Chadrakant D. Kokane et al. (2023) approve that traffic management and road congestion are some of the numerous challenges that are important and are usually faced by the transportation sector. These challenges are said to be caused by an increase in population and urbanization. In 2023, they had as their goal in a published paper online to improve intelligent transportation systems in any smart city grounded on Internet of Vehicles (IoV) with the use of machine learning. In their study, they successfully demonstrated that intelligent transportation systems are been enhanced by machine learning algorithms. These algorithms incorporates efficient transportation, traffic prediction, and effective communication between vehicles. Despite the machine learning method, we can also observe that several issues remain unaddressed, including the implementation and deployment of a fully autonomous intelligent transportation system that is entirely dependent on AI, taking into account the real-world system. We can also note that issues related to cybersecurity, privacy concerns, and challenges associated with the IoV-based smart city ecosystem have not been rigorously addressed. For future research, they recommend further work on implementing the system in a real-world environment with low latency by leveraging and incorporating various AI techniques, specifically machine learning (Chadrakant D, Gopal M, Sonu K, Bharti J, Vilas V, 2023).

Ines A.M. Gil et al. (2025) confirm that the acceleration of urban growth creates social, ecological, and structural challenges that conventional approaches to urban management are unable to adequately address in an article titled "Artificial Intelligence, Society 5.0, and Smart City Adaptation Initiatives for Businesses: An Integrated Approach." In this paper, the authors support their thesis by explaining that traditional urban management systems have become increasingly unable to respond robustly and effectively to these challenges. The question is raised as to how organizations and firms will be able to easily integrate into smart cities most of which are built on AI and Society 5.0 in a world marked by complexity, uncertainty, and growing urbanization. He then critiques previous research, stating that it does not provide a comprehensive and robust decision-making framework to solve this problem; researchers have developed a decision support platform based on elements such as knowledge modeling. The DEMATEL (Decision Making Trial and Evaluation Laboratory) model, along with neutrophic logic as the underlying solution, led them to conclude that it would be best to establish a well-organized decision-making system that promotes human participation, sustainable oversight, collaborative work, and the secure implementation of AI to assist businesses and cities as they transition to Society 5.0 and smart city environmental systems. For future research, the authors recommended focusing much more on practical, innovative smart cities based on interdisciplinary approaches and supported by tangible evidence (Ines A, Fernando A, Neuza C, Florentin S, Momtaj K, Tugrul D, 2025)

Priyanka M. et al. (2025) conducted a study titled "Internet of Vehicles for Sustainable Smart Cities: Opportunities, Issues, and Challenges," in which they confirm that intelligent transportation networks are essential for the population of major metropolitan areas, as they facilitate both vehicle mobility and the movement of the entire population residents. In this paper, the authors' main objective is to highlight the IoV and its importance in smart cities, using the example of vehicle communication with the entire intelligent transportation ecosystem, taking into account traffic management and road safety. The problem this paper seeks to address is the range of challenges faced by intelligent systems in various smart cities around the world (issues such as congestion, road safety, high-quality communication between vehicles, compatibility issues between different systems, and the challenge of large-scale vehicle management due to the complexity of computer networks). They opted for a research and analysis methodology rather than an experimental approach, and therefore propose that smart cities should adopt an IoV infrastructure that incorporates all the components of an IoV network. In this study, the researchers conducted a literature review on IoV concepts and architecture, then, they carried out an in-depth analysis of wireless communication technologies within IoV architectures, followed by an analysis of IoV applications for intelligent transportation. They identified several technical challenges but they did not develop a new IoV architecture or propose a design that would function efficiently in the real world. In terms of future research, they recommend the development of a secure IoV infrastructures that should be compatible with the whole transportation ecosystem The above aforementioned confirms that in order to implement intelligent transportation systems, it is substantial to have in mind three meaningful elements, that is, AI, IOV, and smart city technology. These three elements are necessary universally (globally)when executing smart transportation systems. There is no doubt why Priyanka, M (2005) insisted that IOV infrastructures recently must likely focused on AI and assist or aid everything that happens in intelligent transportation (Priyanka M, Ghanshyam S, 2025)

However, it is clear that a comprehensive study is needed that focuses on regions such as Manitoba, taking into consideration particular infrastructure and environmental challenges.

The unique characteristics of this study that makes it different from other studies conducted is that it incorporates specific features of an assimilated smart mobility framework based on AI. in Concerning the case of Manitoba, this framework combines AI, smart city technologies, and the Internet of Vehicles. This is a new area of study, as it seeks to address specific questions regarding the reality of a city that has a cold climate, and is novel because there has not been any research carried out on the subject. This explains why we compare the policy framework, climate resilience, infrastructure availability, and sustainability goals within an integrated smart mobility model in order to develop an intelligent transportation system in an emerging smart city.

4. Solution Proposal for Building Manitoba's Intelligent Mobility Future

In this section, we designed and presented a smart mobility ecosystem that takes into account the realities of Manitoba.

4.1. Manitoba Intelligent Mobility Framework (MIMF)

We ensured the implementation of a robust architecture responsible for data collection, dissemination, analysis, management, and utilization. This infrastructure is the result of combining innovations from new technologies that enable smart cities to operate efficiently through all of the following components such as AI, IoV, cloud computing, edge computing, and next-generation communication networks which helps create a reliable, high-performance, and sustainable connected transportation environment. The layers that make up this architecture are as follows:

- ✓ Data collection and Integration
- ✓ Smart city infrastructure
- ✓ Internet of vehicles
- ✓ Artificial Intelligences
- ✓ Intelligent decisions support
- ✓ Sustainability and smart mobility outcome

The following model presents the Manitoba Intelligent Mobility Framework (MIMF)

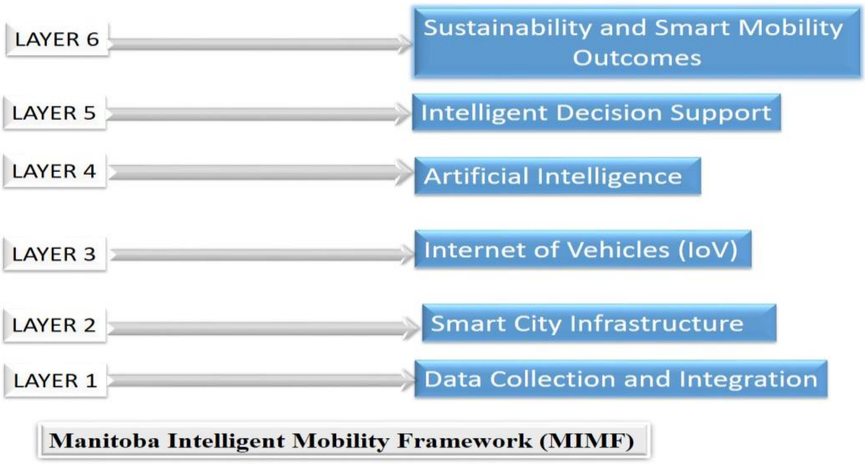

Figure1: Manitoba Intelligent Mobility Framework (MIMF)

Description of the MIMF layers

The aim here is to describe each layer in terms of its functions.

- ➢ **Layer 1: Data Collection and Integration**. We considered this layer as the foundation of our model, whose primary purpose is to collect data from various sources and integrate it to enable real-time operation and maintain a historical record. The data comes from various sources, among others.

DATA SOURCE				
Transportation Data	Vehicle speed	Traffic density	Accident records	Roads condition
Environnemental Data	Snowfall	Temperature	Visibility	Ice condition

Public Transit Datas	Bus schedules	Passenger demand	Route performance	
Vehicle Data	GPS location	Fuel consumption	Vehicle diagnostic	
Manitoba Relevance	Snow-covered roads	Black ice conditions	Reduce Visibility	

Table 1: Layer 1; Data Collection and Integration

- **Layer 2**: Smart City Infrastructure. This part of the model highlights the interconnected infrastructure of the city in Manitoba and consists of the following elements listed in this table.

COMPONENT			
Smart Traffic Signals	Adaptative signal control	Dynamic timing adjustment	
IoT Sensors	Roads occupancy sensors	Weather Sensor	Air quality sensors
Smart Intersection	Connected traffic light	Emergency vehicle prioritization	
Digital Roads Infrastructure	Smart road Signs	Variable message displays	

Table2: Layer 2; Smart City Infrastructure.

- **Layer 3: Internet of Vehicles (IoV).** This layer facilitates communication between vehicles and the entire transportation ecosystem, which involves several types of communication, as outlined in the table below.

COMMUNICATION TYPES			
Vehicle-to-Vehicle, enable :	Collision warnings	Blinds-spot alerts	Cooperative driving
Vehicle –to-infrastructure, enable :	Signal timing information	Road hazard alert	Constructio n update
Vehicle – to – Pedestrian, improve :	Pedestrian safety	Crosswalk management	

Vehicle – to – Network, provide:	Cloud connectivity	Real-time navigation	Data sharing

Table3: Layer 3; Internet of Vehicles (IoV)

- **Layer 4: Artificial Intelligence**. This layer serves as the "brain" of the infrastructure or the model's intelligent engine. It consists of the following modules:

Artificial Intelligence				
Traffic prediction model	Uses	Deep Learning	LSTM Network	Times-Series Forescasting
	Output	Congestion Forescasting	Travel demand Predictions	
Road Safety Analytics	Uses	Computer Vision	Machine Learning	
	Output	Acciden risk zones	Dangerous driving detection	
Smart Signal optimization	Uses	Reinforcement Learning		
	Output	Adaptive signal timing	Reduced Waiting times	
Winter Mobility prediction	Road Icing Risk		Snow accumulation impacts	Accident probabilities

Table 4: Layer 4; Artificial Intelligence.

- **Layer 5: Intelligent Decision Support**. The role of this layer is to convert the various results obtained in Layer four (4) into tangible actions. This layer is responsible for converting the various results obtained in Layer 4 into tangible actions.

Intelligent Decision Support			
For Goverment , provides	Infrastructure planning recommendation	Road maintenance prioritization	Emergency response optimization

For traffic Management Center, provides	Smart navigation	Travel recommandation	Public Transit optimization
Urban Planners	Mobility trend analysis	Smart infrastructure planning support	Sustainability indicators
Commuters, Receive:	Real-time travel information	Route recommendations	Weather-related mobility alerts

Table 5: Layer 5; Intelligent Decision Support

- **Layer 6: Sustainability and smart mobility outcomes (Application).** This final layer enables the delivery of smart transportation services. The table below provides further details on the function of this layer.

Application		
Smart Traffic Management System Provides:	Dynamic traffic control	Congestion mitigation
Connected Vehicle Services; Provides:	Real-time tracking	Schedule optimization
Mobility Dashboard; Provides:	Transportation analytics	Performance monitoring

Table 6: Layer 6; Sustainability and smart mobility outcomes

4.2. System WorkFlow

The WorkFlow System is a tool that helps us better understand how the MINF model operates, specifically, the interactions between the various entities that make up the system. This system is significant as it has as its role to systematize, arrange tasks by coordinating the various actions of not just people but the different systems to ensure that each step is carried out systematically and appropriately. The system description is presented below.

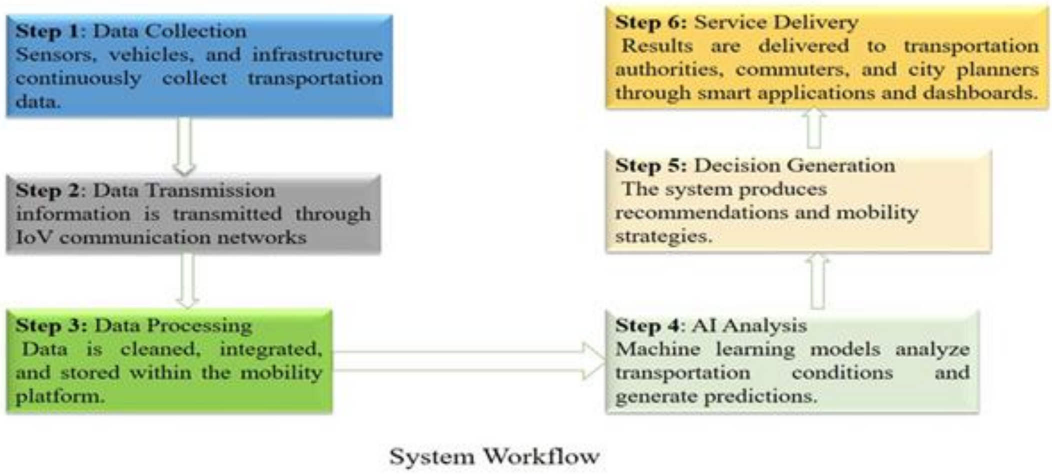

Figure 2 : System WorkFlow

4.3. Artificial Intelligence, Smart Cities and The Internet of Vehicles: Building Manitoba's Intelligent Mobility Future (ecosystem)

- **Entrance of the City from Saint Boniface**
- Manitoba Downtown

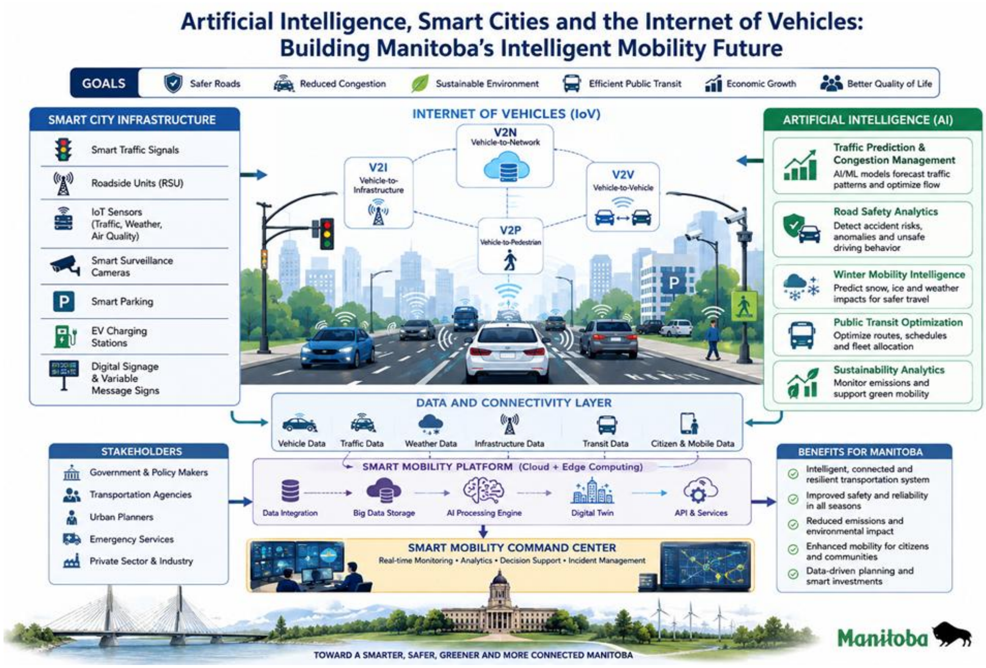

Figure3: Artificial Intelligence, Smart Cities and The Internet of Vehicles: Building Manitoba's Intelligent Mobility Future

4.4. Framework Workflow

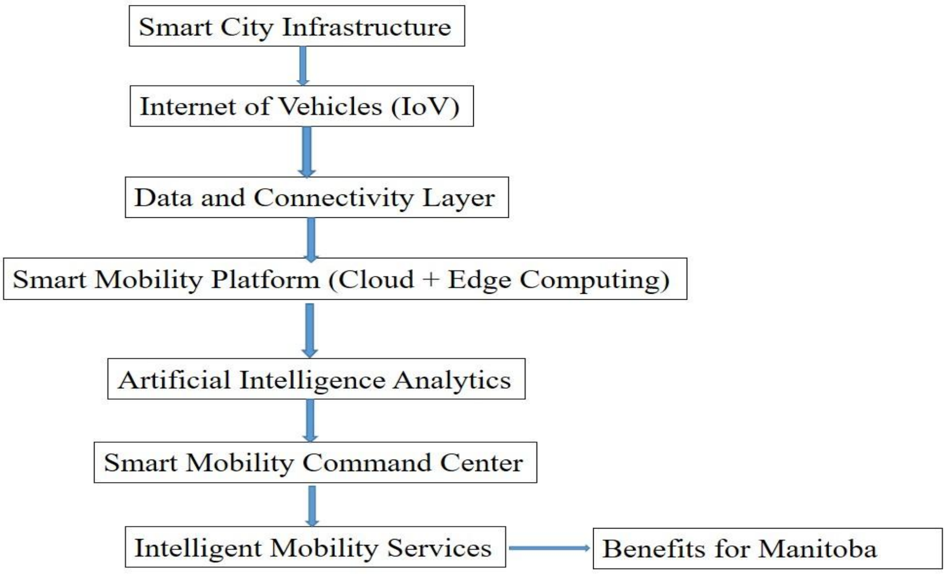

Figure 4 : Framework Workflow

This above circular system ensures the continuous collection, transmission, and analysis of transportation data, which is then converted into concrete measures to optimize mobility throughout Manitoba. By combining artificial intelligence, a network of connected vehicles, and advancements in smart cities, this model facilitates a proactive approach to traffic management, promotes climate-resilient transportation, supports responsible urban development, and guides strategic decisions based on concrete analysis, thereby contributing to Manitoba's vision of innovative, safe, eco-friendly, and seamlessly interconnected mobility.

5. Privacy and Security

The protection of private data and security are key parts of the proposed strategy for artificial intelligence, connected cities, and the Internet of Vehicles, which is designed to shape the future of transportation system in Manitoba. Because the system uninterruptedly collects and analyzes real live data that are happening in smart vehicles, related road infrastructure, IoT devices, public transport, and mobile devices, it is fundamental to ensure the safety of delicate data against cyber risks, interferences, interruptions, in fact, unauthorized access. To achieve and guarantee the safety of the smart mobility ecosystem, the architecture places end-to-end encryption which is a security measure in order to secure Vehicle-to-Everything (V2X) communications, multi-level authentication, role-based access control, and continuous IT security monitoring, which protects information both in transit and at rest. In addition, artificial intelligence is also used to detect irregularities or abnormalities in networks. MOREOVER, it can detect unusual activities, identify cyberattacks quickly, and support proactive risk management. In order to ensure the proposed strategy's privacy, genuine nature, honesty and accessibility of transportation ecosystem data, the following must be put into effect; good security, sturdy personal statements and information practices. It also helps build public confidence, encourages secure collaboration and partnership among stakeholders, and ensures the efficient operation of Manitoba's smart, connected, and sustainable transportation system.

6. Policy and Governance

A comprehensive policy and governance framework that is solid is crucial for the successful development of the artificial intelligence (AI) proposed, connected cities, and the Internet of Vehicles (IoV) ecosystem in Manitoba. Effective policies and practices that are durable and transparent to implement should be established. In order words, clear guidelines concerning data governance, cybersecurity, privacy protection, interoperability, and the ethical use of AI should be incorporated to safeguard the above areas, thereby ensuring that smart mobility systems function in a secure, transparent, and responsible manner.

This framework must not only be consistent but should align with Canada's federal and provincial legislation, as well as the data protection and transportation laws. It should also encourage and conform to communication standards that ensure a smooth running among connected vehicles, intelligent infrastructure, and public transit networks. This strong framework should make sure that intelligent infrastructure, connected vehicles, and public transit networks work together efficiently with few or no problems. Furthermore, government agencies, local authorities, transportation organizations, technology providers, academic institutions, and private companies must cooperate through public-private partnerships to encourage and maintain infrastructure development, innovation, and long-term sustainability. It is only through this way that there can be a successful implementation of the framework. Policies should also promote the adoption of environmental transportation solutions that are easy to imply, electric vehicles, and smart traffic management systems so as to lessen CO_2 emissions in order to increase environmental sustainability. In addition, it is crucial that the policies put in place are procedures measures that are adopted to promote accountability, performance monitoring, risk management in smart transportation technologies. Lastly, the governance system should carry out evaluation regularly and get regular reviews to ensure that resilience, inclusivity, and unending adaptability of the intelligent transportation ecosystem do not falter especially with the persistent evolving technological advancements introduced every day around the world. Therefore, the policy should consider and put in mind the specific transportation needs of state of Manitoba and make sure that the changing policies meet these needs.

7. Suggestion for Future Research

Future research should focus on prioritizing, corroborating and applying the proposed framework for artificial intelligence (AI), smart cities, and the Internet of Vehicles (IoV) in Manitoba. Researches should conduct pilot studies before initiating the process to validate it by determining whether the proposed framework is clear, practical and manageable. The goal is to assess its effectiveness in various transportation scenarios, whether in urban or rural settings and refine it in case of any problems. It would also be beneficial to learn the assimilation of new technologies such as 6G communication networks, digital twins, blockchain, edge computing, autonomous and connected vehicles, and quantum AI. These advancements would aim to improve the scalability, security, and resilience of smart mobility systems. Furthermore, it would be appropriate to analyze the impact of extreme weather conditions on AI-based transportation services, design mobility models adapted to cold climates, and assess public acceptance, the ethics of AI in governance, and the implementation of policies. Future research should focus on validating and applying the proposed framework for artificial intelligence (AI), smart cities, and the Internet of Vehicles (IoV) through concrete pilot projects conducted across Manitoba. The goal is to assess its effectiveness in various transportation scenarios, whether in urban or rural settings. It would also be beneficial to study the integration of new technologies such as 6G communication networks, digital twins, blockchain, edge computing, autonomous and connected vehicles, and quantum AI. Incorporating these advancements would aim to improve the scalability, security, and resilience of smart transportation systems. Furthermore, it is appropriate that further research analyze the impact of extreme weather conditions on AI-based transportation services, and write projects aimed on designing mobility models modified to withstand cold climates. Other researches might chose to investigate the public's acceptance, the ethical considerations of Artificial Intelligence in governance, and the policy frameworks that are required to support effective implementation.

Conclusion

In summary, this study proves that it is momentous to combine artificial intelligence (AI), smart cities, and the Internet of Vehicles (IoV) as they present an opportunity to revolutionize the transportation network of Manitoba and create an interconnected, smart, and sustainable mobility ecosystem. It has developed a comprehensive framework based on the use of AI, smart urban infrastructure, connected vehicle technologies, and real-time data transmission to address major challenges presented by transportation such as environmental sustainability, road safety, public transit efficiency, traffic congestion, and the effects of dangerous winter conditions. By ensuring secure data management, privacy protection, political support, and active stakeholder collaboration, this framework provides a solid and tangible guide that could be used to create resilient, smart mobility solutions towards the geographic and climatic conditions of Manitoba. If this approach proves successful, it could boost the economy by improving the well-being of residents, increase transportation efficiency, and promote sustainable urban development. Finally, this study magnifies our understanding of intelligent transportation systems and proposes a model that is significant and can guide the blueprint of structuring smart mobility initiatives not just in Manitoba but also in other regions around the world with very cold climates.

References

1. Chadrakant D, Gopal M, Sonu K, Bharti J, Vilas V. (2023, 07 29). *Machine Learning Approach for Intelligent Transport Based Vehicular Network Traffic for Smart*. Retrieved from www.IJISAE.org
2. Edith N, Chao C, Amr M, Mohammad S, Fanzhao W. (2021, May 7). *Artificial Intelligente (AI)-Empowered*. Retrieved from https://creativecommons.org/licenses/4.0/
3. K.K.M.B, Herath, Mamta M. (2022, April 30). *Elsevier*. Retrieved from Elsevier: www.elsevier.com/locate/jjjimei
4. Priyanka M and Ghanshyam S. (2025, May 30). Internet of Vehicles for Sustainable Smart Cities: Opportunities, Issues, and Challenges. *MDPI*. Retrieved from MDPI: https://doi.org/10.3390/smartcities8030093
5. Priyanka M, Ghanshyam S. (2025, May 25). *Internet of Vehicles for Sustainable Smart Cities: Opportunities*. Retrieved from https://doi.org/10.3390/smartcities8030093
6. SorayaLemur. (15 October 2025). The Goverment of Canada is investing in new Media Manitoba to foster AI innovation in Manitoba's digital media sector. *PrairiesCan.* Winnipeg: 2025-10-15.