**A02: DRAFT LITERATURE REPORT**

**Optimizing Public Transportation in Järfälla Municipality Through AI-Driven and Multimodal Transport Solutions**

**1.0 Introduction**

Järfälla, a rising suburb near Stockholm, is experiencing significant transportation issues due to its quickly growing population. The current public transportation system is straining to fulfill demand, forcing many inhabitants to rely largely on their own cars. This transition resulted in increasing traffic congestion, pollutants, and poor air quality, directly contradicting the town's goals for a cleaner, more sustainable environment (Ardila-Gomez, & Peralta-Quiros,2019).   
This analysis investigates alternatives for overhauling the transit system, such as the utilization of multimodal transportation options, demand-responsive services, and advanced AI technology to improve efficiency. By applying these techniques, Järfälla hopes to minimize dependency on private cars, reduce pollution, and accomplish its environmental goals. This ambition goes beyond small improvements; it offers a transformative approach to making Järfälla a pioneer in sustainable urban development (Wang, Wang, & Yang, 2020).

* 1. **Problem Statement**

Inefficiencies in public transportation arise from a lack of multimodal options and an overreliance on cars. The lack of integrated, technology-driven transportation systems that use real-time data and artificial intelligence (AI) contributes to the inefficiencies, resulting in higher carbon emissions, congested services, and insufficient transit during peak hours. According to research, a change to AI-enhanced transportation infrastructure could significantly enhance efficiency by optimizing scheduling, real-time monitoring, and adaptive routing, aligning with environmental sustainability goals (Nikitas et al., 2020; Vidojevic et al., 2024).

* 1. **Motivation for Selection and How They Relate to SDGs?**

The motivation for integrating AI-driven scheduling, call-based bus services, and multimodal transportation alternatives in Järfälla is directly related to Sustainable Development Goal 11 (SDG 11), which supports inclusive, sustainable urban mobility. AI technology, which uses real-time data and predictive modeling, enables transportation systems to dynamically adjust timetables, lowering wait times and energy consumption. Cities such as New York have demonstrated the success of AI in regulating traffic and pollutants, providing a model for Järfälla to follow (Nikitas et al., 2020; IEEE, 2024). Call-based buses contribute to SDG 11 by serving low-demand areas and deploying only as needed to reduce emissions and operational costs while maintaining dependable access (UITP, 2020).

* 1. **Scope and Objectives**

The scope of this project is to explore and evaluate innovative AI-driven and multimodal transport solutions tailored to Järfälla’s unique suburban needs, focusing on enhancing the efficiency, accessibility, and sustainability of its public transport system. By integrating AI technologies such as real-time data analytics with flexible multimodal options like call-based buses, this study aims to reduce the municipality’s dependence on private cars, contributing to environmental sustainability goals and aligning with the objectives of SDG 11 and SDG 13. This project directly relates to the research question: *How can AI-driven real-time data analytics enhance resource allocation in Järfälla’s public transport systems during peak and off-peak hours?* Through this inquiry, the study seeks to demonstrate how smart resource management and demand-responsive transport can drive efficiency and reduce emissions, supporting Järfälla’s vision for a cleaner, more accessible transport network.

**2.2 Relation to Sustainable Development Goals**

This research relates to the following two critical Sustainable Development Goals (SDGs):

* **SDG 11: Sustainable Cities and Communities** - focuses on improving the effectiveness and accessibility of Järfälla's public transportation system in order to promote inclusive, safe, resilient, and sustainable cities.
* **SDG 13: Climate Action** - focuses on mitigating the effects of climate change, especially by implementing measures to lower vehicle emissions and enhance air quality.

**3.0 Methodology**

This study followed a structured, systematic approach for finding, selecting, analyzing, and synthesizing relevant literature on AI-driven and multimodal transport solutions in suburban settings.

* 1. **Literature Search**

In order to find relevant studies, I carried out comprehensive searches across multiple academic databases, like Google Scholar, Scopus, and Web of Science. Targeted keywords such as “AI in public transport,” “sustainable suburban transportation,” and “multimodal transport systems” which were used to capture a broad range of literature related to both international context and local context in Järfälla’s transport systems and AI applications.

* 1. **Selection Criteria**

Specific relevant criteria served as a guide for the literary work selection process. Research that directly addressed AI technology in call-based and multimodal transportation, applied to suburban environments, or presented new developments in sustainable transportation was given priority. To make sure that modern techniques and technology were applicable to the situation in Järfälla, we concentrated on works that had been published in the previous ten years.

* 1. **Analysis Framework**

Selected papers were thematically evaluated to discover common themes, case studies, and ways for addressing Järfälla's unique difficulties. Themes such as AI deployment in transportation, effectiveness of multimodal solutions, and adaptability in suburban environments were addressed to understand how worldwide findings may be applied locally.

* 1. **Synthesis of Findings**

The literature's concepts were consolidated by comparing international and local case studies, with an emphasis on practical applications and accomplishments of AI-powered and multimodal transportation systems. This synthesis allowed for a unified presentation of options and methodologies that could be tailored to Järfälla's specific transportation and sustainability needs.

**4.0 Analysis of Literature**

**4.1 Overview of Research Fields**

This research indicates how integrating multimodal transport and call-based services using AI can significantly optimize transportation systems in Järfälla municipality.

**International Context:**

* **USA (New York and Chicago)**: The "Via" system uses a mobile application to offer on-demand, shared rides powered by AI algorithms. This system matches passengers heading in the same direction thus this reduces the need for personal cars overreliance hence improving public transport accessibility. (Via Transportation, Inc. 2023)
* **Singapore**: The "Smart Nation" initiative uses AI to monitor traffic and manage public transport routes. Real-time analytics allow call-based buses to adjust their routes dynamically based on commuter demand, reducing emissions and improving service efficiency. (Kumar Debnath et al., 2011)
* **London**: London’s Artificial Intelligence (AI) plays a great role in optimizing train frequencies and managing congestion in the rail network. By leveraging machine learning and data analytics, AI-driven systems can predict potential delays and adjust train routes in real-time, thus improving the punctuality and efficiency of London's transport system. Implementations, like these at Network Rail, utilize predictive algorithms to anticipate delays and adjust operations accordingly, which has successfully reduced train delays and enhanced the flow of urban transport (Government Digital Service, 2019; Quest Global, 2023).

**Swedish Context:**

* **Gothenburg’s Self-Driving Buses:** In Gothenburg, autonomous buses are being tested as part of the European project, which is being managed by Keolis on behalf of Västtrafik. These AI-enhanced shuttles travel along a 1.8-kilometer route within Lindholmen Science Park, providing a sustainable transit solution that connects to other public transportation options. The buses were created to manage different weather conditions and provide seamless connectivity, demonstrating Sweden's dedication to innovation in public transportation (Keolis, 2021).
* **Västtrafik’s Multimodal Solutions**: Västtrafik, which serves the Västra Götaland region, has integrated a number of multimodal choices, such as buses, trams, and regional trains. While Västtrafik's technologies demonstrate good multimodal integration, they lack advanced AI applications that might improve real-time flexibility and minimize operational inefficiencies. This gap emphasizes the potential for AI to optimise multimodal transit in Järfälla by enhancing resource allocation and service dependability (Drive Sweden, 2021).
  1. **Chosen Perspective**

The chosen perspective is a solution-based approach that solves Järfälla's transportation inefficiencies by incorporating AI, call-based bus services, and improving multimodal choices. AI-powered real-time data analytics can dynamically change schedules depending on demand patterns, optimizing resource allocation and boosting reliability—a approach that is successfully employed in places such as New York to manage congestion and minimize energy consumption (Nikitas et al., 2020; IEEE, 2024). Call-based bus services in low-demand areas, led by predictive analytics, can operate only when needed, reducing fuel consumption and emissions. Combining these AI-enhanced tactics with multimodal options has the potential to considerably reduce car dependency, helping Järfälla achieve its environmental goals (UITP, 2020; IEEE, 2024).

**5.0 Discussion and Conclusions**

**5.1 Methodological Benefits and Weaknesses**

**Benefits:**

* **Targeted Literature Selection**: The methodology focused on recent case studies and relevant literature, providing a robust foundation of actionable insights.
* **Applicability to Suburban Settings**: By emphasizing AI and multimodal transport solutions effective in suburban contexts, the research is tailored to Järfälla’s specific needs.
* **Alignment with Environmental Objectives**: Solutions identified are compatible with Järfälla’s environmental sustainability goals, promoting efficient, low-emission transportation.

**Weaknesses:**

* **Transferability Challenges**: Solutions derived from urban contexts may not translate seamlessly to suburban areas, possibly requiring significant adjustments.
* **Data Privacy Concerns**: Implementing AI in public transport may introduce privacy issues, as collecting real-time commuter data must comply with data protection standards like GDPR.
* **Scalability Limitations**: AI systems in public transport require substantial initial investments, which may limit scalability, especially in smaller municipalities like Järfälla.

**5.1 Insights for Järfälla’s Environmental Sustainability**

The proposed AI-driven and multimodal solutions have the potential to significantly reduce car dependency, traffic congestion, and emissions in Järfälla, thereby directly contributing to local environmental sustainability objectives. Järfälla can increase public transportation efficiency by optimizing resource utilization with real-time scheduling and predictive analytics, resulting in a cleaner, more accessible suburban environment.

**5.3 Contributions to Sustainable Development Goals (SDGs)**

This study supports SDG 11 (Sustainable Cities and Communities) by encouraging inclusive, efficient, and sustainable transportation options, as well as SDG 13 (Climate Action) by implementing emission-reduction and climate change mitigation techniques. AI-enhanced public transportation systems can directly help to Järfälla's progress toward these global goals by encouraging a sustainable, eco-friendly suburban transit system.

**6. Important Lessons that I have Learned in this Study**

The big takeaway? AI and multimodal transport could be Järfälla’s best friends! Imagine a public transport system so smart it knows when you need a ride before you do thanks to real-time scheduling and predictive analytics, AI could turn Järfälla’s buses into peak efficiency machines, reducing both wait times and pollution. Likewise for those quiet, low-demand spots? Call-based buses can pop up only when needed, keeping emissions low and locals happy. Of course, data privacy is key, but if we get everyone on board through data analytics and A.I, Järfälla could be a model for sustainable suburban transit, hitting all the right notes on SDG 11 and SDG 13.

**7. Recommendations for Further Research**

Future research should focus on optimizing AI and multimodal transport solutions for suburban areas like Järfälla. Key recommendations include implementing real-time AI monitoring to dynamically adjust public transport based on demand, especially during peak hours. Small-scale pilot programs for call-based buses can help evaluate the impact on car dependency and emissions while assessing scalability. Addressing data privacy through anonymization and encryption within AI systems is crucial to ensure GDPR compliance. Additionally, public awareness campaigns could help overcome resistance to AI by highlighting its benefits in efficiency and environmental impact.

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