

How More Buses Could Affect Traffic: A Digital Twin of Trondheim’s Sandmoen Bus Depot

Shaira Tabassum, Umar Oluwaleke, Bjørn-Arve Raanes, Gabriel Kiss, and Frank Lindseth

Norwegian University of Science and Technology (NTNU), Trondheim, Norway Trøndelag fylkeskommune, Trondheim, Norway

As cities grow and public transportation expands, the challenge of balancing new services with existing road traffic becomes increasingly complex. A recent study by researchers at NTNU and Trøndelag County takes a deep dive into this issue by focusing on the Sandmoen bus depot in Trondheim, Norway—an important hub where 160 buses serve 46 destinations every day.



SUMMARY

With plans to expand bus operations significantly by 2027, city planners need to predict how traffic conditions might change. Will more buses create gridlock? Can the road network handle the increased load? To answer these questions, the researchers created a detailed, data-driven simulation model—essentially a digital twin of the traffic system surrounding the depot.



INTRODUCTION

A digital twin is a virtual representation of a physical system—in this case, the roads, buses, and background traffic around Sandmoen. By feeding the model with real-world data from several sources, the researchers could simulate how traffic would behave under different future scenarios.



METHOD

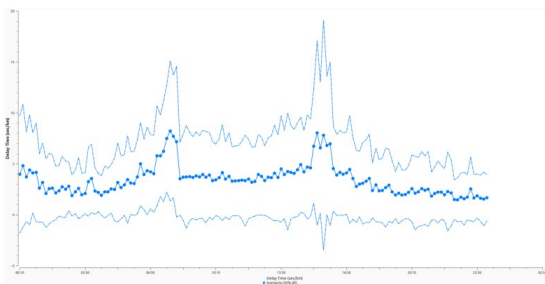
The study used two main types of data. First, detailed traffic counts from the Norwegian Public Roads Administration (NPRA) provided information about vehicle types and sizes on selected roads. Second, anonymized crowd movement data (derived from cellular network

activity), which offered broader insights into how people move around the city.

Although the crowd movement data doesn't specify what kind of vehicles are traveling, the researchers used machine learning to infer vehicle types by learning from the NPRA data. This approach helped them create a realistic picture of traffic flow, including both buses and other vehicles. Figure 1 illustrates sample simulations of traffic scenarios in Aimsun.



Figur 1: Sample screenshots showing the network of the study area during traffic scenario simulations.



Figur 2: Hourly variation in average delay time (sec/km) over 24 hours for all vehicles



RESULT

Once the simulation was set up, the team tested various scenarios: what would happen if the number of buses increased by 50%? What about a 100% increase? And how would these changes interact with different levels of general traffic? The results showed that the system could handle up to a 50% increase in bus operations with only minor increases in traffic delays—especially if background traffic stayed stable or only rose slightly.

However, as traffic volume doubled, delays became significant and the system started to show signs of breakdown. Interestingly, the model also pinpointed when and where delays were most likely to occur, especially during morning

and afternoon rush hours. Figure 2 shows the hourly delay time generated from Aimsun. This level of detail offers valuable input for planners who want to avoid congestion without scaling back transit improvements.



CONCLUSION

In essence, this study demonstrates the power of digital twins in urban planning. By combining real data with predictive simulations, cities can test “what if” scenarios before making costly infrastructure decisions. For Trondheim, this means smarter, data-informed strategies for expanding public transport while keeping traffic flowing smoothly. The research not only highlights the feasibility of scaling up bus services at Sandmoen but also provides a roadmap for other cities aiming to future-proof their mobility systems.

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