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High capacity city transport with intelligent access

A Swedish case study of transporting excavated material

Fredrik Cederstav[a]*, Sara Ranäng[b], Thomas Asp[c], Sten Wandel[d]

[a, b]RISE AB, Lindholmspiren 3A, 41756 GBG, Sweden
[c] Swedish Transport Administration, 411 04 Gothenburg, Sweden,
[d] Lund University, Box 118, 221 00 Lund, Sweden

Abstract

1. Overview and motivation

Investments in infrastructure and heavy vehicle development have made it possible to increase the load capacity of vehicles for all modes of transport without premature destruction of the infrastructure or any negative impact on traffic safety. This has resulted in lower energy consumption, improved labour and capital productivity and fewer vehicles on the roads. An earlier pre-study in Stockholm (2020) with a 5-axle truck, as well as desk top research (Treiber and Bark 2018), suggested that CO_2 emissions can be reduced by 40% and the number of truck trips can be reduced by 50%. These vehicles with increased payload capacity are internationally called High Capacity Vehicles (HCV) and an increasing number of countries are introducing them (ITF 2019). High Capacity Transport's (HCT) schemes typically consist of these four parts; dedicated roads, certified vehicles, operating requirements, and a legal, institutional, and digital framework for the three parts. The last part may include Intelligent Access, which supports the drivers and monitors compliance. Australia also has twenty years of user experience from Intelligent Access schemes that can benefit European partners (Walker C et al 2021).

The purpose of this paper is to give an overview of the results from some trials and research in Sweden with a special focus on a pilot project on HCT for excavated material specifically in urban areas. This project is called HCT City and has a budget of 2.4 million EURO, with 14 partners from industry, cities, universities, and research institutes and will run from April 2021 to March 2024. Most of the previous research has been on long-haul highway transport (Asp and Wandel 2020), where roughly 20% of Swedish goods transport relate to earth- and masses but in urban areas as much as 50% weight-restricted relate to construction or infrastructure projects (TRAFA 2020).

This project will test this hypothesis in real operations at two test sites:

- Varberg: Drilling and excavating a 3.6 km tunnel under the city for a new railway. Focus here is on the system perspective and the plan is to log vehicle data, both from standard and HCT vehicle (longer 25.25-34.5 meter, as well as heavier 74 tons gross weight, or more).
- Stockholm: Excavation to make room for a new residential area. Two new 5-axle heavy truck prototypes will be built and tested with gross weight capacity ranging from 38-42 tons with length under 12 meters, specially designed for urban construction sites and with a capacity double the payload compared to today.

2. Methodology, results, and main contributions

In contrast to most previous research on HCT, the impact on the performance and productivity for the whole construction site is studied here, not only on moving masses from A to B. One hypothesis we will test is that implementing HCT, together with digitalization, will improve the synchronisation between the different

* Corresponding author: Tel. +46-709-888-754;
E-mail address: Fredrik.cederstav@ri.se

operations in a construction site, ranging from production processes to transportation schemes. Data will be collected from several sources, experiments with different vehicles and digitalization will be performed, and then data will be analysed. In Sweden, only few cities have general length restrictions (for ex 12 meter) but many have some length restrictions in the very central areas. In the two pilot cities for HCT City, there are gross weight restrictions ranging between 51.4-64 tons, which means there are major opportunities for productivity improvements. It might even be possible to operate with up to 74 tons gross weight or more, but this needs to be examined.

With Intelligent Access, the operation will be strictly controlled, and the hypothesis is that this could open for more flexible permissions for the operation of heavier vehicles. Tests will be performed with sensors on vehicle axles, in wheel loader buckets, in bridges, and in weight stations so that over- or underloading is avoided. GPS will monitor routes and active speed control will ensure that the speed is reduced over extra sensible infrastructure (Hill and Greenow 2021). The two prototypes being built for the Stockholm pilot will be optimized for city conditions with more axles and improved traffic safety features such as steerable axles, improved telematic system, cameras, and speed control (Geofencing). Thereby, the payload can be doubled. In the Stockholm test site, there is a length limitation of 12 meters, but in Varberg test site, vehicles up to 25.25 meters are allowed. Effects of optimizing both the loading process and vehicle combinations for the transports are investigated in the project.

The impact of HCV on bridges, road wear and traffic safety will be analysed, using a combination of collected sensor data and model simulations. The results will be compared with regular, non-HCV vehicles.

Some key research questions:

- How large is the efficiency potential for the complete HCT-system in a construction site?
- What level of compliance assurance will the local municipalities require to allow the operation of a specific type of HCV on specific streets?

Future research: How to form a decision body on a national level to handle digital dispensation processes for regional and urban roads in Sweden and Europe? (Like TCA in Australia).

3. Conclusion and future works

Before the paper submission in April 2022, the HCT City project will have results from the first year. From the earlier pre-study performed in Stockholm, we already have identified a potential of doubling the payload. Next step could be to digitalize the permit processes, and to adapt the HCT City transport concept with Intelligent Access reforms in other European countries/cities, and in fast growing economies.

References

Asp, T., Wandel S., 2020. Road Access and Weight Control with Geofencing - The Swedish High Capacity Transport case. Proceedings of 8th Transport Research Arena TRA 2020, April 27-30, 2020, Helsinki, Finland

Hill G., Greenow S., 2021. Applying a Risk-based Approach to Road Access using Telematics, HVTT16, Qindgao, China, September 7-9, 2021

ITF, 2019. High Capacity Transport: Towards Efficient, Safe and Sustainable Road Freight, International Transport Forum Policy Papers, No. 69, OECD Publishing, Paris.

TRAFA 2020: Trafikanalys: Homepage at https://www.trafa.se/

Treiber, A., Bark, P., 2018. Infrastructure Solutions for Increased Efficiency and Productivity of Construction Material transport in Cities. HVTT 15 Conference, Rotterdam.

Walker C., Hill g., Gordon j., Kraaijenhagen B., Kural k., Aarts L, Moulis A, 2021. The promising Evolution of Intelligent Access: From Australia to Europe, HVTT16, Qindgao, China, September 7-9, 2021

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