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A Framework for Developing a Regional Freight Transport Observatory

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Abstract: *Previous research has highlighted the lack of freight data as a significant barrier to producing evidence-based freight policy planning. This lack of freight flow visibility makes the formulation of freight policy a piecemeal. The aim of this research is to look at the feasibility and the requirements for establishing a Regional Freight Transport Observatory (RFTO). Eight cases around the world are analysed according to a framework that is consistent with the five dimensions of data stickiness. This research provides a profile of the current state-of-the-art practices in urban freight data sharing which lead to the generation of key ideas for the establishment of the RFTO. Analysis showed that the formulation of freight policy received very limited attention which confirms the need for the proposed research about the RFTO. An independent, neutral, third-party trustee could be a useful approach for transport and logistics data sharing. RFTO is a novel concept that advocates a partnership between public and private stakeholders in securely sharing regional freight traffic information and thus could provide improved visibility on urban freight traffic movements with the goal to inform and support freight policy development and to help develop better approaches to support freight logistics practices in urban areas.*

Keywords: *Last-Mile Logistics, City Logistics, Freight Data Sharing, Freight Data Analytics*

Conference Topic(s): *last mile & city logistics*

Physical Internet Roadmap *(Link): Select the most relevant area for your paper: ☐ PI Nodes, ☐ PI Networks, ☒ System of Logistics Networks, ☐ Access and Adoption, ☐ Governance.*

1 Introduction

In recent years, urban logistics has been undergoing a major transformation due to the change in shopping behaviours. The growth in online shopping has led to a significant increase in urban delivery trips led primarily by haulier and couriers (Rivera-Royero, et al., 2021). In particular, the increases classified as “freight transport by road” and “postal and courier activities” have been up to 114% and 147% respectively during this period (ONS, 2022). These additional delivery trips are exerting more pressures on the already congested urban road networks, kerbside accesses, as well as other issues such as environmental impacts (Jaller and Pahwa, 2020; Strale, 2019).

In the context of the West Midlands (WM) region of the UK, freight transport has been high on the agenda of the local transport authority who is responsible for assessing and planning for the region’s future transport needs so that the transport network can satisfy the demands of businesses and a growing population. Hence, the question is what can be done to balance the negative impacts for the need to reduce carbon and vehicle miles (and thus congestion) in the urban areas, whilst accommodating the growth in consumer demand as well as the wider economic growth. Freight Strategy research in the WM region has specifically highlighted that lack of freight data as a key issue hindering quality analyses of changes in freight demands, identification of constraints,

measuring of capacity shortfalls, as well as quantifying benefits of proposed interventions (WMCA, 2016). This creates significant disadvantages for freight planning. The extensive and fragmented nature of the urban logistics industry can be one of the reasons. Industry stakeholders may only focus on their own operational issues and struggle to see the overall picture (Janjevic, et al., 2019). This lack of visibility is acknowledged as "freight blindness" (NIC, 2018; TfWM, 2021), making the freight policy formulation a piecemeal. This characteristic is also recognised in other regions (TfSE, 2022) as well as at national level (NIC, 2018) of the UK. With the existing available data, it is difficult to draw firm conclusions as well as to test any freight proposals put forward by industry and other stakeholders. In the long-term freight plan of the UK Department for Transport (DfT), the challenge of lack of visibility and understanding of the freight network is also acknowledged (DfT, 2022). Ultimately there is a need to break down the barrier between the public and private sectors to allow better understanding of what are often seen as complementary challenges (TfWM, 2021). Enabling both sides to see each other perspectives will be key to developing and implementing measures collaboratively which support shared objectives.

The WM being a leading area of the UK for transport innovation, a project was therefore commissioned by TfWM within the WM Future Transport Zone programme to address this need. This research was conducted as part of this project that looks at the possibility of establishing a Regional Freight Traffic Observatory (RFTO) to address the underlying issues of the freight blindness at the city or metropolitan level. This research will provide a profile of current state-of-the-art practices in sustainable urban logistics, which involve a requirement analysis for the development of the RFTO. The ultimate goal will be to pursuit the possibility of establishing the RFTO for the development of urban analytics by collecting, analysing and disseminating information that will have the potential to directly inform policy development in this area. This paper, in particular, will focus on a review of current practices and initiatives related to urban transport and logistics data sharing among stakeholders. This includes a total of 8 cases from Europe, Singapore, Hong Kong, and the US. The next section will first describe the development of a framework for the review of these cases. Major findings from the review would then be summarised for which useful lessons can be drawn. This will include a profile of state-of-the-art practices in urban freight data sharing which lead to the generation of key ideas for the establishment of the RFTO. Some future research ideas that are essential to put the proposed RFTO into real practices will also be identified.

2 Development of the Current Research Framework

Urban logistics is a complicated system involving multi, inter-related, and inter-connected stakeholders. The core components, system performance assessment and policy formulation should all be data and information driven. At the same time, data and information flows between stakeholders are highly commercially sensitive and thus data confidentiality and privacy are essential. A systematic literature review of research in urban logistics also concluded with similar results (Lagorio, et al., 2016) and recommended that future research should focus on (i) stakeholders involvement; (ii) urban logistics ecosystem; and (iii) common framework and data sharing platforms. These are well aligned with the purpose of the current study in addressing the underlying issues of freight blindness in the urban logistics enviornment. In view of this, critical issues related to data sharing approaches are reviewed.

Bechtsis, et al., (2022) proposed a generalised data sharing and monetisation framework for data-driven secure, resilisent and sustaniable supply chains. This framework consists of 3 levels of progressively increasing data sharing boundaries and of another 3 layers with data monetisation activities. Data sharing levels starts from intra-organisation within a single partner, to inter-organisational within the supply chain ecosystem, and eventually extends to external public data

sources. Data monetisation activities start by data collection and management at each level. Collected data are then processed and safely propogate to the second layer of data storage for a sustainable and reliable network. At the third layer, stored data are analysed to produce useful information and then flow back to the storage layer.

To investigate the issues related to data and knowledge sharing in general, Huang et al., (2017) theorised a concept of knowledge stickiness to describe the difficulties in transferring knowledge by five contributing factors. This concept of stickiness was then adopted to describe the barriers to inter-agency data sharing in China (Zhou, et al., 2021), which included five dimensions, *(i) data sharing willingness; (ii) data sharing ability; (iii) data articulatability; (iv) data residence; and (v) data absorptive capacity.*

In the context of urban logistics data sharing, this data stickiness concept can identify the potential barriers for the effective functioning of the data sharing platform. Should these barriers be properly addressed, it can facilitate the smooth sharing of data among various stakeholders. Therefore, these data stickiness dimensions can be further extended to establish the research framework for this study. The correspondence between the data stickiness concept and the current research framework is summarised in Figure 1.

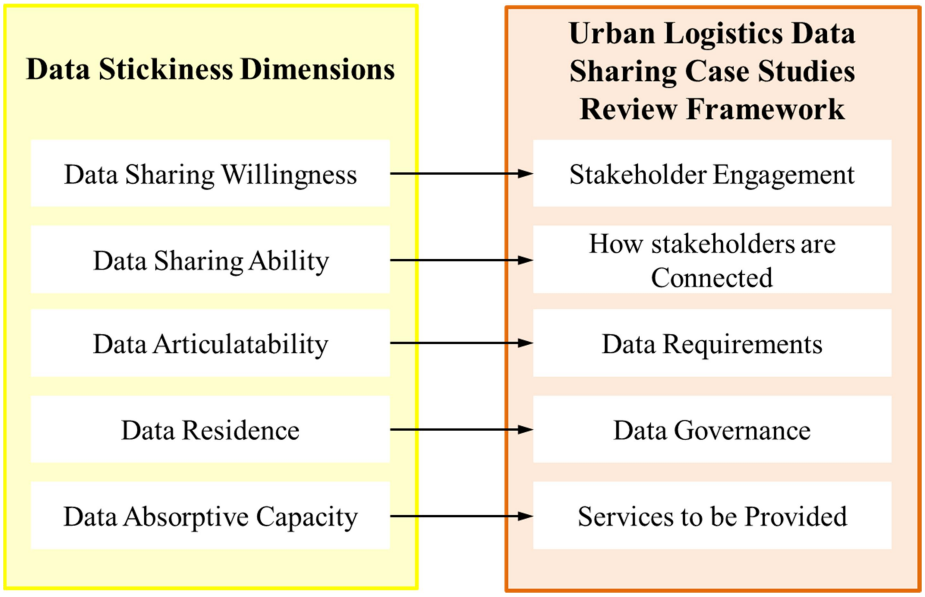

Figure 1: Correspondence between Data Stickiness and the Current Research Framework

Data Sharing Willingness is related to stakeholder engagement, which is totally aligned with the multi-stakeholder characteristic of urban logistics. Therefore, it is important to understand how stakeholders are engaged and motivated to actively involve in sharing data.

Data Sharing Ability refers to the technological infrastructure and the supporting software packages in sharing data. As discussed earlier, logistics stakeholders are largely operated independently with their own internal data managmement systems. The technological solution in connecting these individual and potentially different systems is another key dimension to the success of the data sharing platform.

Data Articulatability concerns about the data readiness, that is whether the data to be shared are readily available and collectable in the appropriate form and quality. In the context of urban logistics, it is related to the identification of the required types of data which would be useful in deriving deeper insight and visibility for other users in the data sharing platform.

Data Residence is the legal, regulatory and privacy restrictions of the data to be shared. Due to the strict confidentiality and commercial sensitivity of data, how the shared data are to be stored and used are of great concerns of the stakeholders. This would undoutedly affect their willingness to participate. So, it is critical to clarify the governance structure and mechanism for the data sharing platform so as to provide confidence for stakeholders to engage securely.

Data Absorptive Capacity is the practical and innovative applications of shared data. The ultimate goal of sharing data is to make better uses of the shared data in providing better visibililty and deeper insight to the urban logistics system, as well as further unlocking the potentials of shared data (e.g. vehicle route planning and optimisation). Understanding how the shared data can be used it is critical to the success of the data sharing platform. This is related to the services to be provided by the urban logistics data sharing platform.

3 Overview of the Reviewed Cases

With an aim to generate ideas for the development of a RFTO, a total of 8 cases were reviewed and summarised in Table 1. It is important to note that the cases reviewed in this study are not exhaustive. Selection of these cases was based on the availability of appropriate literature according to the research framework and the cases' relevancy to the current study.

Table 1: Summary of Reviewed International Transport and Logistics Data Sharing Initiatives

Project Name	Location	Brief Description
Architecture for EurOpean Logistics Information Xchange (AEOLIX)	EU	It demonstrates how stakeholders are connected together within a centralised data sharing facility with achievable benefits in terms of cost savings and logistics support.
Collaborative Urban Delivery Optimisation (CUDO)	Singapore	It highlights the potential for logistics data sharing to facilitate negotiations between shippers and carriers, and to optimise the consolidation process in urban last-mile logistics operations.
An Intermodal Transport Data Sharing Programme (Data Trust)	Hong Kong	It shows the importance of managing data access rights to ensure and respect data privacy, eventually provides data controller with confidence to share data.
Freight Logistics Optimisation Network (FLOW)	United States	It reflects the importance of engaging stakeholders and their commitments to share data, under the leadership and co-ordination of public agencies, to address the freight movement knowledge gap.
iSHARE Scheme	The Netherlands	It shows how sharing of data can be managed and governed under an independent, neutral, third-party organisation with a transparent supervisory and consultative structure involving various stakeholders.
Shared European Logistics Intelligent Information Spaces (SELIS)	EU	It demonstrates how stakeholders are connected with a decentralised approach using the concept of supply chain community nodes (SCN).
Freight Traffic Control 2050 (FTC2050)	London, UK	It demonstrates how vehicle and delivery job order data can be gathered to derive useful information

		showing deeper insight that could help making policy decisions in urban last mile logistics.
FreightShare Lab (FSL) Platform	Edinburgh, UK	It highlights the benefits of data sharing between logistics business partners and how the benefits can be shared among stakeholders.

The purposes of data sharing for each of these cases were first compared and then analysed with respective to the above framework, which included (i) stakeholders engagement; (ii) the overall concept of data sharing; (iii) data requirements; (iv) data governance; and (v) services to be provided.

3.1 Purpose of Data Sharing

The review indicated that most transport and freight data sharing cases were mainly aimed at facilitating collaboration between stakeholders to minimise empty goods vehicle trips and to improve their utilisations, which would eventually lead to reduction in business costs, vehicle energy consumptions and exhaust emissions. Through sharing of freight data, the platform would be able to provide supply chain visibility. These help raising the awareness of a wider spectrum of stakeholders about the benefits of sharing freight data with their counterparts and thus further motivate more operators to participate in the data sharing platform.

3.2 Stakeholders Engagement

Stakeholders are key players of the data sharing platform. Their willingness to engage is critical to the success of the proposed RFTO. According to the review of these cases, the following stakeholder groups could be identified around the scope of urban logistics:

End Users – those who will use the information provided by the RFTO to actively involve in urban logistics operations. These include suppliers, carriers, retailers, consolidation centres and other logistics services providers. They represent one major source of data required for depicting the overall picture of freight traffic movements.

Public Authorities – primarily include local transport authorities, and other public agencies, altogether to provide the rules for and information on the key road network and the distribution of major transport and logistics facilities.

Service Providers and Developers – those who provide contents and services to End Users, Public Authorities, and customers. They provide methods and algorithms to generate useful information and analytics from the shared data, or using the platform's functionalities to develop a service to be offered to various users.

Service Enablers – those who provide the data sharing telematics infrastructures and technologies (e.g. IT solution consultants) to address issues related to system connectivity, as well as the transmission, storage and receiving of data and information.

Technology Suppliers – those who provide the physical systems and hardware such as on-board systems and mobile devices that are used to deliver services to end users.

3.3 How Stakeholders are Connected Together

These cases revealed several approaches for connecting participants to perform data exchange, aggregation and optimisation functions. The first one is a centralised approach that included (i) a connection module to connect various participants together within a centralised facility or information space; (ii) an analytical module to perform basic data analytics that would deliver

useful information to end users; and (iii) a value-added module to conduct advanced analytical and optimisation functions.

Some other cases employ a decentralised approach that relies on a "node" or "community" concept. Local collaborations and connections are established within a specific group of users (i.e. a node or a community). The node's co-ordinators, who look after data exchange issues within the node or community, are then connected together to become an associated network.

A third approach tends to adopt a more passive mode in which data sharing is completely voluntary, and hence relies heavily on stakeholders' motivation and willingness to participate. It is more suitable for projects with strong commitments from stakeholders. This approach might be appropriate in the context of RFTO, particularly if a more phased, organic, bottom-up approach is followed, but comes with its own disadvantages in terms of capturing the full potential of the RFTO.

Apart from the approach for connecting participants, the identification, authentication and authorisation of members together with a set of agreements building around these three aspects are essential to ensure a uniform, easy-to-connect, and controlled way of sharing data. The "Mobility Data Space" can be an example platform of this kind for consideration.

3.4 Data Requirements

Data to be shared is closely related to logistics players' daily operations. To support the core functions of the proposed RFTO, data requirements should be derived from the services to be offered. The data requirements mentioned below only represent, based on the review, some examples and the list is not exhaustive. The review indicated that delivery job order and vehicle data are required, including:

- Freight vehicle data - vehicle manifest data such as vehicle and driver locations (via GPS devices, mobile phone, etc.), collection and delivery schedules, vehicle sizes, capacities and availabilities as well as barcode related activity data;
- Delivery job data (or order data) - time, date, volume and cost information of the job;
- Other data, for example, parcel barcodes, delivery addresses, manifest ID number, driver ID numbers, and various temporal information about barcode related activities.

To derive spatial and/or temporal properties of major logistics facilities and freight movement information, data such as locations of warehouses and distribution centres (at postcode level), vehicle flows, truck load ratios, and gross vehicle weight information (from highway weigh-in-motion devices) is necessary.

3.5 Data Governance

No matter which particular structure is adopted for connecting stakeholders, the data sharing platform needs to be operated by an entity that ensure safe, secure and smooth data sharing operations. It was clear from the review that the RFTO should be implemented in the form of an independent, neutral, third-party Trustee. Governance of data shared by member organisations should be done through a set of agreements clearly stating the membership's terms and conditions. The Trustee shall be responsible for the overall operations of the RFTO, which mainly include membership management activities (i.e. joining and leaving of members), agreement enforcement activities (i.e. making sure members are conform to the agreements they signed), as well as platform marketing activities (i.e. promotion of the platform to a wider span of stakeholders).

3.6 Services to be Provided

One of the key functions of the data sharing platform is to utilise and process the shared data, and eventually convert them into anonymised and useful information that provide insights to various users. Based on the review of international experiences, the platform should possess the capability and functionality to derive data analytics and the results should be disseminated through visualisation tools that display the spatial and temporal properties of freight traffic movements. Participants should also be granted with access to these functionalities, analytics and visualisations. Commonly used forms of displaying system outputs are dashboards showing statistical and delivery schedule information, geospatial and temporal graphics displayed by different attributes such as type of goods, time of day, day of week, etc. Additional value-added services such as models and optimisation functions could also be provided.

4 Ideas for the RFTO

Based on the analyses in Section 3, this section elaborates some initial ideas for the establishment of the RFTO.

4.1 Vision of RFTO

It is clear from the review that stakeholders' motivation and willingness to participate in any data sharing initiative is directly related to the benefits they can obtain from sharing their data. International experiences also showed that very positive results can be realised from sharing data. Therefore, the ultimate ambition of the proposed RFTO should be:

- To facilitate and manage data sharing between stakeholders collaboratively;
- To provide improved visibility along the supply chain;
- To support business logistics operations;
- To improve evidence-based reporting; and
- To inform transport and logistics policy formulation.

4.2 Stakeholders Engagement

As discussed earlier, the proposed RFTO should include End Users, Public Authorities, Service Providers and Developers, Service Enablers, and Technology Suppliers. It is recommended that an evolution approach be adopted for stakeholder engagement. At the initial stage, stakeholders should first be invited to identify key challenges and issues in their logistics operations. These can serve as inputs to the design, planning and development of the RFTO. In the next stage, stakeholders who are interested to participate could collaboratively work in groups to address the more detailed functional, technical, operational, and legal issues with an aim to create an initial set of agreements of data sharing conditions. Finally, the overall governance, data integrity and sustainability issues would be addressed at later stages before the platform is launched.

This approach could ensure that the existing challenges and issues in the urban logistics sector are identified and considered in the RFTO. It also helps to create an impression to the stakeholders that their concerns are being considered and addressed at the development stage. In particular, engaging stakeholders throughout the development process (especially the End User group) ensures that they would be kept informed of how they can benefit from it.

4.3 How Stakeholders are Connected Together

In light of the above review, the trusted third-party model can be considered as one of the options to improve business to government data sharing. Also, stakeholders need to collaborate together so as to provide a thorough understanding on urban freight travel demand. The future planning and transport enhancement would not be as influential without such data insight.

The government, data providers and the trusted third party should work closely on building a trusted system that can serve the data sharing purpose by adding value to create a more effective and integrated transport and logistics system, whilst also balancing each of the data providers' commercial interest. The US passive data sharing approach could also be another option forward as it is bottom up but at the same time driven by the government. Given the cultural proximity of US and UK, it might also be worth to consider.

However, no matter which approach is adopted, the platform should pay attention to:

- Identity and Access Management (IAM), which are critical and need to be appropriately addressed to ensure data security, and data are being used in the way that are permitted;
- Data owners should retain controls of their own data within the data sharing platform. It means that they should have control over what data to be shared with whom under what particular conditions.

4.4 Data Requirements

The RFTO could set up a pilot using currently available data such as locations of major logistics facilities to derive the spatial (or temporal) distributions on maps. Currently available sources of traffic flow data (e.g. loop detectors and cameras in the urban areas, weight in motion) could also be explored to see what can be achieved by better utilising these readily available data. It is anticipated that useful freight traffic information such as vehicle flows on the urban road network might be obtained from these data sources.

Through exploring multiple data sources, there would be clear evidence of data insight and adding value to create more effective and integrated transport and logistics system and their associated facilities with enhanced user experience and effective use of resources.

It is also essential to set up common data formats that allow data providers to contribute partial data with ease, as this can also address concerns on revealing commercially sensitive information.

4.5 Data Governance

The RFTO should be managed and operated by an independent, neutral, third-party Trustee. Governance of data shared by member organisations should be done through a set of agreements clearly stating the membership's terms and conditions. A supervisory and/or advisory governance structure may also be included to monitor the performance of the Trustee as well as providing guidance and inputs to the operations of the RFTO. Inclusion of such structure could also impose accountability on the Trustee. The constituency of the Trustee and/or the supervisory body should ensure transparency and sufficient participation of members of the RFTO.

Under the proposed third party trusted framework, the governance should be done through a set of agreements or Memorandum of Understandings (MoUs) signed between participating organisations and the Trustee so that data providers would share certain types of data with confidence that their commercial interests and privacy concerns are fully safeguarded while serving the interests of the RFTO.

The government should take the role of a facilitator to engage stakeholders in a collaborative and co-ordinated approach to develop the data sharing platform. The governance of the Trustee should be transparently accountable and performance frameworks should be results or outcomes oriented, rather than activity based.

4.6 Services to be Provided

The services to be provided by the RFTO should be able to address the operators' concerns, which means "how the establishment of the RFTO could possibly benefit them?". Therefore, the exact services to be offered by the RFTO should be derived during the system development stage. The services mentioned here represent, according to the above review, the typical services and/or functionalities that a logistics data sharing platform could deliver. These can be broadly categorised into two types: Generic Services and Specific Services.

Generic Services commonly refer to some basic statistically aggregated information (or more advanced data analytics) generated from the shared data. They could be accessed and available in the form of statistical reports or graphical displays via an interactive dashboard function. End Users and Public Authorities can get a deeper insight on urban freight operations, and make use of this information to support their decision making and policy development activities. Examples of Generic Services include supplier demand information, freight flow information, statistical indices reflecting the utilisation and congestion levels of logistics facilities, delivery performance information, spatio-temporal distributions of major logistics facilities.

Specific Services are functions for an individual End User or Public Authority. These can be delivered through specifically developed services by Service Providers and Developers, using the functionalities and Generic Services of the RFTO, and offer to a specific End User or Public Authority. Alternatively, up to the agreement of the participating members, the RFTO can also incorporate those functions and services within the architecture of its data sharing platform. Stakeholders, according to their identity within the data sharing platform, could be allowed to subscribe to those services. These services are usually related to user-oriented optimisation services. Examples of Specific Services include, demand mapping functions, vehicle routing optimisation, delivery round predictions, as well as collaborative delivery schedules and routes determination.

5 Conclusions

This paper performed a review of 8 data sharing initiatives. A research framework generalised from the theory of data stickiness was developed. Some key findings were identified from the critical review and eventually generated some ideas for the development of a RFTO in addressing the important issue of improving freight visibility.

The reviewed cases mainly shared data for improving business operations as the major focus in order to motivate stakeholders' participation. It was found that these cases generally did not include a specific objective to provide evidences supporting public policy evaluation. This highlights the uniqueness of the current study to inform freight policy formulation and to support better approaches to understand freight and logistics needs as part of policy and scheme development.

Whilst the Trustee and the government led approaches can be potentially suitable for the proposed RFTO, a further detailed study should be conducted to understand views of different stakeholders towards different approaches. No matter which approach is to be adopted, the platform should pay special attention to issues related to identity and access management as well as data ownership. Stakeholder engagement should adopt an evolution approach to encourage more active participations.

A pilot should be developed, using the currently available data, with a view to predict possible impacts of any policy changes affecting freight and logistics operations and how to best design these changes to account for stakeholders' needs. Results from the pilot could also be presented to various stakeholders to encourage wider participations.

It is clear from the review that an independent, neutral, third party trustee is a common approach for logistics data sharing. A further study should be conducted to work out the details (e.g. operations

and accountability structures, etc.) of the data governance mechanism in ensuring that data are shared in a safe and secure manner.

Acknowledgement

The work described in this paper was fully supported by a funding from the West Midlands Future Transport Zone in the UK.

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