The Role of the Transport and Logistics Observatory in Gathering Knowledge for Sustainable Urban Logistics Development

Marzena Kramarz, Katarzyna Dohn and Edyta Przybylska
Silesian University of Technology, Gliwice, Poland

mkramarz@polsl.pl
kdohn@polsl.pl
eprzybylska@polsl.pl

Abstract: A well-functioning urban logistics system is one of the dimensions that can contribute to the realisation of a smart sustainable city. This is because smart logistics systems are characterised by the sustainability of flows, which requires the use of various types of modern logistics technologies, including storage, transport and information technologies. Sustainable city logistics aims to reduce the nuisance associated with the flow of people and goods in urban areas, while maintaining the social and economic development of the organisations and cities involved. Data on urban flows of people and goods are scattered, as are decisions on how to organise urban flows. This makes knowledge management in such a complex system extremely difficult, especially in the first stage of the process - identifying and collecting knowledge. The article points out that building knowledge resources for effective decision-making in the field of sustainable urban logistics requires the involvement of different stakeholders. Involving stakeholders in building knowledge resources for sustainable flows of people and goods in the city is a task that can be undertaken by public administration units or independent organisations set up for this purpose. The aim of this article is to define the role of an observatory in the process of gathering knowledge on logistics flows in cities. In order to achieve this objective, a literature review was carried out, focusing on the role of stakeholders in knowledge collection, the types of data and knowledge needed to achieve sustainable flows in the city, and the ways in which data and knowledge can be collected. Two models of knowledge gathering were identified - a decentralised model and a centralised model. The centralised model proposes the coordination of knowledge collection by a regional specialist observatory. The case study analysed the collection of data and knowledge by the Transport and Logistics Observatory in the Silesian Voivodeship. The result of the study is the development of a concept for the collection of logistical knowledge in cities in a centralised model and the identification of conditions and limitations for the implementation of such a concept.

Keywords: City logistics, Sustainable development, Knowledge gathering

1. Introduction

As a field of interest for both researchers and practitioners, knowledge management is developing dynamically and covering an increasingly broad range of organisational management areas. Specialists in the logistics industry also recognise the importance of knowledge management in organising material flows (Tah & Carr, 2001; Yeh, 2008; Wang et al., 2008; Cerchione & Esposito, 2016). Research on knowledge management in logistics and supply chains has inspired the development of solutions for the digital transformation of supply chains (Gagliardi, 2023). These two areas have supported each other during the fourth industrial revolution (Sartori et al., 2022). Research into knowledge gathering, processing and transfer has guided the development of IT support for material flows, highlighting the need for tools that facilitate logistics decision-making based on reliable knowledge obtained from suppliers, manufacturing companies, logistics companies, intermediaries in distribution channels and customers. Conversely, knowledge management in logistics systems, including supply chains, relies on the use of cutting-edge technological solutions that facilitate not only the accumulation and processing of knowledge (e.g. big data, cloud computing and the Internet of Things), but also enhance security (e.g. blockchain technology). However, this compatible, symbiotic development of knowledge management in supply chains and digital supply chain transformation is not sufficiently recognised in urban logistics systems. This is a particular concern in an era of challenges related to the sustainable development of cities and regions.

Urban logistics is a complex system that has a significant impact on the quality of life in a city and on the satisfaction of the city's various stakeholders. With increasing urbanisation, the problems associated with the movement of people and goods in a city are intensifying, the most important of which are pollution, noise, vibrations, land use, and thus the external costs of transport (Handbook on the external costs of transport, 2019). Awareness of this problem is increasing among both public administrations and business representatives, while it is much lower among city residents. Environmental factors negatively affected by external costs of transport are one of the three pillars of sustainable development. The environmental pillar is balanced by a social and an economic pillar. These three pillars, as the foundations of sustainable development, also shape sustainable flows of people and goods in a city (Ackerman 2005). Sustainable flows of both people and goods in the city must involve the various stakeholders who interact with the city's logistics system. Different stakeholder groups can influence the design of sustainable flows in a city in different ways, and at the same time be affected differently by the implementation of sustainable flow solutions. This leads to stakeholders taking on different roles in the design of sustainable flows. The role of stakeholders in the design of sustainable flows in the city was studied by Przybylska, Kramarz, Dohn in 2023. The same authors studied the roles of stakeholders in sustainable flows in the city in 2023. The set of stakeholders was the same in both studies. The following groups were distinguished: inhabitants, production companies, freight transport companies (logistics operators, shippers and carriers), environmental organisations, health-related organisations, arts and culture-related organisations, public safety organisations, organisations related to sport and recreation, R&D organisations, organisations for people with disabilities, other cities, organisations related to food delivery, companies designing smart and logistic solutions in the city, courier and postal companies, hypermarkets and discount shops, wholesale and retail chains, wholesalers and retail shops, service companies, waste management organisations, other municipal companies, tourists and visitors, educational organisations, taxi corporations, transport infrastructure managers, micromobility operators, public transport organisations, estate managers, media suppliers, religious organisations, social welfare organisations.

In their research, the authors point out that working with stakeholders, including how to involve them in the policy of sustainable flows in the city, should depend on the role of the stakeholders. At the same time, taking into account the results of both studies, the authors point out that a given stakeholder group may have a different role in sustainable passenger flows in the city and a different role in sustainable freight flows in the city. The role of a stakeholder influences the way in which it is worked with. The nature of the collaboration is crucial, not only because of the involvement of stakeholders in the creation of innovative urban logistics solutions, but also because of the need to collect data on flows within the urban logistics system and on the development of logistics technologies. This data concerns both the supply and demand side of urban flows and the supply of technological solutions for the movement of people and goods. The dynamics of flows in the city, together with the technologies used in these flows, determine the efficiency of the city's logistics system, affect the quality of life of its inhabitants and the overall attractiveness of the city. Consequently, knowledge management, and in particular the ability to capture data and gather knowledge, is becoming very important. Research on these processes is well advanced at the level of companies, but insufficient at the level of urban logistics systems and sustainable flows of people and goods.

The article therefore seeks to answer the following questions:

- What data are needed to manage sustainable urban flows?
- What are the most effective mechanisms for collecting knowledge on urban logistics flows in a centralised model with a dedicated observatory?

The research was carried out on the basis of a case study of a transport and logistics observatory set up as part of the project "Network of Regional Specialised Observatories in the Entrepreneurial Discovery Process in the Silesian Voivodeship", co-funded by the European Regional Development Fund. The idea behind the Observatory is to carry out tasks related to the identification, monitoring and evaluation of flows in the city's logistics system. The case study (Chapter 4) was preceded by a literature review (Chapter 2), which led to the adoption of assumptions in the developed concept of data collection and knowledge gathering in the city's logistics system (Chapter 3). Chapter 4 also identifies the limitations of the adopted concept and suggests further research directions.

2. Interdependent Determinants of Sustainable Urban Logistics Development: Knowledge Accumulation and Stakeholder Cooperation

2.1 The Problem of Data and Knowledge Gathering as a Step in Building Knowledge Resources in the Urban Logistics System

Knowledge management is a concept that has been researched in management science for many years and the results of this research are being adopted by many organisations. Knowledge management is interpreted as the process of identifying, acquiring and using knowledge to improve an organisation's competitive position (Bennett, Gabriel 1999). Identifying knowledge sources, collecting data and knowledge and building knowledge assets is the first stage of knowledge management (Gupta et al. 2003). There are several models in the literature that present knowledge management as a cycle consisting of several processes. These processes follow one another in a defined sequence, which is cyclical because knowledge building is a continuous process. Botha et al. outlined three key processes: knowledge creation and discovery, knowledge organisation and capture, and knowledge sharing and dissemination. Another model distinguishes between: knowledge creation, knowledge transfer and knowledge embedding processes (Armistead 1999). Some models list more specific processes, for example: knowledge goal setting, knowledge identification, knowledge acquisition, knowledge development, knowledge sharing, knowledge exploitation, knowledge retention, knowledge evaluation (North, Kumta 2018). The differences in the naming of the processes mentioned by different authors are largely due to the level of detail in the analysis and the research perspective adopted. The entire knowledge management process is supported by four factors: leadership, organisational culture, technology and a measurement system (Probst et al. 2000). The characteristics that distinguish knowledge from other traditional resources are: dominance, inexhaustibility, simultaneity and non-linearity (Loyarte et al. 2018). Interpreting these characteristics in relation to knowledge in a city's logistics system allows for a more precise design of the knowledge collection and knowledge building system. Dominance means that knowledge about material flows, disruptions in these flows, the technologies used, the demand side and the supply side determines the choice of logistics infrastructure and also the organisation of flows in the city. Knowledge is therefore of strategic importance in improving the flows in a city's logistics system. The inexhaustibility of knowledge means that the value of a knowledge resource does not decrease when it is transferred. This is particularly important in a city's logistics system as it needs to be transferred between different actors. It also means that knowledge can be used by many different users at the same time. Knowledge is therefore simultaneous. Furthermore, as research in knowledge management shows, the mere fact of having a large stock of knowledge does not directly determine competitive position. Only the ability to apply it in practice gives such an advantage. Knowledge non-negativity therefore means that organisations that have the ability to use knowledge will build their advantage more strongly with small amounts of knowledge than those that have large amounts of knowledge but are unable to use it in practice. In order to apply knowledge management methods effectively, it is essential to distinguish between information and knowledge and to understand their relationship (Sveiby 2001). Information is a specific category of knowledge: it is data, procedures, rules that have been acquired and recorded in an organisation and are publicly available. Such knowledge exists in the form of documents, manuals, training materials, instructions and other accumulated data. On the other hand, there is still knowledge hidden in the human mind, which is the result of experience, special skills and predispositions of employees (Mannonen, & Hölttä 2013). This knowledge is not written down anywhere and is an important form of intellectual capital. While explicit knowledge can be captured using appropriate databases and information technology, tacit knowledge cannot be extracted directly from even the most perfect databases. This is why the ability to collaborate with those who hold this knowledge is so important. In managing knowledge in an urban logistics system, both explicit and tacit knowledge is dispersed among various stakeholders, including government agencies, residents, infrastructure managers, logistics, manufacturing and trading companies, companies that design and provide solutions for the movement of people and goods, and many others. The innovations in urban logistics systems that have been implemented in recent years promote the collection of data, especially data on urban flows, flow times and various types of disruptions to urban flows (Wang, Pan 2024). In particular, such data is collected by intelligent transport systems. These systems can improve traffic flow by measuring the entry and exit of vehicles into the city centre (Laña, et al., 2021). An intelligent transport system can also influence the reduction of maximum vehicle speeds and reduce the number of required stops, especially on road sections where traffic incidents are common (Meneguette et al., 2018). ITS applications require information about both moving objects, such as vehicles and pedestrians in the vicinity, and stationary objects, such as road signs, infrastructure elements and road maps (Mangiaracina et al. 2017). A common database of information about these objects, used by individual ITS applications, can be stored in what is known as a Local Dynamic Map (LDM). Such maps are standardised to allow the management of vehicle sensor data and static data (related to road infrastructure and maps). Database systems are used for data collection and processing (Shimada, Yamaguchi, Takada, Sato, 2015). The application and development of Collaborative ITS Systems (C-ITS) requires the management of not only the sensor information of a single motor vehicle, but also the sensor information of other vehicles obtained through telecommunication solutions. Local dynamic maps combine the functions of managing both dynamic data from multiple vehicles and data about their surroundings (Liu, Ke 2023). Among the main effects of ITS are indicated: an overall improvement in the efficiency of the transport system (in particular, a reduction in travel time, traffic stops and incidents), an increase in the level of road safety and a reduction in the emission of harmful components of exhaust gases, dust and noise (Zhu et al. 2019). The aforementioned positive effects of implementing IST solutions would not be possible without the collection of large data sets through sensors, cameras and other means. These large data sets collected should form the basis for processing them into knowledge about urban flows. The knowledge itself will be useful when it is used to improve flows, to build the city's logistics strategy and to work with stakeholders. However, knowledge about the organisation of flows by the different actors, the choice of logistics technologies, the motives for certain decisions leading to the choice of e.g. transport mode, place of movement, etc. is scattered among the different actors of sustainable urban flows. The acquisition of this knowledge is extremely difficult and requires the adaptation of the knowledge acquisition mechanisms to the specificities of the stakeholders. In this respect, it is useful to draw on the experience developed for data collection and the creation of knowledge resources for companies.

2.2 Data and Knowledge Gathering Mechanisms in the Urban Logistics System

Research on knowledge management in organisations has been conducted for many years. Methodologies have been developed to capture both explicit and tacit knowledge. In the area of urban logistics systems, research is not extensive. Among the few studies in this area, the expert study by Iwan et al. (2024) makes a significant contribution. Iwan et al. (2024) investigated the role of knowledge management in city logistics and identified barriers to the implementation of knowledge-based city logistics. A key element of the research process was an expert survey to which 31 international experts specialising in urban logistics issues were invited. The authors analysed the four stages of knowledge management, which according to Dalkir (2013) are "the processes of identifying, collecting, improving and transferring knowledge".

A similar interpretation is adopted in this article. However, attention is focused only on the first phase of knowledge management - knowledge asset building. Knowledge asset building requires consideration of the components of this process, including identification of knowledge sources, data collection, knowledge extraction, knowledge combination and processing. Knowledge asset building, which includes material flows as well as the development of logistics technologies in cities and the region as a whole, is important for increasing the competitiveness of cities and the smart development of logistics systems. A smart city is a sustainable city. It is thus a city that meets the needs of its current inhabitants without compromising the ability of others or future generations to meet their needs, and thus does not exceed local or planetary environmental limits (Höjer, Wangel, 2015).

Rues and Lindner (2023) conducted research on knowledge management systems in smart cities. Their research considered all aspects of smart cities and therefore did not address logistics in detail. Their analysis resulted in the development of 11 assumptions that demonstrate the role of standardisation as a knowledge carrier for replication activities and as a facilitator of stakeholder engagement. The authors highlight the importance of two features in smart city knowledge management - standardisation and replication. They show that these are important not only because of the diversity of stakeholders within cities, but also because of collaboration between cities. The authors show that standardisation in smart city replication enables comparability and supports the dissemination of diverse information through a process that builds trust and consensus. The research by Ruess and Lindner (2023) significantly enriches the conceptual assumptions of data collection and knowledge asset building in a city logistics system.

As mentioned above, technological developments are contributing to the increasing use of new technological solutions in urban logistics, integrating urban logistics systems with the smart city concept. Such solutions include ICT (Information and Communication Technology) systems and the aforementioned ITS (Intelligent Transport Systems), which allow the collection of 'big data' on urban freight transport, GPS (Global Positioning Systems) devices used in vehicles to identify their exact location, IoT (Internet of Things), blockchain technology, drones, autonomous vehicles and robots [Taniguchi et al. 2023, Zenezini et al. 2022]. Effective use of data collection tools requires a broader view of urban processes and appropriate information management. It is emphasised that city authorities should create an infrastructure that promotes an open IT environment that allows external actors to access anonymised city data.

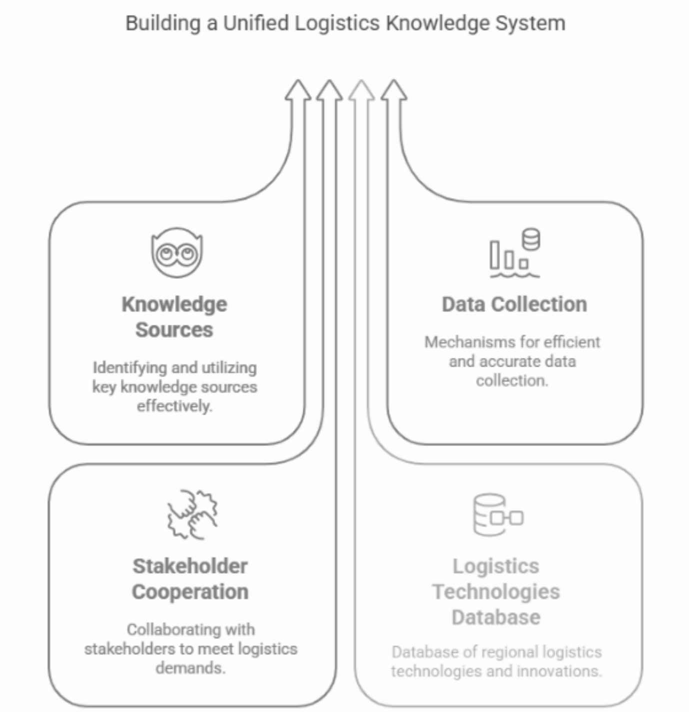
In this context, Rantanen (2007) discusses the possibilities of using collaborative web-based applications to collect and manage local knowledge. He shows how information and communication technologies have provided opportunities for knowledge distribution, representation and sharing in this process. Open source software such as content management systems and web-based GIS (WebGIS) have made expert tools available to the layperson. GIS applications, discussion forums and map-based applications and apps are effective tools for local knowledge building. Urban planning is treated here as an interactive process in which the expert organisation (planners) and the public (residents, associations, other organisations) create, share and process knowledge. The author discussed some definitions of local knowledge and explored GIS as a way to collect, analyse and use knowledge. Theories and applications of knowledge management were explored in relation to participatory planning.

The above approaches to data and knowledge collection should be complemented by methods to capture tacit knowledge in collaboration with stakeholders in sustainable flows of people and goods in the city. The main sources of tacit (implicit/hidden) knowledge are: knowledge gained from task and project activities, knowledge and observations from tests and studies, feedback, interviews and other forms of feedback, collaborative brainstorming and looking at the problem from another angle (Koskinen, et al. 2003). At the same time, additional characteristics of stakeholders such as altruism, commitment, experience, orientation, access to databases should be taken into account. Because of this complexity, it is worth differentiating between methods of knowledge discovery and acquisition. Each of the methods, such as expert panels, formal and informal meetings with stakeholders, free and formalised interviews, provide different stimuli and stimulate the process of tacit knowledge discovery in a different way.

3. Design of a Regional Knowledge Collection System for Sustainable Urban Logistics Development

In some cities, the plan and specific measures to achieve sustainable urban transport are introduced and implemented as strategic documents of the city government, i.e. urban transport plans or SULPs (Sustainable Urban Logistics Plans). Sometimes SULPs are separate documents, and sometimes they are part of a citywide strategy. The preparation of SULPs is also the subject of international research projects (Matusiewicz 2019). Such solutions usually include concepts of data collection and processing, while very rarely ways of collecting explicit and tacit knowledge.

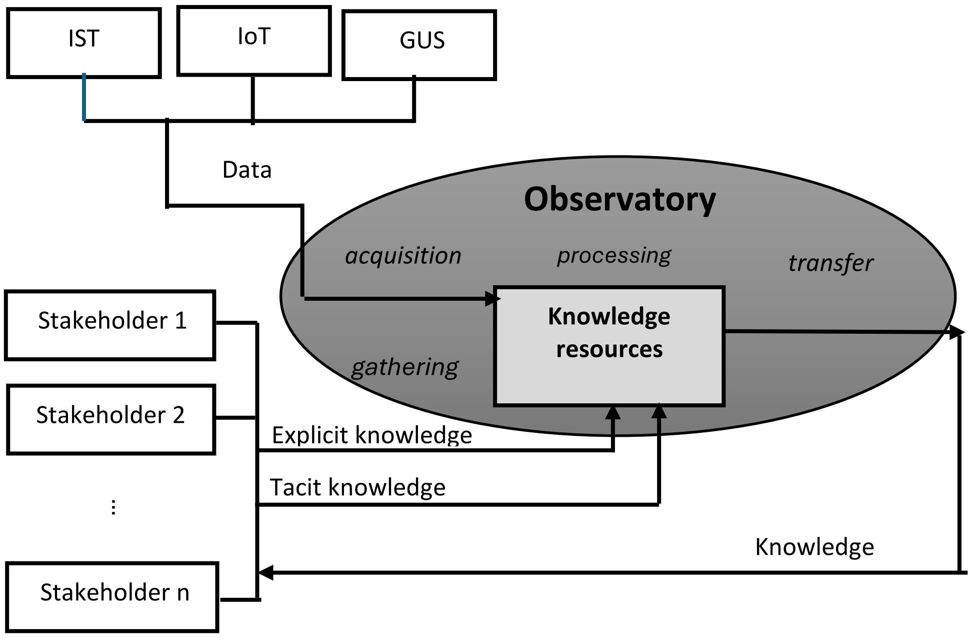
The system of knowledge collection in urban logistics systems can be developed in two variants: The first variant involves the distributed collection of knowledge in different organizational units. The second variant involves shifting the burden of collecting knowledge about urban flows to the transport-logistics observatory, which by definition should be equipped with tools for monitoring all the determinants of these flows. Thus, the second solution focuses on collecting data from primary sources (stakeholder knowledge) and combining them with data from secondary sources (databases). Data should be collected from ICT systems, Intelligent Transportation Systems and other IoT solutions, as well as from industry documents and statistical datasets (e.g. CSO). Knowledge, on the other hand, should be gathered through collaboration with stakeholders of sustainable flows of people and goods in the city (Fig.1.).



Source: Own elaboration with using AI

Figure 1: Identification of data and knowledge in building knowledge resources in the city's logistics system

In the proposed concept, on the one hand, large data sets obtained from functioning information systems and intelligent transportation systems need to be processed to feed knowledge resources. On the other hand, it is necessary to collect and acquire explicit and tacit knowledge from different stakeholders of sustainable flows of people and goods in the city. The knowledge resources created in this way can be processed, refined and transferred in further stages, thus ensuring the cycle of knowledge management.



Source: Own elaboration

Figure 2: Concept of centralized knowledge management in an urban logistics system with an observatory

The data required for the sustainable management of urban flows, which must be obtained from multiple sources, relate to factors that vary in terms of change over time. Therefore, the frequency of measurement of factors will not be constant. Examples of data with characteristics of how they are obtained are given in Table 1.

Table 1: Data extraction mechanisms

Data type	Dynamics of change	Source and acquisition method	Frequency of measurement (frequency of acquisition by the observatory)
Deviations in passenger transport by rail		Railway Transport Office (UTK)	once a year (summary of data collected by UTK)
Deviations in rail freight transport		Railway Transport Office (UTK)	once a year (summary of data collected by UTK)
Congestion in road transport		Inteligent Transportation Systems	Once a month downloading (or daily)
Environmental pollution		IoT	Daily downloading
Transport needs of inhabitants		Data based on mobile apps	Once a year
Availability of storage space		General Statistical Office	once a year (summary of data collected by UTK)
New technologies in passenger transport		Analysis of industry documents, expert research	once a year (summary of data collected by UTK)
New technologies in freight transport		Analysis of industry documents, expert research	Once a month downloading (or daily)
New ICT technologies in logistics		Analysis of industry documents, expert research	Daily downloading

Where:

Day (time)	Week	Month	Year

Source: Own elaboration

As with data collection in knowledge gathering, it is necessary to adapt the mechanisms to the type of stakeholder and the type of knowledge (Table 2).

Table 2: Knowledge gathering mechanisms

Type of knowledge	Nature of knowledge	Stakeholder group (Who has the knowledge?)	Means of knowledge acquisition and frequency
How last mile transport is organised	explicit knowledge	Manufacturing companies, service companies, logistics companies, retail chains	Market research reports and trend analyses Surveys Frequency: once every two years
Transport needs of inhabitants	explicit knowledge	Inhabitants	Surveys Frequency: once every two years
Demand for freight transport realisation by different modes of transport	explicit knowledge	Production companies, trading companies, service companies	Industry reports, workshops, symposia, seminars, cooperation with transport exchanges Frequency: once a year
Quality of transport infrastructure	explicit knowledge	Transport infrastructure managers (e.g. Directorate-General for National Roads and Motorways)	Expert panels Frequency: every two years
Factors determining the choice of means of transport in passenger transport	tacit knowledge	Inhabitants, tourists	Qualitative research (e.g. interviews, focus groups) Observation of transport users' behaviour Frequency: once every two years
Determinants of mode choice in freight transport	tacit knowledge	Production companies, logistics companies	Qualitative research (e.g. interviews, focus groups) Observation of transport users' behaviour Frequency: once every two years

Source: Own elaboration

4. Transport and Logistics Observatory as Coordinator of Knowledge Accumulation for Sustainable Urban Logistics Development in the Silesian Voivodeship

The role of specialised observatories in the innovation ecosystem is increasingly recognised. This is because specialised observatories collect knowledge and data on specific sectors of the economy, which contributes to the development of the region. At the same time, their role is to create a space for communication, cooperation and data exchange between the business community and the scientific and research community, business environment institutions and local government units. In accordance with these needs, within the framework of the system project of the Marshal's Office of the Silesian Voivodeship entitled "Regional Innovation and Management, Implementation and Monitoring of the Regional Innovation Strategy of the Silesian Voivodeship" (3rd edition) within the framework of submeasure 8.2.2 "Regional Innovation Strategies", which was implemented in 2011-2013 in cooperation with the Silesian University of Technology in Gliwice, the University of Economics in Katowice, the Central Mining Institute and the TECHNOPARK Gliwice Science and Technology

Park. The Transport and Logistics Observatory was established in 2020. The aim of the Observatory is to continuously monitor the development of technologies applied in the transport and logistics sectors of the economy of the Silesian Voivodeship. The implementation of the main objectives of the Observatory has led to a broader view of the need to collect data and knowledge on material flows and use it for the sustainable development of logistics systems of cities and enterprises. An inventory of resources and an assessment of the potential of the transport and logistics sector in the Silesian Voivodeship, as well as an analysis of the market and trends, provided the basis for building knowledge resources according to the model shown in Figure 2.

Through networking with different stakeholder groups, expert interviews and questionnaires, explicit knowledge is now being gathered. What is missing from the knowledge pool is tacit knowledge on the determinants of mode choice by stakeholders. A methodology to collect tacit knowledge is being developed. Data on pollution and delays in rail transport are regularly extracted from archival databases. Data received from the CSO are also analysed on an ongoing basis. Difficulties have been encountered in estimating traffic volumes due to the lack of access to data collected by Intelligent Transport Systems in the region. This data is not complete for the region studied. The Upper Silesia and Zagłębie agglomeration consists of 41 municipalities, including 13 cities with county rights (powiat) and 13 urban municipalities. These cities have different levels of implementation of ITS. For similar reasons, it is also difficult to assess the quality of the logistics infrastructure in the region in detail.

In evaluating the proposed concept of knowledge collection and data acquisition, it is worth revisiting the results of the Iwan et al. (2024) study. The results of the study by Iwan et al. (2024) showed that the difficulties in knowledge management in city logistics systems are mainly observed in the processes of data collection and knowledge acquisition. The main reason for the difficulties in this area is the reluctance of city users, retailers, transport and logistics operators to share information. These observations are consistent with the pilot studies carried out by the Observatory. Engaging stakeholders in the development of knowledge resources is an extremely complex process that must take place at multiple levels and utilise a variety of mechanisms. The fundamental challenges associated with the developed model system for knowledge gathering are the large number of different stakeholder groups, their different needs and capabilities, and their different knowledge and needs for cooperation with the city. Involving stakeholders in knowledge building is an extremely complex process that needs to take place at many levels and through a variety of mechanisms. Building trust in the coordinator, the specialised observatory, is crucial. Building knowledge resources therefore depends not only on the ICT technologies available at the level of measuring and monitoring individual factors and at the level of knowledge processing, but above all requires a high level of relational competence on the part of the coordinator, which in the case study is the Transport and Logistics Observatory. The coordinator must develop rules for cooperation with each stakeholder group, adapting the mechanisms for gathering explicit and tacit knowledge to suit each group. The concept developed is universal and can be applied in different regions. The limitation is the availability of data and the complexity of the methodology for collecting explicit and tacit knowledge.

5. Conclusions

Knowledge management in urban logistics systems is an extremely complex but also important problem. The centralised model for building knowledge resources for the sustainable development of urban logistics systems addresses these challenges. There is great potential in the concept developed, which should be exploited in practice and developed further on the scientific side. In particular, it is worth developing research on the relationship between the identified stakeholder roles and the tasks in which they are involved for sustainable urban flows and the way in which they work together to acquire knowledge. The knowledge gaps identified in the pilot study on the translation of knowledge resources built up by the Transport and Logistics Observatory point to the need for further research aimed at standardisation, allowing the replicability of conclusions from the analysis of knowledge resulting from the processing of explicit and tacit stakeholder knowledge and data extracted from different sources. It is important to bear in mind that the knowledge transferred will support not only the stakeholders but also the public administration, which should use it to develop strategies for sustainable flows of people and goods in the city. At the same time, it is worth considering other centralised models that can support both public administrations and stakeholders in sustainable urban flows in regions without specialised observatories. The results of the research indicate a significant need to develop knowledge management in urban logistics systems. This need is becoming increasingly urgent, not only due to the theoretical gaps identified in the transfer of solutions developed for supply chains to urban logistics systems, but also because the developed centralised model addresses these gaps. In the era of the fifth industrial revolution, new challenges are emerging relating not only to sustainable development, but also to the resilience of urban logistics systems in the face of disruption and crisis. The authors are currently developing this area as a supplement to the presented data collection model.

Acknowledgement

The article presents selected results of the regional project “Creation of Regional Innovation Observatory”. The project is financed by the project is financed by the European Funds for Silesia program and state budget (project number: FESL.01.03-IP.02-06CF/23).

Ethics declaration: Regarding the research presented in the article “The role of the Transport and Logistics Observatory in gathering knowledge for sustainable urban logistics development", we report that no ethical approval was required for the research conducted. The research was based on the analysis of data from publicly available sources and reports from transport and logistics institutions, as well as a literature review on sustainable urban logistics development.

AI declaration: This paper uses an artificial intelligence tool to create Figure 1. This tool has been used to create a visualisation that illustrates the identification of data and knowledge in building knowledge resources in the city's logistics system.

References

Ackerman, F. (2005) Material flows for a sustainable city, *International Review for Environmental Strategies*, 5(2), pp. 499–510.

Armistead, C. (1999) Knowledge management and process performance, *Journal of Knowledge Management*, 3(2), pp. 143–157.

Bennett, R. and Gabriel, H. (1999) Organisational factors and knowledge management within large marketing departments: an empirical study, *Journal of Knowledge Management*, 3(3), pp. 212–225. https://doi.org/10.1108/13673279910288707

Cerchione, R., & Esposito, E. (2016). A systematic review of supply chain knowledge management research: State of the art and research opportunities. International Journal of Production Economics, 182, 276-292.

Dalkir, K. (2013) *Knowledge management in theory and practice*, Routledge.

Ehlers, U.Ch. et al. (2017) Assessing the safety effects of cooperative intelligent transport systems: A bowtie analysis approach, *Accident Analysis & Prevention*, 99(Part A), pp. 125–141.

Farooq, R. (2024) A review of knowledge management research in the past three decades: a bibliometric analysis, *VINE Journal of Information and Knowledge Management Systems*, 54(2), pp. 339–378. https://doi.org/10.1108/VJIKMS-08-2021-0169

Gagliardi, A. R., Festa, G., Usai, A., Dell'Anno, D., & Rossi, M. (2023). The impact of knowledge management on the digital supply chain–a bibliometric literature review. International Journal of Physical Distribution & Logistics Management, 53(5/6), 612-627.

Gilbert, J.B., Probst, B. and Romhardt, K. (2000) *Managing knowledge: Building blocks for success*, Wiley, ISBN: 978-0-471-99768-9.

Gupta, J.N.D., Sharma, K.S. and Hsu, J. (2003) An overview of knowledge management, in Gupta, J.N.D. (ed.) *Creating knowledge based organizations*, Idea Group Publishing, Hershey, PA, USA.

Handbook on the external costs of transport (2019) https://cedelft.eu/wp-content/uploads/sites/2/2021/03/CE_Delft_4K83_Handbook_on_the_external_costs_of_transport_Final.pdf

Höjer, M. and Wangel, J. (2015) Smart sustainable cities: definition and challenges, in Hilty, L. and Aebischer, B. (eds) *ICT Innovations for Sustainability*, Springer, Cham, pp. 310.

Iwan, S., Wagner, N. and Kijewska, K. (2023) The knowledge-based city logistics as a new approach for the urban freight transport problems and solutions, *Transportation Research Procedia*, 72(15), pp. 4358–4365. https://doi.org/10.1016/j.trpro.2023.11.333

Iwan, S. et al. (2024) Concept of the knowledge-based city logistics: Problems and solutions, *PLOS ONE*, 19(6), e0305563. https://doi.org/10.1371/journal.pone.0305563

Javeda, M.A., Zeadally, S. and Hamida, E.B. (2019) Data analytics for cooperative intelligent transport systems, *Vehicular Communications*, 15, pp. 63–72.

Koskinen, K.U., Pihlanto, P. and Vanharanta, H. (2003) Tacit knowledge acquisition and sharing in a project work context, *International Journal of Project Management*, 21(4), pp. 281–290.

Laña, I. et al. (2021) From data to actions in intelligent transportation systems: a prescription of functional requirements for model actionability, *Sensors*, 21(4).

Liu, C. and Ke, L. (2023) Cloud assisted Internet of things intelligent transportation system and the traffic control system in the smart city, *Journal of Control and Decision*, 10(2), pp. 174–187.

Loyarte, E. et al. (2018) Model for calculating the intellectual capital of research centres, *Journal of Intellectual Capital*, 19(4), pp. 787–813.

Mangiaracina, R. et al. (2017) A comprehensive view of intelligent transport systems for urban smart mobility, *International Journal of Logistics Research and Applications*, 20(1), pp. 39–52.

Mannonen, P. and Hölttä, V. (2013) Where the knowledge goes? Information gathering and managing practices in a global technical support center, *Procedia CIRP*, 11, pp. 412–415.

Matusiewicz, M. (2019) SULP (Sustainable Urban Logistics Plan) as a tool for shaping sustainable urban logistics: a review of European projects supporting the creation of SULP, *Transport Economics and Logistics*, 84.

Meneguette, R.I., De Grande, R. and Loureiro, A.A. (2018) *Intelligent transport system in smart cities*, Springer International Publishing, Cham.

North, K. and Kumta, G. (2018) *Knowledge management: Value creation through organizational learning*, Springer Texts in Business and Economics.

Przybylska, E., Kramarz, M. and Dohn, K. (2023) Analysis of stakeholder roles in balancing freight transport in the city logistics ecosystem, *Research in Transportation Business and Management*, 49, pp. 1–17.

Przybylska, E., Kramarz, M. and Dohn, K. (2023) The role of stakeholders in creating mobility in logistics systems of Polish cities, *Sustainability*, 15(3), pp. 1–27.

Rantanen, H. (2007) From knowledge gathering to knowledge management, in *Local Authority Planning in Change: Beyond Dichotomies*, Nordic Planning Research Symposium, August 16, Vol. 18.

Ruess, P. and Lindner, R. (2023) Knowledge management for smart cities—standardization and replication as policy instruments to foster the implementation of smart city solutions, *Smart Cities*, 6(4), pp. 2106–2124. https://doi.org/10.3390/smartcities6040097

Sartori, J. T. D., Frederico, G. F., & de Fátima Nunes Silva, H. (2022). Organizational knowledge management in the context of supply chain 4.0: A systematic literature review and conceptual model proposal. Knowledge and Process Management, 29(2), 147-161.

Shimada, H. et al. (2015) Implementation and evaluation of local dynamic map in safety driving systems, *Journal of Transportation Technologies*, 5, pp. 102–112.

Sveiby, K.E. (2001) A knowledge-based theory of the firm to guide strategy formulation, *Journal of Intellectual Capital*, 2(4), pp. 344–358.

Tah, J., & Carr, V. (2001). Towards a framework for project risk knowledge management in the construction supply chain. Advanced Engineering Software, 32, 835-846.

Taniguchi, E., Thompson, R.G. and Qureshi, A.G. (2023) Overview of city logistics and urban freight transport operations, in Marcucci, E., Gatta, V. and Le Pira, M. (eds) *Handbook on City Logistics and Urban Freight*, Edward Elgar Publishing, pp. 141–159.

Wang, C., Fergusson, C., Perry, D., & Antony, J. (2008). A conceptual case-based model for knowledge sharing among supply chain members. Business Process Management Journal, 14, 147-165.

Wang, L. and Pan, K. (2024) Quantitative analysis and model prediction of urban traffic flow optimization by geographic information technology, *Applied Mathematics and Nonlinear Sciences*, 9(1).

Yeh, H. (2008). A knowledge value creation model for knowledge intensive procurement projects. Journal of Manufacturing Technology Management, 19, 871-892.

Zenezini, G., Mangano, G. and De Marco, A. (2022) Experts' opinions about lasting innovative technologies in city logistics, *Research in Transportation Business & Management*, 100865.

Zhu, F. et al. (2019) Parallel transportation systems: toward IoT-enabled smart urban traffic control and management, *IEEE Transactions on Intelligent Transportation Systems*, 21(10), pp. 4063–4071.