Information sharing in sustainable value chain networks (SVCN): innovative technology for transportation in cities

Luai Jraisat (Luai.Jraisat@northampton.ac.uk)
Faculty of Business and Law, University of Northampton, UK

Abstract

The purpose of this paper is to explore the high-order themes related to information sharing in SVCNs with a focus on the applications of the Internet of Things (IoT) as an enabling innovative technology from the perspective of the expert community. This research is an inductive study and adopts a multi-case study strategy in the context of smart transportation for freight flow in the UK. 20 Semi-structured interviews were conducted with experts in smart transportation projects. The phenomenon of information sharing is enabled by effective innovative technologies such as IoT. A conceptual framework is constructed with themes of IoT applications and information sharing in SVCN.

Keywords: Information sharing, Innovative technology, Sustainable value chain network.

Introduction

A lack of information about and understanding of transportation has a major role in most cities. Improving such information is important for information sharing in sustainable value chain networks (SVCN) of transportation in these cities. The phenomenon of information sharing is one of the key subjects to be enabled by effective Information and Communications Technology (ICT), such as the Internet-of-Things (IoT) (Lindholm, 2010; Mirzabeiki, 2013; Andersson and Mattsson, 2015). Optimising the transportation activities with innovative ICT is considering smart solutions to support freight flow in urban cities due to the complexity of the processes taking place in transport systems and the often conflicting expectations of stakeholders (Tachizawa et al., 2015).

In fact, there are a great number of initiatives that are very close in terms of objectives but they do not have a common basis, like standards, conceptions and strategies (Vovk, 2016). Since 2000, more than 40 different projects on smart transportation have been initiated in Europe (Festag, 2014; Vovk, 2016). Nowadays, smart transportation of IoT includes not only a great variety of information but thousands of other systems using data to make intelligent transport-related decisions (Uden and He, 2017). IoT technologies guarantee economic benefits as chain actors will be able to share valuable information and make decisions that are more reasonable. This is to reduce transportation time and transportation expenditure and to reduce the impact of transportation on the society and environment (Haddud et al., 2017).

With visions from a multi-disciplinary perspective, the IoT has become the common paradigm of the modern ICT area by enabling innovative applications in nearly all sectors of the economy (Haddud et al., 2017). However, relatively little attention has been paid to the information sharing between actors enabled by IoT for smart transportation along the SVCN (Andersson and Mattsson, 2015; Uden and He, 2017). Thus, this research aims to explore the high-order themes related to information sharing in SVCNs with a focus on the applications of IoT as a key enabling ICT innovative technology from the perspective of the expert community.

This study will use existing literature as well as case studies to examine the IoT application and information sharing for smart transportation for freight flow in SVCNs. This could be by identifying the possible high-order themes related to information sharing for smart transportation in SVCN with a focus on the applications of IoT as an enabling innovative technology. This can provide benefits in terms of sustainability chain performance (Vovk, 2016; Uden and He, 2017). The study poses the following research questions:

RQ1. How can key themes of the applications of IoT be connected for information sharing in SVCN?

RQ2. How and why are these key themes effectively linked to information sharing in SVCNs to improve value chain performance in practice?

This paper provides relevant views from the perspective of experts in smart transportation projects in the UK. The article starts with a theoretical background on SVCN, IoT and innovative technology and information sharing. Next, the research methodology is outlined. Then key findings and discussion are suggested. Lastly, conclusions are provided with managerial implications.

Theoretical Background

SVCN has been affected by the digital revolution, where an actor's strategy is affected by this digital era, which has created a hub where everything will be connected to everything via the internet (Chase, 2016; Haddud, et al., 2017). SVCN is considered as the theoretical basis of the information sharing phenomenon. SVCN should present a framework to researchers for solving information issues such as sharing, visibility, environment, sources, technology and types (European Commission Information Society, 2009; Vovk, 2016; Haddud, et al., 2017). The SVCN is an approach whereby delivery and transportation businesses are integrated with the growth of e-commerce in the EU. Hence, a roadmap for completing the market for transportation has identified the need for increased transparency and information to all chain network actors as a key objective for improving delivery operations and boosting e-commerce (European Commission Information Society, 2009). Pang et al. (2012) have argued that the revolution of IoT is reshaping the modern chain networks with promising business prospects in order to create sustainable values for freight flow. The development in transportation is one of the factors that indicate the wellbeing of the country. Totally optimising the logistics and transport activities with the support of advanced ICT in urban cities is considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy (Taniguchi et al., 2001).

Historically, research on IoT has been linked to several themes, such as technology, collaboration, social networks, quality, costs, satisfaction, investment, system analysis, system control and connectivity (Pang et al., 2012; Vovk, 2016; Xu, et al., 2016; Uden and He, 2017). In this scenario, authors have argued that it is important to identify a well-established approach to both IoT application and information sharing for smart transportation. Optimising the transportation activities with innovative technologies is considering smart solutions to support freight flow in urban cities due to the complexity of the processes taking place in transport networks (Tachizawa et al., 2015). Thus, this will lead to improved performance for a set of actors along the SVCN rather than a single actor (Pang et al., 2012; Xu, 2016). Although research does not ignore the importance of the IoT in SVCN, it has not focused fully on the application of the IoT in the mechanism of information sharing and especially on strategic issues such as challenges and benefits.

The European Commission Information Society (2008) has defined IoT as “Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts”. Wu et al. (2016) defined IoT as a set of hardware, software, database, sensors, a hub of databases and systems for the support of people. A foundational technology for the IoT is the Radio Frequency Identifications (RFID) technology, which allows microchips to transmit the identification information to a reader through wireless communication (Da Xu et al., 2014). In fact, the IoT is an enabling tool that leads physical objects to be alive and perform actions by connecting these objects and then sharing information for better decisions and improved performance within SVCNs (Gartner Press Release, 2016; Haddud, et al., 2017). To make these objects smart, technologies can be applied such as communication technology, sensor networks, internet protocols, analytic systems, control systems and embedded devices (Fang, et al., 2016; Haddud, et al., 2017). Table 1 shows IoT technologies as identified by previous research.

Table 1-IoT Technologies in the years 2017-2018.

Technology	Description
IoT security	Security technologies will be required to protect IoT devices and platforms from both information attacks and physical tampering
IoT analytics	New analytic tools and algorithms are needed now, but as data volumes increase through 2021, the needs of the IoT may diverge further from traditional analytics
IoT device (thing) management	The IoT also brings new problems of scale to the management task. Tools must be capable of managing and monitoring thousands and perhaps even millions of devices
Short-range IoT networks	Low-power, short-range networks will dominate wireless IoT connectivity through 2025, far outnumbering connections using wide-area IoT networks
Wide-area networks	The long-term goal of a wide-area IoT network is to deliver data rates from hundreds of bits per second (bps) to tens of kilobits per second (kbps) with nationwide coverage, a battery life of up to 10 years, an endpoint hardware cost of around $5, and support for hundreds of thousands of devices connected to a base station or its equivalent
IoT processors	The processors and architectures used by IoT devices define many of their capabilities, such as whether they are capable of strong security and encryption, power consumption, whether they are sophisticated enough to support an operating system, updatable firmware, and embedded device management agents
IoT operating systems	A wide range of IoT-specific operating systems has been developed to suit many different hardware footprints and feature needs
Event stream processing	Distributed stream computing platforms (DSCPs) have emerged. They typically use parallel architectures to process very high-rate data streams to perform tasks such as real-time analytics and pattern identification
IoT platforms	IoT platforms bundle many of the infrastructure components of an IoT system into a single product: (1) low-level device control and operations; (2) IoT data acquisition, transformation, and management; and (3) IoT application development
IoT standards and ecosystems	Standards and their associated application programming interfaces (APIs) will be essential because IoT devices will need to interoperate and communicate, and many IoT business models will rely on sharing data between multiple devices and organizations

Source.Gartner Press Release (2016)

Researchers argue that the SVCN concept allows the focus to move from a transaction to a relational perspective that considers the environment around actors or firms or objects (Tachizawa, et al., 2015). This concept is of great interest in applying the perspective of the network to analysing information sharing within the value chain of smart transportation for freight flow in cities (Andersson and Mattsson, 2015; Uden and He, 2017). Thus, when analysing the association between IoT applications and information sharing the cone-shaped concept map of the business network information ecological chain (BNIEC) illustrated by Xu et al. (2016) should be highlighted (See Figure 1).

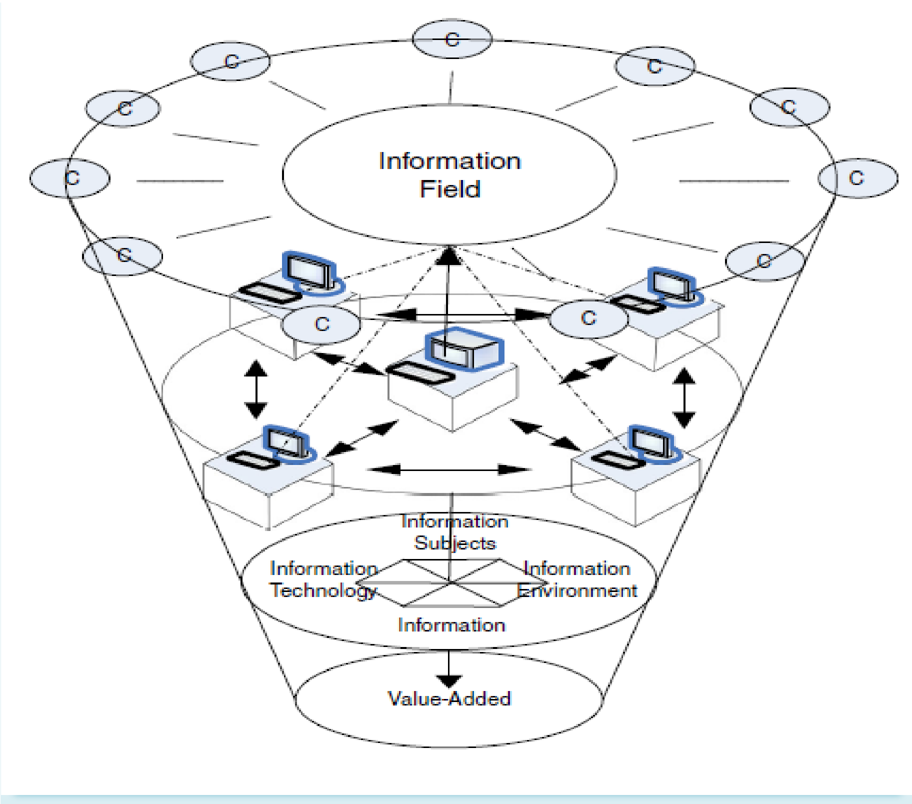

Figure 1-Illustration of information in value chain network
Source. Adopted from Xu et al. (2016)

In SVCNs, the first stage is value added, where the aim is to create benefits and minimize challenges for the actors involved in smart transportation for freight flow (European Commission Information Society, 2009; Pang et al., 2012). This focuses on various issues associated with information problems, improving information value and enhancing performance for all actors (Xu, et al., 2016). This adds value for type 1 stakeholders, namely citizens, drivers, public transportation managers, and the local city administration.

The second stage is IoT components: information, information technology, information subjects, and information environment. This is directly connected with the concept of smart transportation in order to deal with three main concepts: transportation analytic, transportation control, and vehicle connectivity. This brings about value assessment and business-technology applications for type 2 stakeholders, namely data experts, database designers, transportation experts, traffic experts, logistic experts, communication engineers, network engineers, system designers and sustainability experts.

The third stage is links between different actors and objects in the transportation system. Surrounding the focal actor, all actors share information taking on different logical roles. This develops interaction between data hub and transportation systems for type 3 stakeholders, namely data source providers, local services, data management and communication technology. For example, a road condition monitoring and alert application is one of the most important IoT transformation applications (Mirzabeiki, 2013). The need for smart solutions to support goods transport and distribution in cities is mainly due to the complexity of the processes taking place in urban transport systems and the interweaving and often conflicting expectations of particular groups of road users and other stakeholders in urban freight transport (city administrators, inhabitants, entrepreneurs and shippers) (Małecki et al., 2014). The main idea of the concept of smart transportation and green mobility is to apply the principles of crowd sourcing and participatory sensing. This can be supported via various data sources from vehicles, sensors, data centres, infrastructure, smart phones etc. Smart transportation consists of key communication methods such as machine-to-machine (M2M) communications, which include vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications for better links.

The fourth stage and the one which is related to the topic of the present research is information sharing in SVCNs. This stage illustrates how IoT applications facilitate information sharing based on hosting an aggregative information field. This is where all actors or objects “things” of the above types share their hub or database contents with the potential actors (e.g. customer, middleman, retailer, service provider and object) in order to create more benefits and decrease the number of existing challenges.

In fact, there are a great number of initiatives which are very close in terms of their objectives and tasks but they do not have a common basis like standards, conceptions and strategies (Vovk, 2016). Reviewing the milestones that have been reached in Europe, for example, the first research programs for cooperative smart transportation date back to the 1980s, the European project PROMETHEUS (1987–1994) that used inter-vehicle communication in the 57 GHz frequency band (Festag, 2014). By 2000, a new technology was initiated worldwide, triggered by the availability of GPS, embedded systems, and WiFi. In Europe, more than 40 different projects on cooperative smart transportation have been initiated since 2000 (Festag, 2014; Vovk, 2016): initial feasibility studies (i.e. FleetNet and NoW), technology state and standardization (i.e. SAFESPOT, GeoNet, SEVECOM, CoVeL, and COMeSafety), field operation tests on safety and traffic efficiency (i.e. DRIVE C2X, SIM-TD, SCORE@F, etc.), cooperative automated driving (i.e. AutoNet2030 project). Actually, by means of information sharing among vehicles, as well as between vehicles and the roadside infrastructure, vehicles are transformed from autonomous systems into cooperative systems (Vovk, 2016). Nowadays smart transportation associated with IoT is the largest and the most versatile group of business. It includes not only a great variety of information, road, navigating, car systems but insurance and control systems for a vehicle/ driver (telematics) and thousands of other systems using data to make "intelligent" transport-related decisions. IoT technologies guarantee enormous economic benefits as both carriers and transport users will be able to make more reasonable decisions to reduce passenger and cargo transportation time and to cut transportation expenditure and delays. In addition, “green” IoT can apply technologies to reduce the impact of passenger and cargo transportation on the environment.

Methodology

This research is an inductive qualitative study and adopts a case study strategy. From a multi-disciplinary perspective, a conceptual framework can be developed from both the existing literature and contextual field data (Eisenhardt, 1989). The cases are projects in the context of transportation for freight flow in the UK. 20 Semi-structured interviews have been conducted with experts in these projects. This research applies within case and cross-case analyses (Miles and Huberman, 1994). By defining the themes of the associations between IoT applications and information sharing in SVCN it became possible to develop the framework. These projects have been selected because they have smart ICT technologies (e.g. IoT) for transportation, and have a focus on information sharing in their SVCN. Experts as key informants were chosen because they provide an overview of the IoT application, information sharing and their projects as a whole. The aim is to gain a rich understanding of what the applications of IoT are in smart transportation, how far IoT enables information sharing between actors, and what the roles of information sharing in SVCNs are. The UK is one of the key countries which has initiatives in applying IoT to support sustainable development in a number of sectors, especially transportation in cities.

The sampling selection was based on advanced research into the online directory of sustainable projects in the UK and it included projects that have been applied for smart transportation for freight flow in cities. This led to a list of 30 projects, which were then shortlisted to 10 projects based on three steps: satisfactory achievement records, positive email responses and an initial phone interview. Then, two experts in each project were asked to identify a network of smart transportation for freight flow in order to form the unit of analysis as a SVCN. This is where 10 different projects (Case: 1-10): similar 10 SVCN (unit of analysis) where each includes two different experts (sub-unit of analysis) are examined. Table 2 illustrates the selected projects and their details.

Table 2-Case study in the context of SVCN in the UK.

Case	Interviewee	Unit of Analysis	Project Years	Project Status	City
SVCN 1	Public transportation manager, local city administration	Type 1	2016-	Active	London
SVCN 2	Public transportation manager, local city administration	Type 1	2016-	Active	London
SVCN 3	Public transportation manager, local city administration	Type 1	2016-	Active	Bristol
SVCN 4	Data expert, sustainability expert	Type 2	2016-	Active	Birmingham
SVCN 5	Communication technology manager and service manager	Type 3	2017-	Active	Cambridge
SVCN 6	Communication expert, network expert	Type 4	2017-	Active	London
SVCN 7	Public transportation manager, local city administration	Type 1	2015-17	Inactive	London
SVCN 8	Data expert, sustainability expert	Type 2	2013-17	Inactive	Bristol
SVCN 9	Communication technology manager and service manager	Type 3	2010-13	Inactive	Birmingham
SVCN 10	Communication expert, network expert	Type 4	2010-12	Inactive	Newcastle

Each SVCN is made up of a set of stakeholders: type 1 of citizens, drivers, public transportation managers, and the local city administration; type 2 of data experts, database designers, transportation experts, traffic experts, logistic experts, communication engineers, network engineers, system designers and sustainability experts; type 3 of data source providers, local services, data management and communication technology; type 4 of all stakeholders. The interviews were conducted and recorded by the author in person. All the participants were asked the same questions. The interviews were also transcribed and then sent to the experts for revisions. The approved interviews were used to develop the case studies, which were analysed through cross-case analyses (Miles and Huberman, 1994).

Findings and Discussions

The intention of the present research is to contribute to the body of knowledge by providing new propositions for information sharing in SVCN with a focus on the applications of the Internet of Things (IoT) as an enabling innovative technology from the perspective of project experts.

At the cross case level, to answer RQ1, key themes of the IoT applications that can be associated with information sharing in SVCN are explored. The exploratory case studies have indicated that the key themes should be categorized related to the four stages: stage 1- value added, stage 2- Linking IoT components to the concept of smart transportation in order to deal with IoT conceptions, stage 3- links between different actors and objects in the transportation system, and stage 4- all actors or objects, "things" of the above types, share their hub or database contents with the potential actors. The research applies this cross analysis to develop data exploration to enhance replication logic amongst the 10 cases (10 SVCNs), providing the views of 20 project experts. In table 2, the cross-case matrix shows the stages of IoT applications that smart transportation projects follow to create information sharing in SVCNs, with a focus on increasing benefits and decreasing challenges for better performance.

Table 2-IoT applications across the 10 cases of smart transportation projects.

Aggregate dimension	**Second order theme: First order themes**	**Case**									
		1	2	3	4	5	6	7	8	9	10
Stage 1	Benefits and challenges:										
	▪ identify information problems	X	X	X	X	X	X	X	X	X	X
	▪ improve information value	X		X			X	X			
	▪ enhance performance		X		X	X	X		X	X	X
Stage 2	IoT components:										
	▪ information	X	X	X	X	X	X	X	X	X	X
	▪ information technology	X	X	X	X	X	X	X	X	X	X
	▪ information subjects	X	X			X					X
	▪ information environment	X									X
	IoT main conceptions:										
	▪ transportation analytic	X		X	X		X		X		X
	▪ transportation control	X	X	X	X	X	X	X	X	X	X
	▪ vehicle connectivity	X						X			
Stage 3	Actor Interaction:										
	▪ data hub	X		X					X		
	▪ transportation system	X	X		X	X	X	X	X	X	X
Stage 4	Facilitating information sharing:										
	▪ increasing the no. of benefits	X	X	X	X	X	X		X		X
	▪ decreasing existing challenges.	X	X		X	X	X	X	X	X	X

This analysis resulted in 14 first-order themes for IoT applications, which were then coded as 5 second-order themes and in turn into 4 aggregate dimensions. These aggregate dimensions are associated with one overarching theme, information sharing for SVCN, in order to establish the theoretical association for the current study.

Researchers have proposed key findings to carry out development in SVCNs for smart transportation in cities (e.g. Tachizawa et al., 2015; Vovk, 2016; Haddud, et al., 2017). However, a wider body of knowledge about SVCNs associated with IoT is needed to overcome overlapping concepts in order to generate consistent findings (Festag, 2014; Vovk, 2016; Xu, et al., 2016). Thus, the intention of the current research is to contribute to the body of knowledge by providing a new conceptual framework for Information sharing in SVCNs attached to IoT as an innovative technology in smart transportation. The framework in figure 1 illustrates the key themes effectively linked to information sharing in SVCN and thus, in order to improve value chain performance in practice. Amongst these, information sharing has become the central theme, which is formed by themes of IoT applications as antecedences for information sharing.

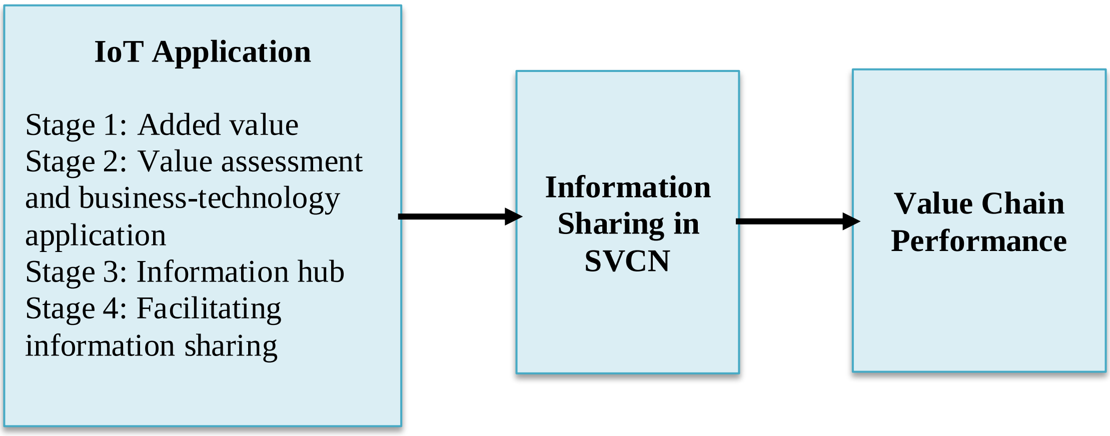

Figure 2-A proposed framework for IoT applications and information sharing in SVCNs

There has been significant interest in applying the concept of sustainable networks to understanding complex interactions and applications within value chains (Caragliu, et al., 2009; Pilbeam et al., 2012; Tachizawa et al., 2015; Xu, et al., 2016; Vovk, 2016). The research proposes a conceptual framework that encompasses three key aspects of sustainable network: innovative technology (IoT applications), information sharing and value chain performance for smart transportation in cities. The present research provides brief explanations for each part of the proposed framework. First, the IoT application (Xu, et al., 2016). IoT as an innovative technology is proposed from the application used by various projects in smart transportation in the five cities considered in this study. The key findings highlight the importance of the four stages of IoT applications to create information sharing in SVCNs. The experts indicated that nine themes, (namely identifying information problems, enhancing performance, identifying information, information technology, transportation analytic, transportation control, transportation system, increasing benefits, and decreasing existing challenges) are the most important concepts and activities that should be included in IoT applications. The experts also indicated that five themes (namely improving information value, information subjects, the information environment, vehicle connectivity, and the data hub) are less important activities that can be included in IoT applications. The proposed framework indicates a set of recommendations for policy makers and project management

In total 14 themes linked to the four stages of IoT applications have an impact on creating information sharing in SVCN for smart transportation in cities. This in turn can bring improved value chain performance with a focus on the sustainability aspects of economic, social and environmental issues. The experts in all cases have illustrated the importance of these sustainability issues, which have the potential to improve the efficiency and effectiveness of transportation systems for smart cities.

For example, key enabling innovative technologies including M2M, V2V, V2I are IoT application technologies of communication that create better links amongst actors. With multiple visions from various viewpoints, the IoT has become a key strategy in many smart cities (Tachizawa et al., 2015; Xu, et al., 2016; Vovk, 2016). IoT offers key benefits to various actors along the value chain, including business to business and business to consumer, in addition to the private and public sectors by enabling innovative applications. These applications provide a hub of information sharing for all actors based on a combination of information technology, telecommunication and objects, allowing the provision of valuable information on time. This can increase the benefits and decrease the challenges, providing promising potential to address visibility and controllability challenges and to focus on more sustainable benefits along the value chain of smart transportation.

Conclusion and Contributions

This research has responded to calls for a holistic perspective on the understanding of how information sharing contributes towards improving SVCNs through focusing on innovative technology (Taniguchi et al., 2012; Uden and He, 2017). A perspective of increased transparency and shared information for all actors is a key objective in SVCNs for improving smart transportation operations by IoT.

With multiple visions from different viewpoints, the IoT has become the common paradigm of the modern ICT area (Atzori et al. 2010). It offers immense potential to consumers, companies and the public sector by enabling innovative applications. This focus is attracting increasing attention from both policy makers and academics, where prior research has suggested that this focus exhibits many unclear characteristics (e.g. Porter and Millar, 1985; Browne and Gomez, 2011). There is a lack of IoT applications that can improve businesses in a sustainable way. Thus, this research aims to explore the high-order themes connected to information sharing in SVCNs with a focus on the applications of IoT in transportation operations as a key enabling ICT technology from the perspective of the expert community along the value chain. In this research, a conceptual framework for information sharing in SVCNs associated with IoT for transportation operations has been proposed.

References

Andersson, P and Mattsson, L (2015), "Service innovations enabled by the "internet of things", *IMP Journal*, Vol. 9, No. 1, pp. 85-106.

Browne, M. and Gomez, M. (2011), "The impact of urban distribution operations of upstream supply chain constraints", *International Journal of Physical Distribution and Logistics Management*, Vol. 41, No. 9, pp. 896-912.

Caragliu, A., Del Bo, C. and Nijkamp, P. (2009), "Smart cities in Europe", *Journal of Urban Technology*, Vol. 18, No. 2, pp. 65-82.

Chase, C.W. Jr (2016), "The digital revolution is changing the supply chain landscape", *The Journal of Business Forecasting*, Vol. 35, No. 2, pp. 20-22.

Eisenhardt, K. M. (1989), “Building theories from case study research”, *Academy of Management Review*, Vol.14, pp: 532–550.
European Commission Information Society (2009). Internet of things strategic research roadmap 2009. In reports of CERP-IoT cluster.
Fang, C., Liu, X., Pardalos, P.M. and Pei, J. (2016), “Optimization for a three-stage production system in the Internet of Things: procurement, production and product recovery, and acquisition”, The *International Journal of Advanced Manufacturing Technology*, Vol. 83, Nos 5/8, pp. 689-710.
Festag, A. (2014), “Cooperative intelligent transport systems standards in Europe”, *IEEE Communications Magazine*, Vol.52, No.12, pp. 166-172.
Gartner Press Release (2016), “Top 10 Internet of Things technologies for 2017 and 2018”, available at: www.gartner.com/newsroom/id/3221818 (accessed April 1, 2018).
Haddud, A., DeSouza, A., Khare, A. and Lee, H. (2017), “Examining potential benefits and challenges associated with the Internet of Things integration in supply chains”, *Journal of Manufacturing Technology Management*, Vol. 28, No. 8, pp.1055-1085.
Lindholm, M. (2010), “A sustainable perspective on urban freight transport: factors affecting local authorities in the planning procedures”, *Procedia Social and Behavioural Sciences*, Vol. 2, pp. 6205–6216.
Miles, MB. and Huberman, AM. (1994), *Qualitative Data Analysis* (2nd edition), Thousand Oaks, CA: Sage Publications.
Mirzabeiki, V. (2013), “An overview of freight intelligent transportation systems”, *International Journal of Logistics Systems and Management*, Vol.14, No. 4, pp 473 – 489.
Pilbeam, C., Alvarez, G. and Wilson, H. (2012), “The governance of supply networks: a systematic literature review”, *Supply Chain Management: An International Journal*, Vol. 17, No. 4, pp. 358-376.
Tachizawa, E.M., María J. Alvarez-Gil, and María J. Montes-Sancho (2015), “How “smart cities” will change supply chain management”, *Supply Chain Management: An International Journal*, Vol. 20, No. 3, pp.237-248.
Taniguchi, E., Thompson, R. G., and Yamada, T. (2012), “Emerging techniques for enhancing the practical application of city logistics models”, *Procedia - Social and Behavioral Sciences*, Vol.39, pp. 3-18.
Uden, L. and He, W. (2017), “How the Internet of Things can help knowledge management: a case study from the automotive domain”, *Journal of Knowledge Management*, Vol. 21, No.1, pp.57-70.
Vovk, Yu. (2016), “Resource-efficient intelligent transportation systems as a basis for sustainable development. Overview of initiatives and strategies”, *Journal of Sustainable Development of Transport and Logistics*, Vol.,1 No.1, pp. 6-10.
Wu, L., Yue, X., Jin, A. and Yen, D.C. (2016), “Smart supply chain management: a review and implications for future research”, *The International Journal of Logistics Management*, Vol. 27, No. 2, pp. 395-417.