

**Examining Information Infrastructure:
A Framework for Public and Private Investments in Intelligent
Transportation Systems to Support Supply Chain Performance and
Community Livability & Safety**

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ABSTRACT

Freight movements and deliveries into dense urban US regions challenge businesses and governments working within constrained resources to meet customer and societal needs. We examine the relationship between public and private investments in intelligent transportation systems (ITS) as complementary drivers to improve supply chain performance (SCP) and community livability and safety (CL&S). A research framework drawn on precepts from complementarity theory combined with business intelligence and shared value is developed. We propose five key propositions and provide a taxonomy of ITS benefits mapped to SCP and CL&S based on our literature review and industry interviews. Our conceptual study results suggest that increased information sharing provided by ITS infrastructure can contribute to the public and private realms by creating synergy. The study informs managers from a practical perspective regarding the shared value model synergies evident from ITS investment decisions. We discuss theoretical and managerial contributions, study limitations, and directions for future research.

Keywords: Intelligent transportation systems, ITS, Supply chain performance, Community livability and safety, Shared value models, Theory of complementarity, Business intelligence

INTRODUCTION

Balancing the necessity of moving the correct assortment of products into urban areas while limiting the effects of environmental, social, and logistics costs is a challenge for private firms and governments (Crainic et al., 2004; Figliozzi, 2011; Schliwa et al., 2015). The globalization of supplier networks coupled with the erratic availability of products in a post-pandemic world has complicated the supply chain management (SCM) process in meeting customer and societal objectives (Fonseca & Azevedo, 2020). Over time, supply chains have increased in complexity, and simultaneously, there has been substantial growth in information technology (IT) investment by public and private entities (FMCSA 2018; Forger 2019).

Intelligent transportation systems (ITS) are information processing, communications, sensing, and other technologies used to improve surface transportation problems through information sharing (Barfield & Dingus, 1998; Schafer & Nilsson, 2016; Vandezande & Janssen, 2012). ITS is a mechanism to address the mentioned challenges and create shared value synergies for society and commerce (Porter & Kramer, 2011). Consequently, there is a growing need to understand how public and private investments in ITS influence community livability and safety (CL&S) and supply chain performance (SCP) (Schafer & Nilsson, 2016; Schofer & Mahmassani, 2016; USDOT, 2017; Zhou & Shen, 2010).

The literature suggests that community livability and transportation benefits are the goals of ITS (Mahmassani, 2016; Schofer & Mahmassani, 2016; USDOT, 2017; Zhou & Shen, 2010). There is scant literature for the conjoined examination of ITS investments for supply chain performance and community livability and safety (Schafer & Nilsson, 2016). Evaluating the effects of public and private investments in ITS on society (i.e., CL&S) and private enterprise (i.e., SCP) is a significant omission in the literature, given that public agencies and private enterprises often differ in their outcome goals, even in light of triple bottom line and shared value models (Elkington, 1994, 2018; Porter & Kramer, 2011). Precepts from the theory of complementarity (Milgrom & Roberts, 1994, 1995), business intelligence (Negash, 2004; Snow, 2006), and shared value (Porter & Kramer, 2011) are combined to develop a conceptual framework to explain the effects of integrated ITS investments on supply chain performance and community livability and safety.

ITS provides a digital connection and a proven approach to achieving enterprise integration, transformation, and collaboration (Hsu & Wallace, 2007). The use of ITS for commercial vehicle operations (CVO) and freight movements is particularly notable for the movement of products and goods. The highest levels of congestion and people are in dense urban areas. These dense urban areas are also where the most freight deliveries are

required, which compounds the congestion and delay problems for goods delivery. The successful implementation of ITS for commercial vehicles requires cooperation between both government and private industry (Barfield & Dingus, 1998; Crainic et al., 2004). Building collaborative public-private exchanges with integrated models to overcome the barriers to implementing ITS is essential (Schafer et al., 2016; Shaheen et al., 2013). Business-to-government information exchanges can promote cost reductions and efficiency improvements (Bharosa et al., 2013). Highway infrastructure belongs to the public domain, yet businesses use transportation infrastructure to ensure the timely and efficient delivery of goods to market (Hsu & Wallace, 2007; Schafer et al., 2016).

This study addresses two critical questions about public and private ITS investments: community livability, safety, and supply chain performance.

- First, will investment in ITS technologies enhance supply chain performance and improve community livability and safety to create shared value synergies?
- Second, do public and private ITS investments drive both, or must we find balance and equity between supply chain performance and community livability and safety?

We inform these research questions by developing a theoretical framework grounded in the complementarity theory combined with business intelligence and shared value. We conducted a literature review and industry interviews to posit five key propositions. We classify ITS technology investments between their public and private investment sources and benefits to society and practice.

This paper contributes to theory through the development of a conceptual framework. We examine the relationship between public and private investments in ITS as complementary drivers to improve supply chain performance and community livability and safety in a shared value model (Porter & Kramer, 2011). Considering the precepts of shared value, our literature review and applied taxonomy results suggest that increased information sharing provided by ITS infrastructure can contribute to both the public and private realms to create synergy. Given the public realm, results assembled from the literature and interviews suggest increased livability in the form of safety improvements by way of accident reductions and other improvements to social costs, such as reduced congestion and noise pollution (Appleyard, 1980; Lin & Yu, 2008; Mahmassani, 2016; S. Vaughn, personal communication, May 8, 2020). Allowing for the private realm, digitized infrastructure, and increased information sharing for transport conditions improve supply chain performance through increased transparency for delivery reliability and cost reductions through driver safety improvements (Burnos & Gajda, 2016; Khan et al., 2019; Lin & Yu, 2008; Mahmassani, 2016; S. Vaughn, personal communication, May 8, 2020; Wang et al., 2020). A sample of ITS is provided to illustrate how public and private

investments are classified and integrated for system improvements through ITS technologies. Further, the study informs managers from a practical perspective regarding the shared value model synergies evident from ITS investment decisions. We conclude the paper with a discussion of future directions and limitations.

LITERATURE REVIEW

Given the multidisciplinary nature of this topic at the intersection of public and private transportation technology investments in ITS, community livability and safety, and supply chain performance, the literature review is organized into two subsections. The first section examines studies integrating public and private investments in infrastructure projects. The second section reviews studies on advanced technologies for ITS applications.

Public and Private Investments in Infrastructure

The first stream of literature examines public and private investments in infrastructure. Much work is devoted to public-private partnerships (Liu et al., 2014; Osei-Kyei & Chan, 2017; Pittz & White, 2016; Shaheen et al., 2013). Another body of work frames the stream as collaborations between businesses and the government for infrastructure projects (Quelin et al., 2017). Early work was devoted to critical success factors (Jamali, 2004; Jefferies, 2006; Liu et al., 2014). Some previous work identifies that collaboration between businesses and the government helps overcome economic barriers that burden moving forward with infrastructure projects and thus promote healthier economic conditions (Shaheen et al., 2013). Recent studies examine various project risk assessments (Hwang et al., 2013; Osei-Kyei & Chan, 2017; Xiong et al., 2017) and outcomes that contribute to long-lasting partnerships and entrepreneurship (Pittz & White, 2016).

There is scant literature that examines public infrastructure investments as an impetus for private investments as complementary transportation assets; a notable exception is Schafer and Nilsson (2016). Their study begins to examine this issue from a transportation performance lens, and their results suggest a significant relationship between public investments in ITS infrastructure and private investments in ITS. Additional research should be conducted in this area to include both public and private outcomes from complementary infrastructure investments, and this paper seeks to fill that gap.

Advanced Technologies for ITS Applications

The second stream of literature examines advanced technologies used for ITS applications. In their seminal work, Barfield and Dingus (1998) defined ITS technologies as cutting-edge communications, sensing, and information processing technologies used to solve transportation problems. Prior work identifies ITS as including electronic tolling, vehicle-mile taxing, weigh-in-motion, photo enforcement, fleet management, computer-aided dispatch (CAD), automatic vehicle location (AVL), automatic cargo tracking, electronic pre-clearance, vehicle compliance checking, driver monitoring, and connected vehicle technology (Fries et al., 2012; Jarasuniene, 2007; Mahmassani, 2016; Schafer et al., 2016).

Early research on ITS began in the mid-1990s and focused on feasibility issues and prospects for enabling technologies (Hopkins, 1997; McCord & Hidalgo, 1996). The next stream of research examined the benefits of implementing ITS technologies for commercial vehicles to reduce delays at weigh stations using automatic vehicle identification (AVI) and weigh-in-motion (WIM) technologies (Benekohal et al., 1999; Klinginberg, 1998). A later study examined quantitative metrics for private transportation performance outcomes of ITS applications (Schafer & Nilsson, 2016). Recent work is devoted to understanding the rollout effects of connected vehicle technologies and smart cities (Gordon & Trombly, 2018; Khan et al., 2019; Mahmassani, 2016).

We seek to extend prior research by linking how public investments in ITS infrastructure influence private sector activities. Ultimately, these investments influence the public domain regarding community livability, safety, and private outcomes for supply chain performance.

THEORY AND PROPOSITION DEVELOPMENT

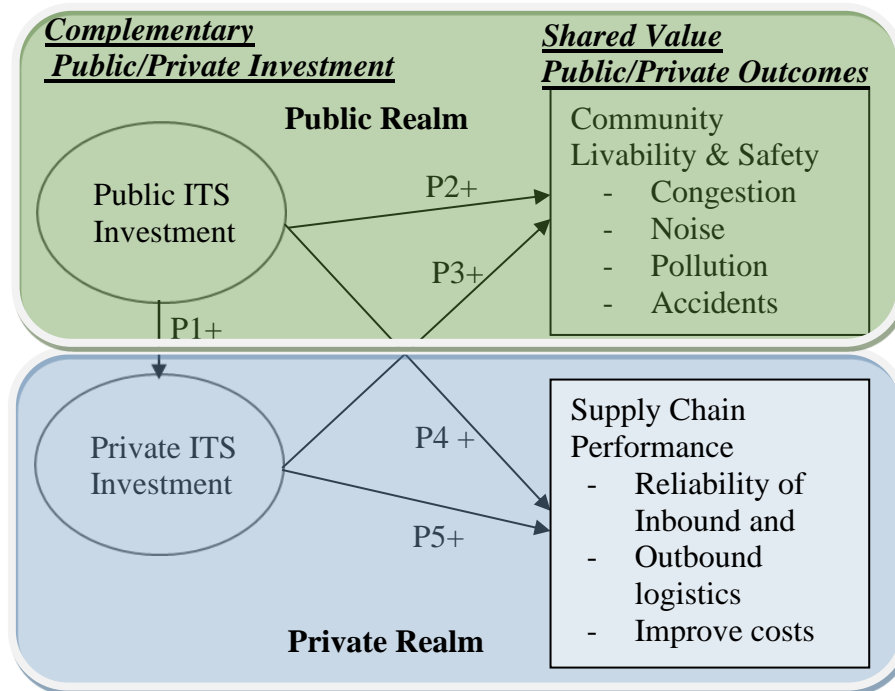
We draw on the theory of complementarity (Milgrom & Roberts, 1994, 1995) combined with business intelligence (Negash, 2004) and shared value (Porter & Kramer, 2011) to develop the framework for this study. We begin our discussion with the theory of complementarity.

Complementarity signifies the favorable relationship between factors in a system, particularly where the presence of one element increases the value of others (Wan et al., 2018). Complementarities occur when the marginal benefits from one resource increase the presence or value of other resources (Milgrom & Roberts, 1994, 1995). For example, in this study, we suggest that public investments in ITS infrastructure provide an impetus for complementary private investments in ITS (Schafer & Nilsson, 2016). Further, integrated ITS provides a business intelligence framework to process, manage, and analyze system operational data that is important to users. Business intelligence provides analytical

tools for operational data to improve the timeliness and quality of inputs for an improved decision-output process (Negash, 2004; Snow, 2006). Finally, the shared value goes beyond corporate social responsibility in a way that reexamines capitalism to create synergistic value models for private enterprise (i.e., supply chain performance) and society (i.e., community livability and safety) (Porter & Kramer, 2011).

In our research framework (Figure 1), public and private ITS investments represent the complementary business intelligence assets between public and private sources to build ITS infrastructure. Public ITS investment motivates private ITS investment, allowing the private enterprise to tap into and improve decision-making for performance outcomes related to public and private interests. In this model, community livability, safety, and supply chain performance represent the shared value created as outcomes.

We define the constructs in the research framework (Figure 1) as follows. *Public ITS investment* is defined as the level of advanced technologies invested in by public agencies (i.e., sensors, communication technologies, computational systems, and other decision support system components) that provide intelligent transportation system infrastructure for weather, incident, emergency, maintenance, and regulatory monitoring and management of system users and assets (Gordon & Trombly, 2018). *Private ITS investment* is defined as the level of firm investment for advanced technologies (i.e. GPS, satellite, sensors, transponders, smart cards, weigh-in-motion, onboard display, and other component technologies) that support intelligent transportation systems to monitor location and status, vehicle operating and cargo conditions, weather, congestion, and smooth highway inspections, tolls and gateway crossings (Lai et al., 2008; Pokharel, 2005; Steelman et al., 2019). *Community livability and safety* are defined as the level of congestion, noise, pollution, and accidents in a region (Appleyard, 1980; Godavarthy et al., 2018; Szibbo, 2016). *Supply chain performance* is defined in the spirit of logistics as the reliability and timeliness of inbound and outbound flows of goods for optimal service and cost reduction (Rodrigues et al., 2004).

Figure 1 *Research Framework*

1. Public and Private ITS Investments

Transportation planners realize that in a time of limited resources (i.e., space and funding), building ever more infrastructure is not sustainable, and innovative alternative solutions must be sought (Crainic et al., 2004; Zhou & Shen, 2010). ITS accomplishes this by combining better infrastructure, advanced communication technologies, and information and control technologies across the entire transportation system rather than building more infrastructure, which is not sustainable (Zhou & Shen, 2010). In the public realm, the goals and objectives of ITS are to improve the efficiency and flow of traffic to reduce transportation-generated pollution and improve safety (Vandezande & Janssen., 2012; Zhou & Shen, 2010). ITS can act as a tool for supply chain integration and visibility to improve performance and reduce costs in the private realm (Lin & Yu, 2008; Wang et al., 2020).

Increasing competitiveness from globalization, particularly in a post-pandemic world, has once again turned attention to the supply chain design problem; firms must maintain high levels of customer service while at the same time reducing costs (Dias et al., 2009; Fonseca & Azevedo, 2020). A supply chain supports three types of flows at the operational level: materials, information, and money, and concurrently, the processes and logistical

capabilities, organizational structures, and enabling technologies support the supply chain network (Hsu & Wallace., 2007).

ITS is a promising area to mitigate both the capacity and safety challenges that users face on modern roadway systems (Mahmassani, 2016; Schofer & Mahmassani, 2016; USDOT, 2017). Business intelligence, like ITS, is a collection of decision-support technologies that enable decision-makers to make better and faster decisions. ITS improves order shipment and customer support in manufacturing and transportation; it simplifies fleet management (Chaudhuri et al., 2011). Both capabilities lend to more consistent flows to improve capacity and safety. Given the capabilities of ITS, it ought to make sense that building up public assets for ITS becomes a meta capability as a copious social asset that, once widely available, organizations can tap into additional operating strategies (Miles et al., 2006). The digitized infrastructure supports real-time data to facilitate better decisions in related operations (Hsu & Wallace, 2007). As such, digitally connecting subjects (i.e., users/drivers) to infrastructure provides a platform for services and support to users and stakeholders by connecting both of these domains to the firm's enterprise information systems, which enables adaptive control for logistics applications toward global optimization (Hsu & Wallace, 2007). Public investments in ITS infrastructure provide an impetus for complementary private investments in ITS (Schafer & Nilsson., 2016). Therefore, we posit:

P1: Public ITS investment will positively influence private ITS investment.

2. ITS Investments for Community Livability and Safety

Residents not disturbed by high noise levels, pollution, traffic, or accidents denote community livability and safety (Appleyard, 1980). Consequently, one of the problems with livability in communities is high levels of traffic congestion and pollution (Devia et al., 2011). Increased congestion that leads to longer drive times, wasted time and costs, and increased pollution from idle vehicles affects livability and safety (Devia et al., 2011). Americans waste approximately half a billion hours a year stuck in traffic, and that number is proliferating (Gore, 1999). ITS investments are vital because specialized ITS improves transportation infrastructure's throughput, safety, and reliability to address community livability and safety problems (Mahmassani, 2016; Schofer & Mahmassani, 2016; USDOT, 2017). Subsequently, investments in ITS infrastructure technology will reduce transportation-generated pollution and improve transport efficiency, livability, and safety

(Zhou & Shen, 2010). Related specifically to livability and safety, Lin and Yu (2008) identify significant air quality improvements with open road tolling ITS technology.

Given the benefits of ITS, using advanced technologies for ITS will improve livability and safety in communities by helping to reduce congestion and pollution in fulfillment of some of the goals for the livability principles (Godavarthy et al., 2018; Szibbo, 2016). We present the following propositions based on the literature:

P2: Public ITS investment will positively influence community livability and safety.

P3: Private ITS investment will positively influence community livability and safety.

3. ITS investments for supply chain performance

ITS avails the enterprise of new information about fleet performance (Vaughn, S. personal communication, May 8, 2020). Transportation and logistics operations can add value by compressing lead times and order fulfillment (Davis-Sramek et al., 2008). Integrating complex supplier networks and distribution channels through the supply chain's visibility (e.g., monitoring and tracing) provides a significant competitive advantage (Dias et al., 2009). Investments in ITS technology can support integrated information sharing that informs the organization of macro-infrastructure conditions to improve delivery routing decisions (Mahmassani, 2016; Schofer & Mahmassani, 2016; USDOT, 2017). Information from public ITS supported by complementary private ITS can feed SCM decision support systems (i.e., transportation management systems) to ensure the timely delivery of goods and components (Miller et al., 2017; Srouf & Newton, 2006). ITS is a comprehensive tool for supplier system integration where positive effects from technology integration are identified on delivery and flexibility performance indicators (Wong et al., 2011). Considering that ITS works under the same premise and similar structure as any other information system, prior empirical results indicate that at least one dimension of time-based reliability performance is improved with the integration of information system infrastructure and process improvements in a supply chain (Jayaram et al., 2000; Schafer & Nilsson, 2016).

ITS provides an enabling technology that supports a wide range of information flows to various users that could benefit from the timeliness of deliveries, particularly for just-in-time systems (JIT) (Ward & Zhou, 2006). JIT systems work on the premise of increasing profits by eliminating waste. The requirement of carrying inventory and subsequent working capital costs are reduced or eliminated with JIT practices where quality materials are delivered at the right time, in the correct quantity, as needed. Collecting real-time data on congestion or delays becomes more critical for companies working within a JIT system

(Ward & Zhou, 2006). For example, Mobis North America in Toledo, Ohio, supplies parts to Chrysler for the Jeep Wrangler. There is only a 45-minute window of inventory between the two operations. If Mobis falls behind schedule or the plant shuts down due to late delivery, they risk shutting Chrysler down at a substantial cost to Mobis (Schafer, G.M., personal communication, September 14, 2014).

Furthermore, using an information and computer technology framework based on intelligent multi-agents collaborating within a single framework allows the integration of different supply chain strategies for stock reduction in a lean supply chain. Products exhibiting irregular demand patterns and short product life cycles that require an agile supply chain will have noticeable savings from reduced stockouts and obsolescence, thus ultimately contributing toward reliability improvements to support supply chain performance (Dias et al., 2009). The increased interaction between important parameters of supply chain management will enhance the organization's ability to meet its desired supply chain performance. We posit the following propositions:

P4: Public ITS investment will positively influence supply chain performance.

P5: Private ITS investment will positively influence supply chain performance.

CATEGORIZATION AND BENEFITS OF ITS TECHNOLOGY INVESTMENTS

This section categorizes ITS technologies to illustrate how complementary public and private investments work together as an integrated system. Table 1 identifies some common ITS technologies and briefly describes their contributions. We list components of the underlying enabling technologies and map the benefits of the particular overarching technology to community livability and safety (CL&S) and supply chain performance (SCP). The portion of public or private investment required for various ITS technology components is indicated. For example, some ITS technologies require only public investments (*i.e.*, photo enforcement), while other systems require complementary investments between the public and private sectors (*i.e.*, electronic credentialing, electronic tolling, weigh-in-motion) (Schafer et al., 2016). The last column provides literature support.

By examining the table logically and practically, we can understand the relationships in the model framework. Public investments in specific ITS infrastructure motivate investment in complementary technology from private industry firms. Investments from private industry sources benefit private firms with improved SCP and society with improved CL&S. Firms that purchase transponders for their fleet to work in combination

with electronic tolling systems not only benefit from faster product delivery but also surrounding vehicles benefit from the reduced congestion and subsequent exhaust and delays at toll sites (Schafer et al., 2016). We observe similar results from publicly funded infrastructure for vehicle compliance checking. This system is a public investment that also provides efficiency benefits for freight movements, reducing delays for surrounding vehicles (Benekohal et al., 1999).

Table 1 *ITS Technology, Descriptions, Components, Benefits, Investment Type, and Sources*

Technology	Description	Components	Noted Benefits	CL&S*	SCP+	Investment Type	Sources
Photo Enforcement	A traffic enforcement camera captures an image of a vehicle that enters an intersection against a red traffic light.	1. Camera 2. Underground traffic sensor 3. Electric meter 4. Computer system linked to a camera	1. Significant reduction in red light violations 2. Decline in crashes	√ √	√ √	Public investment for all related technology infrastructure	Retting (2010)
Commercial Vehicle Information Systems and Networks (CVISN)	Allows selected motor carriers and private service bureaus to apply for interstate credentials administration (registration and permitting), electronic screening (transponder-based weigh station bypass), and safety information exchange.	1. Personal computer for automated carrier transaction 2. Internet 3. Fleet management systems	1. Reduced paperwork 2. Saved 60-75% on credentialing costs 3. Vehicles commissioned 60% faster 4. Minimal start-up costs		√ √ √	Both Public: Creating software and storing data Private: Enrollment and downloading software	Agrawala and Kallianpur (2009)
Vehicle Compliance Checking (Electronic)	The system will allow trucks – whose	1. Single load cell (weight pads,	1. Improve pavement fatigue	√	√	Both Public: Sensors, hardware,	Burnos and Gajda (2016)

Technology	Description	Components	Noted Benefits	CL&S*	SCP+	Investment Type	Sources
pre-clearance & Weigh-in-motion)	weight, dimensions, and credentials are compliant with rules – to bypass the port of entry at greater speeds, resulting in fewer vehicles needing verification at inspection stations.	inductive loops, axle sensor) 2. Bending plate (weight pads, inductive loops, axle sensor) 3. Piezoelectric sensors (class 1 sensors, inductive loops, temperature sensors)	2. Lower fuel costs 3. Increase freight transport 4. Make travel faster	√ √	√ √	3 rd party partnership Private: Enrollment, transponder or app	
Electronic Tolling	This system allows vehicles to pay tolls without stopping at a booth.	1. Antenna 2. Lane controller 3. Host computer system 4. Transponders	1. Reduce tolling delays 2. Reduce vehicle emissions 3. Reduced operating costs	√ √	√ √	Both Public: Implementing antenna, lane controller, host computers, distributing transponders Private: Purchase transponders, enrollment	Lin and Yu (2008)
Connected and Automated Vehicle Technology	An interconnected network of moving vehicles and stationary infrastructure units, in which individual vehicles can communicate with other vehicles and infrastructure/agents collaboratively and meaningfully.	1. Embedded sensors 2. Backend computation infrastructure 3. Dedicated Short-Range Communication (DSRC), Cellular technologies (such as 4G, 5G), Wireless Fidelity (Wi-Fi), Worldwide Interoperabil	1. Significant reduction in crashes 2. Reducing congestion 3. Reducing energy consumption 4. Decrease emissions and greenhouse gases	√ √ √	√ √	Both Public: Sensors, backend computation, communications infrastructure, roadside infrastructure Private: Onboard sensors and communications technology	Wang et al. (2020); Khan et al., (2019); Mahmassani (2016)

Technology	Description	Components	Noted Benefits	CL&S*	SCP+	Investment Type	Sources
		ity for Microwave Access (WiMAX), Bluetooth					
* Community Livability and Safety (CL&S)							
+ Supply Chain Performance (SCP)							

DISCUSSION AND CONCLUSIONS

This study aimed to develop a framework to help managers and policymakers conceptualize intelligent transportation systems' complementarities and shared value. ITS technology is a unique infrastructure to promote integrated information sharing, improve community livability and safety, and enhance supply chain performance (Appleyard, 1980; Lin & Yu, 2008; Mahmassani, 2016). ITS combines better infrastructure with information and control technologies to reduce traffic congestion by maintaining traffic flow, reducing transportation-generated pollution, improving transport efficiency, and producing economic benefits (Burnos & Gajda, 2016; Mahmassani, 2016; Wang et al., 2020). We developed a conceptual framework drawing from the theory of complementarity (Milgrom & Roberts, 1994, 1995) combined with business intelligence (Negash, 2004; Snow, 2006) and shared value (Porter & Kramer, 2011).

This paper argues that integrating investments between businesses and governments to develop ITS further will create shared value synergy to improve supply chain performance and enhance livability and safety in communities. Given the public realm, livability increases through safety improvements through accident reductions and other improvements to social costs, such as reduced congestion and noise pollution. In the private realm, digitized infrastructure provides increased information sharing to promote supply chain performance improvements through increased transparency for delivery reliability and cost reductions from driver safety improvements. We provided a sample of ITS and component descriptions to illustrate how public and private investments are classified and integrated for system improvements through ITS technologies. This study contributes to researchers and managers for both businesses and governments.

Theoretical Contributions

This conceptual examination informs how complementary public and private investment in ITS technologies enhances supply chain performance and improves community livability and safety. Public and private ITS investments drive both to create

shared value synergies. The development of the theoretical framework is an important contribution toward future empirical studies to examine the relationships between public and private investments in ITS as complementary drivers to improve supply chain performance and community livability and safety in a shared value model (Porter & Kramer, 2011). Results from the literature review suggest that increased information sharing provided by ITS infrastructure can contribute to the public and private realms by creating synergy consistent with the precepts of shared value. Results from the literature and interviews suggest increased livability through safety improvements through accident reductions and other improvements for social costs, such as reduced congestion and noise pollution in the public realm (Appleyard, 1980; Lin & Yu, 2008; Mahmassani, 2016). Digitized infrastructure and increased information sharing for transport conditions improve supply chain performance through increased transparency for delivery reliability and cost reductions from driver safety improvements in the private realm (Burnos & Gajda, 2016; Khan et al., 2019; Lin & Yu, 2008; Mahmassani, 2016; Wang et al., 2020; Vaughn, S. personal communication, May 8, 2020). This study differs from prior research because it examines public and private investment inputs as an impetus to drive synergistic shared value model outputs.

Managerial Implications

Managers should explore opportunities for investments in complementary ITS technologies to create shared value that enhances supply chain performance and contributes to community livability and safety. Public and private ITS investments enable practical performance improvements for more reliable and less costly customer deliveries, particularly in dense urban regions where congestion is a significant challenge. It is often difficult to quantify sustainable system improvements in terms of ITS applications (Schafer et al., 2016). This work contributes conceptually by linking supply chain performance improvements to the information sharing of ITS, which is also used to improve community livability and safety. Managers and policymakers can apply the proposed framework to promote enterprise and community synergies in a shared value model. Shared value builds goodwill with customers, employees, and the community.

Limitations and Future Research Directions

While this study makes valuable contributions to the literature, it is not without limitations. Given that this is a conceptual study, the implications may not be empirically supported or generalizable in context. The study points to crucial future research

opportunities. Future researchers could use quantitative methods (i.e., econometric models) to analyze secondary data from public sources combined with proprietary data from firms to examine the conceptualized relationships. The proposed framework aims to bring out the importance of an integrated approach of public and private investments in ITS to improve supply chain performance and logistics and transportation issues related to community livability and safety. Future researchers could examine the influence of each individual or groupings of component of ITS technology on supply chain performance and community livability and safety outcomes. A more granular approach would be valuable for supply chain managers to understand better the impact of their investment decisions on shared value outcomes. Finally, future researchers could use a granular approach to help policymakers create environments that more effectively motivate private investments in technology and infrastructure that create shared value for commerce and communities.

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